Annexes

INTERNATIONAL EXPERT MEETING ON APICULTURAL DEVELOPMENT IN THE HINDU KUSH-HIMALAYAS
21st JUNE to 23rd JUNE, 1989 (Programme)

TIME	21 JUNE	22 JUNE	23 JUNE
		SESSION I: Chairman: Dr. R.P. Yadav	**SESSION V: Chairman: Dr. M. Banskota**
9:00		Mountain Perspectives and Apiculture **N.S. Jodha**	Economics of Apiculture in the Hindu Kush-Himalayan Region **M.S. Rathore**
9:30		Genetic Diversity in Himalayan Honeybees **L.R. Verma**	
10:00	REGISTRATION OF PARTICIPANTS	Mountain Women and Apiculture **Meera Maskey**	Royal Jelly, Pollen, Venoms and Propolis: Production Technology and Marketing Potentials **Yang GuanGhung**
10:30		Discussions	
11:00		Tea Break	Tea Break
		SESSION II: Chairman: Mr. S.N. Regmi	**SESSION VI: Chairman: R.B. Singh**
11:30		Advanced Apiculture in China - Lessons for other Mountain Areas **Jin Zheng-ming**	A Discussion: Apicultural Research and Training in the HKH Regions: Future Perspectives Lead Paper: **K.K. Shrestha, L.R. Verma**
12:00		Apiculture in NWFP, Pakistan **Mohammed Shahid**	
12:30		Apiculture in Bhutan **Fritiz Maurer**	
		SESSION III: Chairman: Dr. K.C. Sharma	Closing Session
2:00	Inaugural Session **Chairman: Dr. Colin Rosser**	Honey Hunters in Nepal **Diane Summers**	Chairman: **Colin Rosser**
2:30		Honey Plant Resources of the HKH Region **Tej Partap**	Summing up of Workshop and Resolutions: **Dr. L.R. Verma**
3:00	Field Trip to Kirtipur and Godavari Apiaries	High and Low Land Linkages in Migratory Apiculture in Pakistan **Rafiq Ahmad**	Closing Remarks: **Mr. K.K. Shrestha**
3:30		Tea Break	
		SESSION IV: **Chairman: Dr. S.S. Teaotia**	
4:00		Problems of Apiculture with Apis cerana F. in Developing the Countries of South East Asia **S. Wongsiri**	
4:30		Perceptions of Apiculture in Nepal **Fritiz Ham**	
5:00		Apicultural Development in the U.P. Himalayas **S.S. Teaotia**	

List of Participants

Bhutan

1. Dasho Khandu Wangchuk
   Director General of Agriculture
   Royal Govt. of Bhutan
   Thimpu, Bhutan

2. Mr. Fritiz Maurer
   Bumthang, Bhutan

China

1. Mr. Jin Zheng-Ming
   Director
   Institute of Apicultural Research
   Xiang Shan, 100093
   Beijing
   China

2. Mr. Yang Guanghuang
   Institute of Apicultural Research
   Xiang Shan, 100093
   Beijing
   China

Nepal

1. Mr. K. K. Shrestha
   Project Manager
   Beekeeping Training and
   Extension Support Project
   HMG/Nepal

2. Mr. Dick Bogaards
   Co-manager
   Beekeeping Training and
   Extension Support Project
   HMG/Nepal

3. Mr. J. B. Shrestha
   Asst. Industrial Entomologist
   Beekeeping Training and
   Extension Support Project
   HMG/Nepal

4. Mr. Fritis Ham
   Beekeeping Training and
   Extension Support Project
   HMG/Nepal

5. Mr. A. N. Shukla
   Assist. Industrial
   Entomologist Beekeeping
   Training and
   Extension Support Project
   HMG/Nepal

6. Mr. V. B. Handrik
   Beekeeping Training and
   Extension Support Project
   HMG/Nepal

7. Mr. S. B. Pandey
   Asst. Industrial Entomologist
   Beekeeping Training and
   Extension Support Project
   HMG/Nepal

8. Mrs. R. B. Pradhan
   Senior Entomologist
   Entomology Division
   HMG/Nepal

9. Mr. S. L. Joshi
   Entomologist
   Entomology Division
   HMG/Nepal

10. Mrs. Nabin C.T.D. Shrestha
Entomology Division
HMG/Nepal

11. Dr. K. C. Sharma
Chief Entomologist
NARSC, Khumaltar

12. Mr. G. D. Kafle
Chief
Industrial Entomology
Khopasi

13. Mr. B. R. Palikhe
Asst. Industrial Entomologist
Khopasi

14. Mrs. Soni Thapa
Himalayan Bee Concern
Kirtipur

15. Mrs. Meera Maskey
Bee Scientist
RECAST, Tribhuwan University

16. Mr. S. K. Gautam
General Secretary
Nepal Bee Development Council

17. Mr. Kashi Raj Upadhya
Vice President
Nepal Beekeepers' Association

18. Mr. Ishwori Chandra Sharma
General Secretary
Nepal Beekeepers' Association

19. Miss Miriam Bishop
c/o Peace Corps Volunteer Office
Kathmandu, Nepal

20. Mrs. Diane Summers
c/o French Embassy
Kathmandu, Nepal

21. Miss Padma Sana Sakya
Centre for Women and
Development
Kathmandu, Nepal

22. Captain D. B. Thapa
Himalayan Bee Concern
Kathmandu, Nepal

23. Mr. B. K. Gawali
Deputy Entomologist
Khumaltar

Pakistan

1. Dr. Rafiq Ahmad
Chief Scientific Officer
Honeybee Research Programme
Pakistan Agricultural
Research Council
Islamabad

2. Dr. Mohammad Shahid
Chairman
Department of Entomology
NWFP Agricultural Univerisity
Peshawar, Pakistan

Thailand

1. Dr. S. Wongsiri
Chulalongborn University
Bangkok 10500
Thailand

ICIMOD

1. Dr. Colin Rosser
2. Dr. Ram Yadav
3. Dr. Mahesh Banskota
4. Dr. N. S. Jodha
5. Prof. Li Tianchi
6. Dr. Deepak Bajracharya
7. Mr. Lakpa Tsering
8. Mr. Anwar Chaudhry
9. Dr. S. S. Teaotia
10. Dr. M. S. Rathore
11. Dr. Tej Partap
12. Mr. Saroj Basynat
13. Dr. Hikmat Bista
14. Dr. Kk. Panday
15. Prof. L. R. Verma (Convenor)

List of Workshop Papers

Mountain Perspectives and Beekeeping	N.S. Jodha
Apiculture in Mountain Life-Support Systems	Eva Crane
Genetic Diversity in Himalayan Honeybees	L.R. Verma
Distribution of *Apis Cerana F.* and its Sub-species in China	Yang Guanhuang
Apiculture and the Pollination Ecology of Mountain Crops	L. R. Verma
Honey Plant Resources of the Hindu Kush-Himalayan Region	Tej Partap
The Investigation of Genus Eurya as an Important Honey Plant Source in China	Liang Shikui and Ren Zaiji
Economics of Apiculture in the Hindu Kush-Himalayan Region	M.S. Rathore L.R. Verma
Royal Jelly, Pollen, Venom, and Propolis: Production Technology and Marketing Potentials	Yang Guanhuang
Apiculture - An Income Generating Cottage Industry for Rural Women in Pakistan	Nasreen Muzaffur
Mountain Women and Apiculture in Nepal	Meera Maskey
Role of Cooperatives for Apicultural Development in the Uttar Pradesh Himalayas	Kamal Taori Yogeshwor Singh
Apicultural Development in an Integral Programme for the Development of Horticulture and Rural Economy in the Uttar Pradesh Hills	Yogeshwor Singh
Problems of Apiculture with *Apis cerana F.* in the Developing Countries of South East Asia	Siriwat Wongsiri
Apis cerana Apiculture in Japan	Tetsuo Sakai

Abstracts of Papers

MOUNTAIN PERSPECTIVES AND BEEKEEPING

N. S. Jodha

The development situation in most mountain areas reflects a widening gap between efforts and achievement. The major reason is disregard for the mountain perspective by development activities. Hence, efforts should be diverted to activities/options that fit in very well with mountain characteristics and also negate the side effects of processes and factors contributing to unsustainable situations in the mountains. Apiculture possesses attributes that can satisfy these requirements in the following ways.

- Inaccessibility, as a major mountain characteristic, plays a less constraining role in apiculture because hive products are characterized by low weight, high value, non perishability, high storage capacity, and easy transportation.

- Apiculture offers options for communities in the economically marginal category because it is a low investment activity (unless operated on a commercial scale). In addition it is flexible enough to match any scale of operation and is, hence, ideally suited for small farmers.

- Apiculture does not lead to increased land use intensity, which causes degradation, because it is a non-land based activity. It does not compete with other resource demanding components of farming systems.

- At micro-level, apiculture is an additional income generating activity that does not need much investment. At macro-level, investment may be quite high but there is a greater use of the temporal and spatial diversity of mountain resources that otherwise go unutilized.

- The pollination activities of honeybees are an important integrative function, as they contribute effectively to the sustainability and diversity of agriculture and botanical resources, in general, and thereby contribute to increased productivity and environmental health.

The above attributes of apiculture help to relieve the stresses caused by resource activity patterns in mountain areas. Their detailed quantification will sharpen the role of apiculture in a mountain context.

APICULTURE IN MOUNTAIN LIFE-SUPPORT SYSTEMS

Eva Crane

Opportunities for apiculture occur in the mountainous regions of all continents and at latitudes ranging from 0°, at the equator, to latitudes as high as 50°N and 30°S. Apiculture is currently carried out in mountain regions at all technological levels. In many of these regions, honey hunting has given way to traditional apiculture with fixed-comb hives, and in some of them traditional apiculture has been wholly or partly replaced by the use of top-bar hives with movable combs or, more commonly, of movable-frame hives.

Flowering plants that can support honeybee colonies, and provide surplus honey for beekeepers, are found at sea level from the equator to a latitude of about 55°N. The final vegetation belt providing bee forage consists of pine forests, and it may extend from a latitude of 65° at sea level to a height of nearly 4000m. Some of these forests provide a honeydew flow that can be exploited by migratory apiculture. Honeydew is produced by aphids on certain trees and the bees collect it as an alternative to nectar. Experience at high latitudes in Western Canada shows that apiculture can be carried out, even if the flowering period lasts for less than four months in the year, and even if, during the remaining eight months, temperatures are too low for bees to fly.

Many types of honeybees (Apis species) except Apis florea, live and produce surplus honey in mountain regions. These include the European honeybee, Apis mellifera, Asian hive bee, Apis cerana, and wild rock bee, Apis dorsata laboriosa. Experiments on temperate-zone European bees, in the Rocky Mountains, above 40°N of Colorado, USA, suggest that these colonies were altogether little affected by the higher altitudes between 2896 and 4268m above sea level. Apiculture with Apis cerana at 3017m above sea level is possible in the Hindu Kush-Himalayan Region.

Introduction of the European (temperate-zone), Apis mellifera, in certain countries of the Americas, Australasia, and Asia is now the basis of a number of flourishing apicultural industries. This species is much more productive than most of the native, Apis cerana, and more suited to modern bee management with movable-frame hives. But many importations of the exotic, Apis mellifera, have been disastrous because new diseases or parasitic mites that have been introduced with the bees, have infested the native, Apis cerana. In certain Asian countries, due to the introduction of Apis mellifera, populations of Apis cerana are likely to decline to a level that is no longer viable. Since Apis mellifera requires a higher capital investment and higher technological operation, it may not provide opportunities for modest economic improvements which are needed by poor families living in remote mountain areas.

There are special difficulties in promoting and developing apiculture in many parts of the Hindu Kush-Himalayan Region. These problems lie less in the high altitude itself, or in the native bees or bee forage, than in bee diseases and parasitic mites introduced with exotic honeybees. Other problems include poverty, inaccessibility due to broken terrain, lack of education, and, in some regions, lack of apicultural traditions.

In our attempts to alleviate poverty by using apiculture as a life-support system, we should concentrate our attention on aligning our proposals according to the background of the people we are trying to help. In areas where the educational level is higher and transport is easier, beekeepers can learn to work at a higher technological level, and may obtain a good income from apiculture. But, in poorer areas, we must promote types of apiculture, and of hives, that can conform to the general way of life of the people. There must never be a Western intrusion at an entirely different technological level

GENETIC DIVERSITY IN HIMALAYAN HONEYBEES

L. R. Verma

The Hindu Kush-Himalayan Region has a thriving apicultural industry. Great strides are being made by modernizing apiculture with native and exotic honeybee species. From an apicultural perspective, temperate (high hills and interior valleys), sub-temperate (mid-hills), and sub-tropical (low lying hills) zones are ideally suited for apiculture. Out of the four species of the genus Apis, found in the Hindu Kush-Himalayas, Apis cerana, Apis dorsata, and Apis florea are sympatric and Apis mellifera, the European bee, is allopatric in distribution. Recently, Apis laboriosa, from the Himalayas, has been reported as a distinctly new honeybee species and its taxonomic status needs further confirmation.

Through the centuries, as a result of the continuous process of natural selection , different geographic races of a particular species of

honeybee have evolved. Such geographic races of Apis mellifera, existing in tropical Africa, North Africa, the Near East, and the Mediterranean regions have been identified through computer based biometric analysis. However, very little is known about the Asian hivebee, Apis cerana. So far only four different races of Apis cerana, namely, Apis cerana cerana, Apis cerana himalaya, Apis cerana indica, and Apis cerana japonica have been distinguished. Apis cerana is distributed over northern-China, north-western India, northern Pakistan, and Afghanistan.

Discriminant analysis results show that Apis cerana in the north-west Indian Himalayas further comprises of two separate biometric groups or geographic populations, that have been arbitrarily named Himachali and Kashmiri. Apis cerana, from the north-east Indian Himalayas, form a separate cluster from the bees of the north-western Himalayas and are a separate race named Apis cerana himalaya. Multivariate discriminant analysis results show that the following 3 geographic populations of Apis cerana himalaya are distinguished: (1) The foot hills of the Himalayas, (2) the Brahmaputra valley and Khasi hills, and (3) The Naga and Mizo hills. These biometric groups are biologically meaningful because they occupy adjacent areas. Present results also suggest that any taxonomic decision, on construction of evolutionary relationships and the populations of Apis cerana, should be based on the total distribution of the species in the entire Hindu Kush-Himalayan Region. As the Himalayas rose in height, the bees probably invaded the higher elevations from different populations in the lowland areas surrounding the mountains.

DISTRIBUTION OF APIS CERANA F. AND ITS SUB-SPECIES IN CHINA

Yang Guanhuang

A survey conducted by the Chinese Bee Resource Co-ordination Team, from 1976 to 1983, reveals that Apis cerana are found in all the provinces of China, except the Xinjiang Autonomous Region. The major distribution areas of the genus is to the south of the Yangtze river. Apis cerana, in China, can be classified into 5 sub-species namely, Apis cerana skorivoki, Apis cerana indica, Apis cerana cerana, Apis cerana hainanensis and Apis cerana abaensis. Out of these, Apis cerana hainanensis and Apis cerana abaensis are reported for the first time. These findings also suggest that Apis cerana can further be divided into 5 different biometric groups and Apis cerana hainanensis consists of two different biometric groups or geographic populations.

APICULTURE AND THE POLLINATION ECOLOGY OF MOUNTAIN CROPS

L. R. Verma

Apiculture forms an integral component of different farming systems such as agriculture, horticulture, and animal husbandry. It has been estimated that the value of honeybees as pollinators of different agricultural, horticultural, and fodder crops is 10 to 20 times more than their value as honey and beeswax producers. Amongst the Hindu Kush-Himalayan countries, India has taken the lead in enhancing the productivity levels of different cultivated crops through bee pollination.

In this Region at present, both the exotic, Apis mellifera (European honeybee), and Apis cerana (Asian hive bee) are used for the purpose of pollination. Keeping in mind the controversy regarding the introduction of Apis mellifera into several parts of Asia, including India, it is important to know which of these two species is the better pollinator of agricultural and horticultural crops. Therefore, our research group has made a detailed investigation of the foraging behavior of the native honeybee, Apis cerana, and the European honeybee, Apis mellifera, in relation to the pollination of apple bloom, under different agroclimatic conditions in Himachal Pradesh, and the results are summarized as follows.

The insect pollinators visiting apple bloom were of 44 species belonging to 5 orders and 14 families. Frequent pollinators were Apis cerana, Eristalis sp., E. tenax, E. angustimarginalis and

Halictus dasygaster. Among these, Apis cerana was the most frequent and abundant pollinator. The tree branches located from 2 to 3m above the ground attracted a significantly higher proportion of insects (40.58%) than the branches above (27.19%) and below (32.21%). The foraging activity of Apis cerana was maximum between 1100 to 1200 and 1400 to 1500 hrs. when the temperature of the orchard ranged between 21.5 and 22.8 °C. However, the peak activity hours for E.tenax and E.angustimarginalis were from 0800 to 0900 hrs. at a comparatively lower temperature (16.6 °C).

The foraging behavior of Apis mellifera and Apis cerana honeybees on apple flowers was studied at three altitudes in the northwest Himalayas (1350, 1875, and 2400m above sea level). Apis cerana began to forage earlier in the morning than Apis mellifera and stopped later in the evening at all three altitudes. Foraging trips by Apis mellifera lasted significantly longer ($P<0.01$). In both species nectar collectors outnumbered pollen collectors ($P<0.01$); the mean ratio of pollen to nectar collectors being 1:2.08 for Apis cerana and 1:2.78 for Apis mellifera. Peak foraging activity for Apis cerana occurred at 0900-11:30 hrs. when the temperature ranged between 15.5 and 21 °C, and 11:00-13:30 hr. for Apis mellifera when the temperature was 21 to 25 °C. By placing both species in the same orchard, the duration of peak activity might be prolonged and better pollination obtained. Foragers of Apis mellifera carried significantly heavier pollen loads, touched more stigmas, and remained longer on individual apple flowers than those of Apis cerana. Altitude affected the times of initiation and termination of foraging activity, and the duration of a foraging trip, but not other behavior parameters such as preference for nectar or pollen, peak time of foraging, pollen load, number of stigmas touched, or average time spent visiting a flower.

In self-incompatible varieties of apple, such as Royal and Red Delicious, there was no fruit set in the absence of insect pollinators, and it was 10.12 and 8.27 per cent higher in honeybee pollinated flowers compared to open pollinated flowers. However, in self-compatible varieties, such as Golden Delicious and Red Gold, honeybees and other natural insect pollinators were not essential for good fruit set. The fruit drop in Golden Delicious and Red Gold, without any insect pollinators, was significantly higher ($P<0.01$) than in open and honeybee pollinated flowers. The difference in the fruit drop of honeybees and open pollinated flowers of all four varieties of apple was non-significant. Cross pollination by honeybees significantly increased the fruit quality in terms of weight, length, breadth, volume, and number of seeds per fruit.

Some laboratory studies on the toxicity of various biocides used in apple orchards in Himachal Pradesh on Apis cerana and Apis mellifera were also undertaken. As per the norms of the International Commission for Bee Botany, our results suggest that among the fungicides Foltaf, Diethane M-45, Hexacap, Bevestin, Difolitan, and Capstan are moderately toxic to honeybees, whereas, insecticides such as Sumithion, Metacid, and Metasystox are highly toxic to honeybees. Our results also suggest that LD_{50} values, as calculated by probit analysis for Apis cerana, were significantly lower than Apis mellifera. These findings reveal that the former species of honeybees are less tolerant to the effect of biocides than the latter.

In the Hindu Kush-Himalayan Region, apricots, almonds, peaches, pears, plums, and cherries are other temperate fruit crops and considerable areas are being cultivated with these crops. Practically very little is known about the pollination requirements of these fruit crops under the ecological conditions of this Region. However, research work carried out in Western countries, where bee pollination is an integral part of orchard management technology, reveal that honeybees are the primary agents of pollination and that their introduction into the orchard at the time of bloom significantly increases the yield and quality of different temperate fruit crops.

Besides temperate fruits, other mountain crops, that are dependent upon or benefited by bee pollination are vegetable oil and fodder seeds. Different seed quality components i.e. physical, genetic, and viability are greatly improved if the flowers in bloom are pollinated by honeybees. For all these crops, cross pollination is either essential

to or beneficial to enhancement of seed production. Similarly, cardamoms and buckwheat are the other two important hill crops for which bee pollination is essential for good fruit and seed set respectively.

One of the best strategies for increasing the yield and quality of the above cultivated crops in the Hindu Kush-Himalayan Region would be to adopt a planned bee pollination programme as one of the essential inputs. This has hitherto not been practised in this Region. The main reason for this is ignorance and the lack of technical know-how on the part of agricultural extension agencies and farmers. Efforts should be made to create awareness among them regarding the beneficial effects of honeybee pollination as this is an important biological input without negative ecological consequences.

HONEY PLANT RESOURCES OF THE HINDU KUSH-HIMALAYAN REGION

Tej Partap

Proto-cooperation between honeybees and plants is one of the phenomenon used by man to his advantage. It has been providing economic, ecological, and nutritional benefits to him. Exploiting these options or benefits, apiculture facilitated various primary objectives, such as the manufacture of different hive products. The primary objective could be the pollination of crops to increase production and in this case the hive products become by-products.

In each option, however, bee forage becomes an important issue. No matter what the primary objective may be, in order to improve the carrying capacity of apiculture, it is important to meet the forage needs of slack seasons, e.g. the winter period.

Currently, although there is an increased emphasis on the improvement of apiculture for the benefit of mountain farmers, there is a diminishing resource base of natural bee flora, because of deforestation. It has brought into focus the need to supplement the carrying capacity of honey plant resources.

This paper discusses various options. In this respect, it touches upon issues such as the need for assessing the carrying capacity of honey plant resources in an area, evaluating seasonal forage needs, and the methods of coping with them. A proposition is made concerning appropriate honey plant species' selection for mountain areas, and this is termed the mountain perspective. Under this approach, a strong case is built for using indigenous under-exploited genetic resources as potential honey plantations.

For plantations, from an apicultural viewpoint, choosing the best known honey plants, from the world honey resources' directory, and introducing them with a single purpose, would be inappropriate and, in the long run, it would have adverse ecological consequences. To quote the examples of Eucalyptus spp and Callistemon spp., as honey plants, while the former is known to have created ecological side effects in the environment in terms of phytosociology, the latter is only of ornamental and limited value. On the other hand, a good alternative would be to look for potential, indigenous, multiple plant species that have flowering seasons coinciding with slack forage seasons.

As far as land use is concerned, the recommended approach would be to incorporate honey plants with cropping systems, and other types of land use planning. Some examples of this are seen in the community forestry plantations of Nepal and the social forestry programmes in the Indian Himalayas. Full use of road side plantations for apiculture are important and examples of these can be seen in Pakistan.

Another option for efficient land use, for honey plants used for commercial apiculture, is to migrate bee colonies. Mountains are the most appropriate habitats for this exercise and provide opportunities for harnessing honey resources in space and time. Two examples are quoted from the Hindu Kush-Himalayan Region as models. In the first, Prinsepia sp. and Plectranthus sp. are suggested as sources of forage for the scarce forage period. They are wild plants that have multiple uses and unconventional land use under them. There is a need to prepare floral calendars for different agro-ecological zones and assess the need for plantations and choice of species.

THE INVESTIGATION OF GENUS EURYA AS AN IMPORTANT HONEY PLANT SOURCE IN CHINA

Liang Shikui and Ren Zaiji

Eurya spp. is a very important plant in the hilly areas of southern China. Beekeepers in China have yet to harness its full potential, and a few researchers working on this plant have proved that this is a very important source of nectar and pollen for honeybees. In China more than 80 species of Eurya are found, and they are scattered over the vast tropical and sub-tropical hilly areas.

There are about 10 species of Eurya that flower during autumn, winter, and spring and they are important from a beekeeping point of view. The flowering period lasts for 10 to 15 days.

Eurya honey is transparent or light amber. It does not granulate readily. Yield of Eurya honey per colony varies from 10 to 40 kg. Chinese bees, Apis cerana, produce 3 times more honey from this plant than European bees, Apis mellifera. Eurya honey is rated highly in China.

More investigations are needed on the eco-physiology of Eurya spp., in order to assess its full potential as a major honey plant in southern China.

ECONOMICS OF APICULTURE IN THE HINDU KUSH-HIMALAYAN REGION

M.S.Rathore and L.R.Verma

In order to meet the food requirements of the fast growing population in the Hindu Kush-Himalayan Region, the pressure on land is constantly increasing. Consequently, this Region is facing serious environmental problems of land degradation, soil erosion, deforestration, and desertification. In such a depressing situation, any source of food or income that does not require land is potentially important for sustainable development. Apiculture is one such activity that is not land based, does not compete with other developmental efforts, demands low capital and time and yet has potential to supplement the income of rural households. It provides important linkages with other farming systems such as agriculture, horticulture, and animal husbandry through the pollination activities of honeybees. Production and use of different hive products can help to overcome the problem of malnutrition in rural areas.

The present paper reviews the studies made on the economics of apiculture in some countries of the Hindu Kush-Himalayan Region. Such studies in Bangladesh revealed that apiculture can be started with a very low investment and that even the poorest person can do so with very little financial support. On the other hand, studies from Pakistan showed that this enterprise can be taken up both at household and commercial levels to generate large amounts of profit and employment.

In Himachal Pradesh (India), this enterprise has a duel purpose i.e. to generate income and increase the yield of horticultural crops through cross pollination by bees. With the introduction of European bees, the economics of the operation improve and the net profit doubles. This is mainly because of the higher yield of these exotic bees in comparison to native hive bees. In Nepal, high profits from apiculture with native bees are mainly because of the high price of honey.

There is need for a more systematic study of the economics of apiculture for this Region in order to assess the immense importance of this enterprise, for different target groups, in the mountain areas of the Hindu Kush-Himalayan Region.

ROYAL JELLY, POLLEN, VENOM AND PROPOLIS: PRODUCTION TECHNOLOGY AND MARKETING POTENTIALS

Yang Guanhuang

Royal jelly is one of the most important hive products for which production technology developed in China after 1959. In southern

China, the production of royal jelly from one colony of Apis mellifera varies from 0.5 to 2 kg, whereas, in northern China, it ranges from 0.3 to 0.5 kg per colony a year. Experiments are also being conducted to produce royal jelly from Apis cerana colonies. However, this native bee species produces only half the quantity of royal jelly in comparison to Apis mellifera. Since royal jelly changes in chemical composition during storage, markets for selling fresh royal jelly are being established. Royal jelly is also being used as a raw material in medicines, tonics, beverages, and cosmetic products.

Production of pollen, as a commercial hive product, started in 1983. It is collected in good plastic pollen traps at the entrance of the bee hive. Pollen is used in health foods, tonics, and medicines. Venom production started in 1953, in China, and is now used to cure arthritis and cancer. Only the European honeybee, Apis mellifera, produces propolis and this is used for medicinal purposes. Propolis production technology is still in the developmental stage in China.

APICULTURE - AN INCOME GENERATING COTTAGE INDUSTRY FOR RURAL WOMEN IN PAKISTAN

Nasreen Muzaffor

Rural women are an important and vital component of the agricultural community in Pakistan. Beekeeping can be started as an income generating activity to improve the economic lot of rural women. It would also improve the health and nutritional standards of women and children. Thus, transfer to appropriate technologies, such as apiculture for women, will have positive effects both on health and family income.

An increase in the female work force, in such a suitable and scientific profession, will help to bring them into the main stream of development; as is the case in many developed countries. The income generating programmes would not only ensure high economic returns through the sale of hive products, with only a small initial investment, but would provide them with unique opportunities for enhancing the productivity levels of certain agricultural crops through bee pollination activities. Some low cost hives, developed for apiculture in remote areas, would popularize this occupation among those who can not afford to buy expensive equipment.

MOUNTAIN WOMEN AND APICULTURE IN NEPAL

Meera Maskey

Rural women in Nepal are the most neglected and under privileged group, despite the fact that they play a key role in the socioeconomic system of the rural community. Women in rural mountain areas perform several household activities and have no income source to supplement them. Among the different off-farm activities, apiculture can provide a good source of income. In certain parts of Nepal, such as Rapti, Karnali, and Seti Zones, apiculture is already an additional source of income for rural families. Apiculture has specific advantages for mountain women. It is less time consuming and does not interfere with their routine household activities. It is easy to learn and practice.

In Nepal, through modern apiculture, it is possible to generate income to the extent of 3400 NER per hive per year. Hive products are in demand locally. A majority of women in Nepal are illiterate, and apiculture does not require any specialized education.

Apiculture by traditional methods is already a part of the cultural heritage of rural communities in Nepal. However, the honey yield per hive, through such traditional methods, is very low (2-4 kg. per colony) in comparison with an average of 15 kg per colony through modern apiculture technology.

In Nepal, honey is in great demand and the price is about 200NER per kg. An apicultural concern can be started with two colonies and be multiplied up to 10 by artificial swarming. The

sale of bee colonies can also be an additional source of income, and the price of each bee colony is 400 NER.

Honeybees can also boost the yields of different agricultural crops, by 30 to 40 percent, by their pollination activities. However, this potential is yet to be realized by Nepalese farmers.

In Nepal, honey is harvested from the wild nests of bees through traditional honey hunting methods. This involves killing a large number of adult bees as well as their brood.

In mountain areas, the native, Apis cerana, is kept in traditional hives. This species is gentle in temperament, easy to handle, and ideally suited to women apiculturists. A few progressive apiculturists also use modern movable frame hives for beekeeping with Apis cerana. Amongst them, the Newton "A" village type gives the maximum honey yield.

Nepal is also very rich in bee flora and, in the Kathmandu valley alone, 180 plant species have been identified as pollen and nectar resources.

Studies on the economics of apiculture reveal that the total initial investment for 10 bee hives, in the first year, is 13,000 NER with a net profit of 21000 NER. In subsequent years, the net profit is much more.

ROLE OF COOPERATIVES FOR APICULTURAL DEVELOPMENT IN THE UTTAR PRADESH HIMALAYAS

Kamal Taori and Yogeshwor Singh

Apiculture is an extensive industry. It does not need much physical labour and, as such, can be undertaken as an ideal subsidiary industry. It is largely dependent on nature, and, thus, a group approach is the best model for this agro-based industry.

A programme of apiculture on cooperative lines in the Uttar Pradesh hills, as well as the plains, was launched in 1986-87. Over 100 cooperative societies have been organized, in the Uttar Pradesh hills, out of which 70 per cent have started functioning well. The basic features of this programme are the provision of a technical assistant, coordinated efforts of various agencies, and involvement of an old and experienced apiculturist from the area. The programme has taken firm root and there is a clear indication that development will continue at a faster pace.

APICULTURAL DEVELOPMENT IN AN INTEGRAL PROGRAMME FOR THE DEVELOPMENT OF HORTICULTURE AND RURAL ECONOMY IN THE UTTAR PRADESH HILLS

Yogeshwor Singh

Honeybees are the potential base for village industries' development, as well as for higher and better yields of horticultural crops, pulses, oil seeds, and fodder seeds. As an industry, apiculture has the capacity to generate employment through the manufacture of appliances, processing of honey, production of value-added products, and marketing.

As such, this agro-based industry has potential as a poverty eradication programme. Modern apiculture basically needs the availability of standard hives, processing outfits, and a marketing network for proper development. It has an essential input of integration and coordination between various departments, agencies, farmers, and apiculturists. This also needs an umbrella of regular research and developmental activities, bee forage information, development of management practices based on the local environment, and development of marketing strategies. The paper discusses various programmes that are being implemented as well as the need for various agencies.

PROBLEMS OF APICULTURE WITH APIS CERANA F. IN THE DEVELOPING COUNTRIES OF SOUTH EAST ASIA

Siriwat Wongsiri

Apiculture with the European honeybee, Apis mellifera, in some countries of south-east Asia, especially in Thailand, has expanded in the last few years and is now an established industry. Such an expansion of the apicultural industry has been possible because of the recognition of bee parasitic mites as the major enemies of exotic bees, and the development, in the recent past, of methods for their partial control . However, apiculture with the native hive bee, Apis cerana, is still facing many problems that can be solved through research and training efforts. The major problems, requiring immediate attention, are the standardization of mass queen rearing techniques and solving the problem of frequent absconding.

Promotion of beekeeping with the native, Apis cerana, is of great interest in south-east Asia because it requires low capital investment.

APIS CERANA APICULTURE IN JAPAN

Tetsuo Sakai

Japan has a very old and rich tradition of apiculture with the native hive bee Apis cerana japonica, and the first documentary evidence is as early as 627 AD. However, with the introduction of the European honeybee, Apis mellifera, for commercial apiculture in Japan, the populations of this native honeybee species have declined rapidly and consequently apiculture with this species is on a very small scale. Out of a total of 300,000 honeybee colonies in Japan, only 50,000 to 100,000 are of the native Apis cerana japonica, including wild ones.

This bee species is mostly kept in traditional standing log hives or wooden boxes, although a modern movable frame hive has also been developed by the Institute of Honeybee Science, Tamagawa University, Tokyo. It is interesting to note that Apis cerana japonica honey fetches 5 times more than honey from Apis mellifera. This difference is due to different tastes and flavours of honey from this native bee species and also because of its well recognized medicinal value.

In Japan, honey bees are extensively utilized for the pollination of strawberries in greenhouses and also for different field crops. In order to meet the pollination requirements of different cultivated crops, an additional 100,000 bee colonies are needed. Because of the co-evolution of Asian crop plants and honeybee species, under the same ecological conditions, this native bee species should be better suited for cross-pollination purposes than Apis mellifera.

Apis cerana japonica is better adapted to cold temperate climates than the exotic Apis mellifera, due to its hardy characteristics. Wintering clusters of this native bee species survive well, even in northern Honshu where the minimum temperature falls below -20 ^{o}C. Unlike Apis mellifera, this native bee species can escape the attack of wasps and can co-exist with the parasitic varroa mite without any harmful effects. Wax from Apis cerana japonica colonies contains much higher levels of free fatty acids compared to Apis mellifera and this could have specific different industrial uses.

Since Apis mellifera and Apis cerana can not co-exist in the same ecological habitat, due to robbing and other problems, zonation of areas for apiculture, with these native and exotic species of honeybees, is essential if apiculture with both the species is to be promoted in the same region.

APICULTURAL RESEARCH WORK IN CHINA

Jin Zhenming

There are, at present, more than 7 million honeybee colonies kept in modern hives in China. Out of these, 70 per cent are European honeybees (Apis mellifera L.) and others are native hive bees (Apis cerana F.). The annual honey production is over 200,000 tons per year, and the total royal jelly and bee pollen production is 800 and 1000

tons per year respectively. In addition, beeswax and propolis are the other two important hive products harvested. About 30 to 40 percent of the above hive products are exported and the rest are used for domestic consumption. About 90 percent of honey and all the royal jelly, in China, is produced from the European honeybee, Apis mellifera.

The Institute of Apicultural Sciences, of the Chinese Academy of Agricultural Sciences, is mainly responsible for apicultural research and extension activities. There are more than 100,000 apiaries in China, each having 30-80 bee hives. Apiculture with the native, Apis cerana, is practised mainly in the mountain areas.

PRESENT STATUS OF APICULTURE IN PAKISTAN

Rafiq Ahmad

Apiculture is practised on a small scale throughout Pakistan, except in the desert areas. Apart from a few progressive apiculturists, who are familiar with modern technology, traditional methods are widely used. Therefore, in comparison to the developed countries, honey yield per colony is quite low.

Honey bees and insect pollinator populations in Pakistan are amongst the lowest in the world. As a result of this, yields of certain fruits, vegetables, fodders, and oil seed crops are adversely affected. All the four species of the genus Apis are found in Pakistan. There are at present 14,000 colonies of the European bee, Apis mellifera, maintained in modern hives by progressive apiculturists. The number of native, Apis cerana and Apis dorsata, may be between 35,000 to 40,000 and 65,000 to 75,000 respectively. Apis cerana colonies are usually kept in traditional hives. The major honey plants are cultivated crops and forest vegetation. Among them Brassica sp., Helianthus sp., Medicago sp., Panicum sp., Sorghum sp., Acacia sp., Albizia sp., Fraxinus sp., Eucalyptus sp., Plectranthus sp., and Dalbergia sp. are the important honey resources. At present the bee flora in Pakistan can support 0.5 to 0.6 million colonies and produce 8,000-10,000 tons of honey per annum. Such an expansion in the apicultural industry can provide gainful employment for an additional 30-40 thousand persons. Since bee flora is not available throughout the year, in any region, migratory apiculture between lowland and highland areas is practised with rewarding results.

There are 12 different types of modern and traditional bee hives in use in Pakistan. Wax moths, hornets, and mites are the serious pests, predators, and parasites that affect bee colonies in Pakistan. Sacbrood virus disease is a serious problem affecting Apis cerana colonies. Studies on the economics of apiculture suggest that it is a reasonable profit earning activity, both for part-time as well as full time apiculturists. The current annual honey production for different species of honeybees, in Pakistan, is about 640 tons. The wholesale price of honey at producer and intermediary level is 40 to 50 and 60 to 80 rupees per kg respectively. Honey in small cases and bottles is sold at the rate of 80-140 rupees per kg in city markets.

APICULTURE IN THE NORTH WEST FRONTIER PROVINCE OF PAKISTAN

Mohammed Shahid

The North West Frontier Province (NWFP) is located in the north west of Pakistan between 30° to 37° North and 68° to 70° East. It has a temperate climate and ecological conditions are varied but ideal for apiculture. All the four species of honeybees are distributed throughout the Province. The exotic, Apis mellifera, produces three times more honey than Apis cerana and is relatively resistant to the attacks of wasps, wax moths, and acarine disease. However, this exotic species is very susceptible to varroa mite, hornet attacks, and foul brood diseases. The NWFP is very rich in bee plant resources. Dalbergia sissoo, Acacia sp., Adhatoda sp., Citrus sp., Zizyphus sp., Eriobotrya sp., Brassica sp., and Helianthus sp. are the major sources of pollen and nectar. Surveys of honey bee flora in the NWFP suggest that there are five different honey

flow seasons and that migration of bee colonies to a particular locality, during different flow seasons, is a must for commercial honey production. The exotic, Apis mellifera, is becoming more popular among the apiculturists of this Province, and this species is gradually replacing the native, Apis cerana.

Training courses, apicultural equipment, and literature are now available from the National Agricultural Research Centre, Islamabad, the Department of Agricultural Research, ARI, Tarnab, Peshawar, and the NWFP, Agricultural University in Peshawar. Afghan refugees brought with them hundreds of Apis mellifera colonies of Russian origin, and these have now multiplied into thousands over the past 8-9 years. The United Nations High Commission for Refugees also imported hundreds of Apis mellifera colonies, from Australia, for the Afghan refugees. So the NWFP now has Apis mellifera from Russia, Australia, and Europe. Attacks from wax moths, bee eating birds, acarine disease, varroa mite, and insecticidal sprays are serious constraints to apiculture in the NWFP.

THE ROLE OF APICULTURE IN THE DEVELOPMENT OF THE RURAL ECONOMY IN THE NORTH WEST FRONTIER PROVINCE OF PAKISTAN

Bashir M. Khan

The North West Frontier Province (NWFP) of Pakistan is very suitable for apiculture, on account of its different ecological zones containing rich bee flora. It contains 8.33 million hectares of land, of which about 2 million hectares are cultivated. This Province has the potential to produce 35 tons of honey per annum against the present low production of 2 tons only.

In order to exploit the diverse floral resources for obtaining surplus honey, migratory apiculture is vigorously followed. All the four species of honeybees are wide spread in this Province. Honey hunters collect a lot of honey from Apis dorsata colonies at a nominal rate, by leasing forest reserves from the Forest Department from February to June. There are special bee dens, full of Apis cerana colonies, in some specific valleys of the NWFP, where the practice of honey hunting and the collection of wild bee swarms of Apis cerana are very popular amongst the mountain farmers. 85 per cent of the Apis cerana colonies in the NWFP were destroyed during 1981-82, due to acarine disease which was introduced from Apis mellifera/Apis cerana colonies brought by the Afghan beekeepers.

SALIENT FEATURES OF APICULTURE IN NEPAL

G. P. Kafle

The rural people of Nepal have exploited honeybees for honey since time immemorial, and apiculture is traditionally linked with crop farming and animal husbandry. Apiculture with Apis cerana, in Nepal, is still a traditional household activity and accounts for an average honey yield of 5 to 6 kg per colony per year. However, some progressive apiculturists can obtain higher honey yields of 25 kg per colony from the native hive bee, Apis cerana. Other species of wild honeybees namely, Apis dorsata/laboriosa and Apis florea, are erratic honey yielders and have provided honey to the people living near the forest areas.

When the Terai and inner Terai were densely forested, Apis dorsata honey was a big source of forest revenue. Even today, forest dwellers hunt for its honey and sell it in the nearby rural markets. A professional hunter manages to collect up to 30 kg of honey per colony per year.

Two distinct races of the native, Apis cerana, i.e. yellow and dark ones, are found in Nepal. This species is kept and managed traditionally around human settlements and honey is drawn by squeezing the combs. Attempts to introduce a few colonies of the European honeybee, Apis mellifera, have not been successful so far. Traditionally, Apis cerana is kept in Khope hives (wall hives) or in mud hives. Attempts have also been made, through a UNICEF project, to introduce the popular

Kenyan top bar hive for apiculture with Apis cerana but with little success. Different types of movable frame hives modified from Newton B models of Indian make are now in common use.

Various cultivated as well as wild plants provide mixed types of bee forage which vary in different agro-climatic belts of the country. Migratory beekeeping between the Terai and the mountain areas of the Kingdom can yield good results. Sacbrood virus disease killed more than 90 per cent of the colonies of Apis cerana in Nepal in 1983. However, this disease has a 4 year cycle and now the normal population of this native hive bee has been restored.

PERCEPTIONS OF APICULTURE IN NEPAL

Fritiz Ham

Apiculture in Nepal is passing through a transitional phase. All three types of apiculture, i.e. honey hunting, traditional (in logs and wall receptacle hives), and modern frame hive are in vogue. The first two types result in the death of large numbers of adult bees and broods in the process of harvesting honey. Many of the apicultural trainers in Nepal possess knowledge about apiculture with Apis mellifera, and they try to apply this to the native, Apis cerana. Many of them do not keep bee colonies for themselves, and thus they lack practical experience. Many of the modern hives in use are of poor quality and highly priced. For the establishment of apiculture on sound scientific lines, there is a need to distribute properly designed bee hives to beginners, inititate train the trainer programmes and adopt management practices appropriate to apiculture with the native, Apis cerana.

STRATEGIES FOR APICULTURAL DEVELOPMENT IN NEPAL

Miriam Bishop

The development of apiculture in Nepal is being hindered on two fronts. Firstly, there are problems caused by the native hive bee, Apis cerana. Compared to the European honeybee, Apis mellifera, it can be as difficult to get surplus honey production from the local Apis cerana as it is to get eggs from wild birds instead of chickens. However, the variations in biological and economic characteristics existing within Apis cerana, from larger, more populous colonies in the cooler areas of Nepal, to the smaller more swarm-inclined colonies in the hot terai, indicate that the potential for genetic improvement also exists. Identification of beneficial sub-species and races in Apis cerana and their genetic improvement by selective breeding would be the key to success. Before such a breeding programme is launched, it is essential to develop techniques for successful queen rearing and artificial insemination for this native bee species.

The undesirable traits, such as frequent absconding and swarming, in Apis cerana possibly emerged during the process of evolution. This could have arisen as a result of their harmful exploitation by man, through traditional honey hunting methods, in which most of the bees got killed and no honey store was left behind in the nest for consumption by bees during the dearth periods. As a result of this, the colonies of Apis cerana that survived and propagated in nature had developed the trait of migrating/absconding to safer and better honey flow pastures. Modern management practices with movable frame hives, which emphasize the collection of moderate honey harvests, in a timely manner and without harming bees, may eventually reverse this trend.

Another problem facing the apicultural industry in Nepal is that different development and extension agencies consider distribution of modern bee hives to farmers as an index for a successful apicultural development programme. It is rather the skill and knowledge of the apiculturists that are more important. To assume that the hive itself will produce surplus honey without additional efforts is a wrong notion, and apicultural extension workers should remove it from the minds of beekeepers. They themselves must learn how to find the answers for managing bees against undesirable traits or characteristics.

A research programme on the selection and breeding of Apis cerana, coupled with better training for the beginner in apiculture, plus thorough and timely follow-up, should improve apiculture in Nepal.

APICULTURE IN BHUTAN: PROBLEMS AND PROSPECTS

L. R. Verma

In the Bhutanese valleys, lower and high hills, with moderate climates, are the most suitable areas for apiculture. Bhutan is rich in bee resources and all four species of the genus Apis are found there. The European honeybee, Apis mellifera, was introduced in the Bhumthang and Phuntsholing areas in 1986 and 1987 respectively. The native, Apis cerana, is generally kept in primitive traditional hives by the farmers in southern Bhutan. In the northern parts of Bhutan, there is no beekeeping tradition, because harvesting honey from the nests of honeybees is considered a sin. However, such religious beliefs are changing gradually.

Major honey flow seasons in Bhutan are April-May and October-November. The annual average honey yield from Apis cerana and Apis mellifera is 3 and 30 kg per colony respectively. Beeswax is the property of the Forest Department. Traditional log hives are made from oak wood and modern bee hives are made of blue pine wood. Acarine and Tropiolaelaps mites as well as European foul brood have been reported on Apis mellifera. Local people and tourists are the major consumers of honey and it is sold at 50 Bhutanese Nu per kg. There is no research and development programme in apiculture. However, one Bhutanese national is receiving training in Canada.

Apples, oranges, and cardamom are the major horticultural crops grown in Bhutan and occupy about 90 per cent of the total area under fruit crops. All these fruit crops require cross pollination by honeybees for efficient and sufficient pollination. A conservative estimate of the number of hives needed exclusively for pollination of horticultural crops, at present, is about 50,000, whereas, the present number of bee colonies in modern hives is not more than 100.

Strategies for apicultural development in Bhutan include exploration of bee genetic resources and zonation of beekeeping areas, survey of honey plant resources and preparation of floral calendars, management of bee colonies for pollination, schedules for migratory apiculture, establishment of extension cum demonstration apiaries, beekeeping training programmes, and assessment of the honey market situation.

APICULTURAL RESEARCH AND TRAINING IN THE HINDU KUSH-HIMALAYAN REGION: FUTURE PERSPECTIVES

Krishna Kumar Shrestha
L.R. Verma

Apiculture with the native hive bee, Apis cerana F., in many countries of the Hindu Kush-Himalayan Region is still an old traditional household activity and it is yet to develop on the same modern scientific lines as the European honeybee, Apis mellifera, in the developed countries. Apis cerana has many valuable characteristics of biological and economic importance, and these have not been scientifically explored. They include its gentle temperament, industriousness, lesser susceptibility to protozoan and parasitic mite diseases, and the fact that less chemical treatment of colonies is needed to control them. Varieties of sub-species and geographic races/populations of this native bee species occur in this Region. Their honey yield varies from 3-50 kg per colony per annum and there are excellent opportunities for their genetic improvement by selective breeding. These native bees, because of their shorter flight range, are especially suited for the cross pollination of crops grown in the small holdings of this Region. However, there are several constraints such as frequent swarming and absconding, proneness to robbing, and lower honey yields. These problems can be overcome through research and development efforts.

In the past, several attempts were made to improve apiculture with the native, Apis cerana, through technical and financial assistance from different national and international agencies. However, such efforts have not yielded satisfactory results, because the high cost technology of western bee management is not applicable to the native bee species due to different ecological and socioeconomic conditions.

Keeping these problems in mind, there is a strong need for an International Apicultural Research and Training Centre in this Region. The overall objective, of such a centre, should be to generate and deliver improved apicultural technology, through research and training, primarily concerned with Asiatic species of honeybees. Several resolutions have already been passed at different international forums in favour of establishing such an International Centre for the promotion of apiculture with native bee species. For establishing such a Centre, Nepal would be a good host country, because it is very rich in native bee resources and the European honeybee, Apis mellifera, has not yet been introduced into this country. Moreover, varied physiographic conditions, abundance of bee flora, strong commitment of HMG Nepal to the promotion of apiculture, and the close linkage of apiculture to the cultural heritage of the rural people of Nepal make it an ideal place for such an International Centre. ICIMOD, in Kathmandu, covers all the Apis cerana countries of the Region, and should take the initial steps in establishing such an International Centre for Apiculture in Nepal.