Beekeeping in Humla district West Nepal: a field study

Commissioned by the District Partner Programme (DPP) - SNV Nepal
With extra results from a study commissioned by ApTibeT

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List of abbreviations used in the text

4S – Surya Social Service Society Jumla (local NGO)
ADO - Agricultural Development Office
ApTibeT – Appropriate Technology for Tibetans
BPC - Beeswax Processing Centre Jumla
CBO – Community Based Organisation
DDC – District Development Committee
DFID – Department for International Development (UK government development agency)
DFO – District Forestry Office
DPM - District Programme Manager of DPP
DPP – District Partners Programme of SNV
EDO - Economic Development Officer of DPP
EFB – European Foul Brood Disease
HCDA – Humla Conservation and Development Association
ICIMOD – International Centre for Integrated Mountain Development
JPP - Jajarkot Permaculture Programme
JTA – Junior Technical Assistant (post in Agriculture development office)
kcal – kilo calories
Kg - kilogram
KTM – Kathmandu
KTS – Karnali Technical School Jumla (a training school for agriculture, construction and health workers run by the Centre for Technical Education and Vocational Training)
N – north
NARMSAP – Natural Resource Management Sector Programme
NGO – Non-Government Organisation
NTFP – Non-timber Forest Products
NW – north west
PAR – participatory action research
PRA – Participatory Rural Appraisal
S – south
SIDC – Snowland Integrated Development Centre (local NGO)
SLC – School Leaving Certificate
TORs – Terms of Reference
TSBV – Thai Sac Brood Virus Disease
UK – United Kingdom
UMN – United Mission to Nepal
USCCN – Unitarian Services Committee Canada Nepal
VDC – Village development committee
VDP – Village Development Programme (local NGO)
WWS – Women’s Welfare Society

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1 Introduction

1.1 Humla district and its problems

The district of Humla lies in the NW corner of Nepal, bordering Tibet, India and Nepali districts of Bajura, Bajhang, Doti and Mugu. *'Altitude in the region varies between 1,219 and 7,315 metres above sea level. The second largest district in Nepal, Humla district covers an area of 5,655km^2, has a population of approximately 34,383 (Central Bureau of Statistics 1995) and ranks 4th from poorest in the ranking of the 75 districts of Nepal, according a 'composite index of development' (Banskota et al 1997). In Humla, mountainous terrain accounts for over 50% of the total land area so only around 1% of land is devoted to agriculture, while high altitude pasture accounts for another 24% (Central Bureau of Statistics 1995). Despite this, agriculture is the main occupation in Humla, and 98% of the population are engaged in seasonal agricultural activities, which for the majority, is their primary source of income. Because of a lack of suitable flat land (some 91.87% of the total land area of Humla District is located in areas with more than 30^o of slope), a cold climate, and poor irrigation and fertiliser availability, overall productivity is very low. In villages situated above 2760m, productivity issues are worsened by the inability to grow more than one crop per year. Per capita calorific values for food production are 1132 kcal, the second lowest in Nepal (Banskota et al 1997). Because of lack of alternative incomes (only 7.7% of the population are engaged in regular non-agricultural activities), the population is extremely vulnerable to drought, crop failure, pest damage and other natural calamities. Widespread food deficits are common, and most families produce only sufficient food for between three and six months. To meet the shortfall, most rely on unsustainable trade practices in timber and herbal products with the Chinese border and lowland Nepal and / or meagre subsidised food rations airlifted into Simikot by the Nepal Food Corporation.*

These problems are compounded by poor infrastructural links with the rest of Nepal. Isolated from motor roads (c. 10 days walk from the district capital Simikot to the nearest road head in Achham), Humla ranks 3rd (from the bottom) in terms of institutional and infrastructure development, and 7th in terms of poverty and deprivation (Banskota et al 1997). Government services in the remotest areas, if present at all, often comprise empty buildings (health posts, schools, agricultural development offices) with no staff or materials (Evans 2000). In terms women's empowerment, Humla ranks lowest of all the 75 districts (Banskota et al 1997). Lack of adequate drinking water, sanitation, health care, education, credit and finance compounds the problems the population face as a result of inadequate food security, by increasing their vulnerabilities to disease, both in terms of nutritional deficit and pathogens, and by reducing their options for change, such as developing new agricultural techniques or investing in alternative income generation activities.

In spite of its many difficulties, Humla district scores 56th of the 75 districts (i.e. relatively highly) according to a natural resources endowment index (Banskota et al 1997). This means that its development lies in the judicious use, conservation and restoration of forest and pasture resources and sustainable means of increasing agricultural productivity and efficiency.' The use of these habitats by bees makes a positive contribution to their conservation through pollination and provides income for those who keep them or who harvest wild colonies through production of honey, beeswax and pollen. Hence 'development and promotion of apiculture is one of the most environmentally positive means of increasing productivity. Indigenous knowledge in beekeeping and honey hunting (collectively termed here as 'apiculture') is ric9h

throughout the Karnali Zone and barter of honey and beeswax has long been an important traditional income source for high hill farmers (Saville & Upadhaya 2000). The mixed-flower honey from these altitudes is renowned for its superior medicinal properties and flavour compared to honey from lower altitudes and its local market is by no means yet saturated.' [Source: proposal for DFID prepared for ApTibeT by the author.]

1.2 Justification for the study

The Karnali Zone of Nepal is famous for its honey, which is highly reputed throughout Nepal and the area is the home of the endangered species of Apis cerana subspecies cerana, which has higher honey yielding capacity and less swarming and absconding behaviour than lower altitude subspecies. However, despite comparative advantages over other areas of Nepal in terms of natural resources for beekeeping, to date neither development organisations nor local entrepreneurs have been able to develop any innovative or highly profitable beekeeping industry in the area. Previous attempts to develop beekeeping in Humla district have failed as the section quoted below from the author's report to ApTibeT of an April 2000 field trip shows.

"Several attempts to improve the benefit from beekeeping for Humla people have been made by institutions active in Humla in the last 50 years.
The first attempt to introduce 'modern' frame beekeeping top Humla appears to have occurred as much as 50 years ago! One old man called Suka Sejuwal in the village of Thapa Gaun in Maila VDC told us about beekeeping training that he attended 50 years previously in his own community run by beekeeping specialists from the beekeeping centre in Joelikote near Nainital, just over the border of West Nepal in Uttar Pradesh, India. He said that at that time the Indian visitors demonstrated how to use a frame hive and a honey extractor. When asked whether he had taken up the new technology he said that he didn't know anyone in his village who had tried it, but heard about a couple of people in the nearby VDC of Sri Nagar who had tried it. He didn't know how they had got on with the trial, but the fact that all the beehives we saw in use were traditional log hives made from digging out a log would suggest that the technology did not get widely accepted.

More recent attempts to introduce similar kinds of 'modern' frame hives called Newton hives were recorded in north Humla.

- *The district Cottage Industries (Gharelu) office, in collaboration with the Women's Welfare Society (WWS) a local NGO, had run a beekeeping training for women mainly from Hepka VDC in 1998 using Sita Lama who was the woman agriculture development officer for USCCN as the chief trainer;*
- *USCCN had also trained farmers in Bargaon, Baiji Bada, Dozjam as part of their 'Self Help Initiative Promotion Project' in 1998 again using Sita Lama as the main trainer;*
- *Snow Land Integrated Development Centre (SIDC) provided beekeeping training to 20 farmers from Lali and Kharpunath in 1998 using their own motivator as trainer (Pabitra Rai).*

At all these training courses the focus of the training was on the shift of technology from traditional hive to Newton hive. According to reports from trainees we interviewed, these training courses included an introduction to the life cycle of bees, the work performed by the queen, workers and drones, classes on construction and use of the

Newton hive and honey extraction from it, and protection of hives from rain, ants and mice.
The beekeeping training we heard about from trainees lacked information about honey processing without extractor, beeswax processing, bee disease, absconding, swarming, medicinal applications of bee products, and bee feeding. These are topics that in Jumla proved to be highly applicable to subsistence farmers who keep bees in top bar hives.

In all cases there had been distribution of beekeeping materials to the trainees including: bee veil, swarm bag, smoker, gloves & queen excluder to fit the Newton hive. These items were proudly produced unused in the same condition that they had been given to the trainees. Apart from the bee veil and swarm bag all these items are totally redundant for traditional beekeepers. Even the queen gate, which can be useful with fixed comb hives, was too small to be useful on a log hive. When questioned, the trainees said that the training had been entirely verbal with no practical sessions. In the case of the 'Gharelu' training the women had been given training allowances of Rs200 per day to attend. The women said that the training had been good, but when asked if they had made any changes to the way that they kept their bees since the training we found that none of them had done so.

1.3 Use of Newton frame hives – proven to be inappropriate

Everyone we talked to about these beekeeping trainings, both employees of the NGOs concerned and trainees who had attended the training said that they didn't feel that the Newton hive had been useful. The staff of USCCN said that their bee colony established in the Newton hive in Bargaon had absconded after an attempt to divide the colony, and that this had created a negative effect with the community. Beekeepers in Dozjam and Baiji Bada said that they felt that the Newton hive was poorly suited to the local conditions because it required too much wood in comparison to the log hive. This is because planks of wood have to be cut by hand using an adze unless two people with a special saw are employed to saw planks (which would cost too much). In comparison to the traditional hive it is far more complicated and time-consuming to make and requires very precise measurements that are difficult to make. Bhum Lama, a local beekeeping expert, complained that he would need two people to make a Newton hive but could make the traditional hive on his own without assistance. He said that the Newton hive appeared to be suitable in summer but bees would die of cold in the winter.
Women who had attended the 'Gharelu' training course said that the Newton hives was good but not suitable for their own use. They complained that it was too expensive and also too cold for the bees.

It is interesting that the responses of Humla farmers echo exactly the findings in Jumla district between 1995 and 1999. Farmers in Jumla disliked the Newton hive for the same reasons as Humla farmers did. When hive temperatures were measured in an experiment in KTS apiary in Jumla it was indeed found that the Newton hive was significantly colder than log hives in the winter and subject to much sharper changes in temperature in general (Saville, Upadhaya, Shukla and Pradhan 2000).

It is most important that future beekeeping interventions in Humla district do not repeat the mistakes of those reported here. The approach taken by the NGOs / 'Gharelu' office was to assume that 'modern or 'Western' solutions to problems such as those taught to students studying agriculture are necessarily better than indigenous systems that have evolved for centuries. Whilst Newton hives have application for commercial beekeepers

in Kathmandu valley, the plains and perhaps the more accessible lower mid-hills, they are not appropriate to the conditions of the Karnali Zone."

So, in order to avoid the repetition of mistakes referred to above, it is necessary before launching any new beekeeping initiative in Humla to look for limiting factors that might make a new beekeeping enterprise fail and for potentialities that might make a beekeeping enterprise successful. This was the aim of making field visits into the working areas of the Village Development Programme and Humla Conservation and Development Association (NGOs working with DPP Humla of SNV) during September 2000.

1.4 Objectives of the study

- To analyse the health of the bee population and share knowledge on causes of bee decline in:
  - Melcham VDC: Charigaun, Korka, Melchham, Mashidhara
  - Hepka VDC: Tangin, Hepka, Dinga
- To disseminate knowledge on bee diseases and other causes of bee colony death and means to prevent and control them.

Full details of the terms of reference including a list of activities of the field study are given in Appendix 1 and an introduction to the authors in Appendix 2.

2 Itinerary

Date	*Activities*
13 Sept.	Flew from Kathmandu to Nepalgunj Met Henk Munneke to discuss their programme in Humla and the consultancy TORs and aspects of the District Partner Programme (DPP). Stayed in Nepalgunj at DPP guesthouse.
14 Sept.	Flew Nepalgunj to Simikot, Humla Met DPP staff and our guide-porter Tschering Dorje. Visited offices of Village Development programme (VDP) and Humla Conservation and Development Association (HCDA) to plan field activities. Stayed in Simikot at DPP guesthouse.
15 Sept.	Walked from Simikot to Gadapaari, Hepka VDC via Dinga Focus group discussion and key informant interviews in Dinga Brief group discussion in Gadapaari. Evening activities not possible due to the community being engaged in death rites of a community member. Stayed at Gadapaari.
16 Sept.	Focus group discussion and key informant interviews with Gadapaari beekeepers Inspected *Apis cerana* bee colonies. Gadapaari community had a village meeting of their own, so activities had to be curtailed. Walked from Gadapaari to the Gompa above known as Lama Gaun. Inspected bee colonies, held key informant interview. Stayed in the Gompa with Lama family.

17 Sept.	Walked from Lama Gaun to Hepka. Few farmers were available to talk in Hepka. Held key informant interviews in Hepka. Inspected *Apis cerana* bee colonies of Hetuk Lama. Walked from Hepka to Tangin Focus group discussion with Tangin beekeepers. Stayed at Tangin.
18 Sept.	Held key informant interview with 2 beekeepers in Tangin. Had problem getting anyone to allow colony inspections in Tangin. Walked from Tangin to Hepka Met lead farmer from Tangin and held key informant interview. Walked Hepka to Simikot Stayed in Simikot at DPP office / guesthouse.
19 Sept.	Logistical preparations for Melchham field trip. Meeting with HCDA to discuss field trip and potential for beekeeping development and market facilitation of bee products through their small herbal processing and marketing industry. Meeting with Mr. Shankar Pokharel (District Programme Manager - DPM) and Mr. Khatiwada (Economic Development Officer - EDO) to discuss TORs, approach of the field study and workshop plans in depth. Stayed in Simikot at DPP office / guesthouse.
20 Sept.	Walked from Simikot to Durpaa. Group discussion on bees and beekeeping. Inspection of *Apis cerana* colony. Stayed in Durpaa in local hotel.
21 Sept.	Walked from Durpaa over Margole Lekh to Kollaas with Sunam Budha (ex-VDC chairman of Melchham) and HCDA runner Kara Siraha. Stayed in Kollaas.
22 Sept.	Walked from Kollaas via Kuti (Gothi VDC) to Charigaun Brief discussion of beekeeping and water supply problems in Kuti Introduction to HCDA field staff and Charigaun community members in Charigaun. Brief focus group discussion about bees and bee disease. Stayed in Charigaun with Sunam Budha and family.
23 Sept.	Full day of activities with Charigaun farmers: - Focus group discussion - Key informant interviews - PRA preference ranking exercise - PRA trend analysis - Beeswax cream and candle making - Inspection of *Apis cerana* colonies Walked from Charigaun to Korka Key informant interviews in Korka Stayed in Korka

24 Sept.	Full day of activities with Korka farmers: - Focus group discussion - PRA trend analysis - Beeswax cream and candle making - Inspection of *Apis cerana* colonies Walked from Korka to Melchham Welcome and introduction to Melchham CBOs Stayed in Melchham at HCDA office
25 Sept.	Full day of activities with Melchham farmers: - Focus group discussion - Key informant interviews - PRA preference ranking exercise - PRA trend analysis - Beeswax cream and candle making - Inspection of *Apis cerana* colonies Walked from Melchham to Mashidhara Welcome and introduction to Mashidhara CBOs Stayed in Mashidhara
26 Sept.	Full day of discussions / exercises with Mashidhara farmers - PRA trend analysis on bee populations - PRA preference ranking of livelihood sources - Key informant interviews - Focus group discussion on bees and beekeeping - Demonstration of making wax candles and creams - Inspection of *Apis cerana* colonies Stayed at HCDA office in Melchham
27 Sept.	Walked Melchham to Rimi via Darma Stayed in Bohoragaun below Rimi village with ex- VDC chairman
28 Sept.	Walked from Rimi (Humla) to Bhattechaur (Mugu) via Chankeli Lekh Stayed at Bhattechaur in hotel.
29 Sept.	Walked from Bhattechaur (Mugu) via Ghuchi Lekh to Neurighad (Jumla). Stayed at hotel in Neurighad.
30 Sept - 16 Oct	Walked from Neurighad to Jumla. Preparation of a report on beekeeping in Hepka and Melchham VDCs of Humla on the basis of our findings

3 Methods

3.1 Overall approach and site selection

The basic survey approach was to walk from village to village by and interact with members of the communities we passed through or stayed in. Activities were particularly focussed in villages of Hepka and Melchham VDCs given in the Terms of Reference by DPP, but where local NGO staff suggested that other communities than those listed should be visited (as in the case of Gadapaari and Lama Gaun in Hepka VDC) we added these to our itinerary. The nature of the interaction varied depending upon willingness of community members to talk to us, and the importance of beekeeping to them. The guide-porter who accompanied us, Mr. Tschering Dorje, assisted with translation from the Lama language into Nepali and also with demonstration of beeswax processing. In Hepka VDC Phunjok Lama (VDP project coordinator) assisted us in contacting community and CBO members and in translation into Lama language. In Melchham VDC Hira Rokaya, Sunita Budha, Dharma Bahadur Shahi and Prayag Bahadur Shahi (four motivators of HCDA) and Kara Siraha (HCDA runner) assisted us in PRA exercises and group activities with Melchham CBO members.

3.2 PRA tools employed

In communities visited, PRA tools were employed focussing on beekeeping and use of bee products as follows:

3.2.1 Focus group discussions

Discussions were held with groups of varying sizes depending on the level of participation. The importance of beekeeping and problems associated with it were discussed. Bee disease levels and symptoms were discussed in detail.

3.2.2 Preference ranking of income / livelihood sources

First the income sources to be included in the ranking exercises were listed and a matrix table scratched into the ground. Different materials were accumulated by the villagers and agreed upon to represent different crops or activities. For example wool was used to represent sheep, straw to represent wheat, old combs to represent bees and so on. Then each item was compared with each other on a pair-wise basis, the preferred item being placed in the matrix cell. Where wheat was preferred, the chart had a predominance of wheat straw, whereas where sheep husbandry was preferred, the chart had a predominance of wool, and so on. This resulted in a matrix that was clear for literate and illiterate participants to understand. After pair-wise ranking, a rank score was calculated for each item. Reasons for each income source receiving this score were listed and discussed.

3.2.3 Trend analysis of changes in bee populations over recent years

Trend analysis was conducted by drawing squares on the ground each representing a different year and then getting beekeepers to place stones in the squares to show the number of occupied beehives they had that year. Squares represented 2000, 1999, 1998, 5 years ago (around 1995) and more than 10 years ago (before 1990). In Hepka trend analysis was not possible because too few beekeepers attended meetings, but in Melchham VDC trend analysis was conducted in all 4 villages surveyed. In Charigaun all

stones were clumped together so only the number of colonies in total could be found. In the other villages the number of bees per household and the number of households with bees was shown by putting each beekeeper's stones in a separate clump in the box.

3.3 Key informant interview questionnaire

In order to standardise information gathered from each community and enable easy comparison of beekeeping conditions and knowledge a questionnaire was devised and used. This included questions about bee populations, honey yields and prices, honey processing and harvesting practices, disease symptoms and treatment, pests of bees, insecticide poisoning, hive sanitation, hive inspection practices and comments of farmers about beekeeping. At least one questionnaire was completed with key informants for each community visited. A sample questionnaire in Nepali and English is given in Appendix 3. Whenever possible questions from the questionnaire were asked according to semi-structured interviewing principles, attempting to make the interviews conversational rather than rigid.

3.4 Inspection of bee colonies and sampling of pest and disease organisms

In communities where beekeepers would allow us to do so, beehives were opened and colonies inspected as thoroughly as possible without destroying large numbers of combs. Where possible we requested to open weak colonies rather than strong ones in order to look for disease organisms and disease symptoms. A bee colony inspection form with questions on appearance of bee brood and indications of the health of bee colonies was completed for every colony opened. A sample form in Nepali and English is given in Appendix 7.

Any pest or disease invertebrate organisms found were sampled in 75% alcohol and will be taken or sent to appropriate organisations for identification. First the Natural History Museum in Kathmandu will be used and if identification proves difficult there, samples will be sent to The British Natural History Museum in London. A list of invertebrate samples taken and their suspected identification is given in Appendix 9. Results of invertebrate identification will be given later once responses have been obtained from the necessary institutions.

Larval and pupal smear samples were taken by drying squashed bee larvae or pupae on paper or spread onto a microscope slide and stained with 'nigrocin' stain. These samples are to be analysed for European Foul Brood and / or Thai Sac Brood Virus infestation in the Beekeeping Shop in Kumaripati, Kathmandu. Results will be presented later when analysis has been completed. A list of smear samples taken is given in Appendix 10.

In cases where samples of bee combs were cut from hives, training in identification of the different stages of development of bees (from egg through larva and pupa to adult) and in identification of pollen, sealed and unsealed honey in the comb was given. In cases that pest or disease organisms and or symptoms were detected these too were shown to farmers and explained in depth.

3.5 Collection of honey samples

In order to identify major forage sources and to check upon the quality of fresh honey from the comb in areas surveyed, 30-60 ml honey samples were collected from every

community where beekeepers agreed to sell or give samples. A total of seven (7) honey samples were taken and the locations and farmers' names are listed in Appendix 11.

The honey was taken from colonies inspected rather than from already harvested and processed honey stores. Pollen analysis of the pollen from different species of plant found in the samples will provide some indication of the most important forage species in the communities visited. Unprocessed honey quality can also be tested (e.g. for water content sugar composition and so on). Results of these analyses should be available by the end of November or mid-December. It would be interesting to access both raw and cooked honey from the same communities after this year's honey harvest and compare the quality with that of fresh unprocessed honey taken from the comb.

3.6 Demonstration / Training

In order to gain the trust of informants, and also to ensure that the survey was not merely an extractive process of information gathering but more of a positive exchange of information, simple demonstrations of beeswax processing, bee venom therapy and bee feeding were conducted where people showed sufficient interest and had time to participate. Photographs of bee disease symptoms and appropriate technology top-bar hives were also shared with farmers.

3.7 Language

Although Nepali was the main language of communication, wherever possible local dialects were used to enable all the community members to take part. This was possible because the Jumli language is very similar to the dialect spoken by the Hindu people of Humla, so both the researchers were familiar with it. Since our guide-porter was Lama he was able to translate into the local dialect for us with the Bhotia communities.

3.8 Gender issues – the difficulty of reaching women

As always in the Karnali Zone, it was difficult to make contact with women and find out what they really felt about beekeeping. In many cases, women were busy working in the fields or preparing food at the times that we held discussions. However, in Melchham VDC women were able to participate relatively well and took part in PRA and beeswax processing training exercises. Unfortunately logistical constraints and shortage of time meant that women-only PRA exercises could not be organised, especially as the female motivators themselves have the double task of childcare of young babies together with community social mobilisation. The extent to which the presence of male members influenced the women's responses is difficult to tell but certain women at least were able to raise their voices and discuss preferences with the men.

3.9 Definition of 'disease'

Many farmers used a blanket term 'disease' for loss of bee colonies but the reasons for losses can be various (section 4). In some cases diseases of developing bee brood or perhaps even adult bee diseases are the cause of bee colony death but very often lack of food, cold and insecticide poisoning negatively affect bees and cause colony death too. Further details of 'disease' symptoms observed by farmers and by the researchers when inspected hives and the kinds of problem leading to death of bee colonies are given in sections 5.5 to 5.7 below.

3.10 Difficulty of obtaining objective data

In order to triangulate results, two ways of estimating trends in bee numbers were used in the survey. The first method was the PRA trend diagram given in section 5.4. This appeared to give quite reliable data from those who participated, especially as villagers discussed between themselves to draw conclusions. The second method was to interview key informants about their own bee colonies and changes in numbers in recent years (results given in section 5.5) and also to ask them to estimate the approximate number of bee colonies in the village. Since the majority of interviewees could not remember back to 5 or 10 years ago, only the most enthusiastic beekeepers (who are likely to have more bee colonies) gave data for further back than 3 years. This means that apparent trends are not statistically valid and need to be interpreted with care. Similarly the data on estimated number of bee colonies in the village taken from interviews (given in table 3) are also likely to contain errors since individual farmers could only estimate roughly the numbers of bee colonies in the village as a whole.

Unfortunately the two methods yielded data that was difficult to compare. Data appear to suggest that individual interviewees estimated higher numbers of bee colonies in their communities compared with groups of farmers counting stones in PRA exercises. It is likely that individuals overestimated but there may also be under-estimation in stone-counting if anyone who has bees and is not there is forgotten. As a result of the potential error in the two methods both are presented to allow the reader to see the kind of data available.

3.11 Conversions to metric for the various measures used in the text

All weights and measures used in Nepali villages and especially in remote areas such as Humla ten to be variable. The various volume measures are particularly confusing and vary even from house to house or between villages, as well as between regions of the country. This means that all calculations involving weights and measures can only be approximate. In the raw data (presented in full in Report Supplement) the actual measures described by farmers are given. These enable any interested field worker or researcher to double-check if the conversions used here approximate well enough to the measures used in the individual villages. At the time of the survey, a lack of appropriate equipment for accurate weights and measures and a lack of honey to measure and weigh made it impossible to make empirical calibrations of locally used measures.

The manna is a volume measure, which seems to vary from place to place. There are ‘manna’ volumes dating from the reign of different Kings. The Tribhuvan (old) manna is smaller than the Birendra (new) manna. The manna used in Humla now is probably closer to the old manna and is smaller in volume than the new manna used in Kathmandu. The new manna is equivalent to ½ Kg of dehusked rice (chamel), ghee, millet, wheat but NOT rice with husks (dhan) or barley, or flour. In Humla a ‘phoktin’ measure is often used for measuring grain and other commodities but it was not quoted as a measure for honey.

Water containers may be used to measure and store honey in Humla and these vary in size. The old deisgn tend to be large and were of a uniform size according to the mould of the local copper workers. The more modern containers tend to be a smaller size, but

now that containers are made in different places in factories and imported from different areas many different sizes can be found.

Dhaarni is a weight measure used in villages, which appears to be relatively uniform compared to the volume meaures. This was the commonest measure used for honey in South Humla. Patti is a volume measure (1 patti = 2 manna in Humla and 1 patti = 4 manna in other parts of Nepal). Pattis are not used to measure honey as usually the containers are baskets (unsuitable for holding honey).

Table i) Approximate rates of conversion from indigenous Nepali measures to standard metric measures as used in calculations

Name of Measure	*Equivalent in metric system for honey*	*Equivalent in Nepali / Humla measuring system*
Humli Manna	Since manna measures vary in size 660-750g of honey is equivalent to the small (old) manna in Humla. The authors made estimates from alcohol botlles used for measuring in Humla and found a 450ml manna to be equivalent to 685g honey. This is the measure used in subsequent calculations.	
Standard Nepali Manna	c. 800 - 830 g honey is equivalent to the new larger (Birendra) manna.	
Gaagra / gaagro	A 50 manna gaagro should hold 33-37.5 kg and a 32 manna gaagro should hold 21-24 Kg.	A small gaagro that can be carried on the hip holds about 32 manna. A large gaagro that could be carried in a ‘dhoko’ basket holds 50 manna.
Dhaarni	2.5 Kg honey	
Litre	1 litre = approx. 1.6 Kg honey. Although it was not clear if the litre measure used was actually a litre or another commonly found alcohol bottle of smaller volume.	

4 Background information on potential causes of bee death for *Apis cerana* in Humla (and Nepal in general)

Information on bee diseases affecting bees in Asia has been accessed from the following texts, plus the experience of the consultant: Allen (1994); Gregory (1999); Pongthep (1987); Shimanuki and Knox (1991). For information in Nepali for use by field staff in Humla readers should consult Shukla (2000).

4.1 Thai Sac Brood Virus (TSBV)

TSBV disease affects the later (4^{th} & 5^{th}) instars of developing larvae and the pre-pupae. The virus causes the pre-pupa to stop developing and die such that they can be seen with heads pointed upwards and attached to the upper surface of the unsealed cell by their tongue. This means that there are more unsealed cells than in a normal comb, which should have sealed brood cells (in which the pupae metamorphose into adult bees clumped together. In TSBV infected combs, if cells are sealed at all often they have abnormal irregular sized pores, unlike healthy sealed brood that is capped evenly with wax. If such cells with pores are opened, they often reveal dead pre-pupae with pointed heads as described above. If infected pre-pupae are removed they often have the appearance of a plastic bag with granular watery contents, revealing the broken down tissues of the bee. This sac-like appearance of the pre-pupae leads to the name ‘sac-brood’. Once dead, the pre-pupae dry to form a ‘scale’ inside the cell, usually lying along the lower long surface of it rather than at the bottom of the cell. This may be brown or grey and becomes rubbery before drying out completely.

Colonies infected with TSBV are prone to absconding and worker bees may be seen carrying dead larvae out of the hive. When the bees abscond often several colonies will do so simultaneously, clustering to form one large colony with several queens rather than separate clusters each with one queen. Often the rotten brood give of a bad smell, the bees become more defensive and the workers take on a darker appearance. This is because of the fact that new workers are not emerging to replace the old ones so that only older bees remain to perform all the duties. As workers age they lose their covering of yellow-brown hairs and become black and shiny.

There is no effective allopathic cure for TSBV yet discovered. However feeding with the herbal decoction in Appendix 13 can help to control the disease. Breaking of the brood rearing cycle through bio-technical management is the best form of control. This can be done by removing all brood combs (and burning them) and providing fresh comb foundation in a clean hive. The time taken for the bees to rear brood in the new combs should break the cycle of re-infection of developing brood. However removal of the brood combs usually causes absconding. Caging of the queen for 7 days can also control the disease, together with removal of infected combs. However, this too can cause absconding or death of the queen. Re-queening infected colonies is a good form of treatment, but new queens are not often available at the time of infection. TSBV is one of the most difficult diseases to control.

4.2 European Foul Brood (EFB)

EFB is a bee disease caused by the bacterium *Melissococcus pluton*. This, like TSBV, affects the developing larvae but usually at a young stage (1^{st}- 4^{th} instars). It can be detected by the lack of sealed brood, which are unable to develop because bees die in the larval stage, and by rotting of the unsealed brood. When the larvae are first infected their tracheal system (breathing pipes which permeate throughout the whole body) can be seen more easily (as white lines) than in healthy larvae. Watery fluid collects around the larvae. The larvae change colour from white to yellow, eventually turning brown or grey as they die and rot. The larvae lie twisted in the cell and may look 'melted' as they die. Dead larvae form brown scales that stick to the bottom of the cells but can be loosed and removed with a toothpick. As with TSBV, a bad smell comes form infected combs and the bees may become more defensive and darker in colour. The *Melissococcus pluton* bacteria tends to live in the gut of the bee larvae like a parasite (Gregory 1999). If the larvae are well fed there is sufficient food for both the bacteria and the larvae to survive, however once there is shortage of food the bacteria begin to attack the tissue of the larvae and cause death of their hosts. Once the larvae show EFB symptoms, die and start to rot secondary bacteria may infect. These usually cause the sour smell and total breakdown of the larval tissues.

EFB is native to the European Honeybee *Apis mellifera* but has been found to seriously affect *Apis cerana* since its accidental introduction to *Apis cerana* areas together with *Apis mellifera*. EFB has been the major cause of bee colony deaths in Jumla district in recent years, since the introduction of *Apis mellifera* to the district around 1990 (Saville in press[2]). On the basis of the rapidity with which EFB spread throughout Jumla district and the fact that Jumla is only 5 days walk from the southern border of Humla, it is possible that the disease has spread to Humla by now.

EFB is often treated with the antibiotic terramycin or oxytetracycline. However studies in UK and elsewhere (Gregory 1999) and experiences in Jumla have shown that the antibiotic is only bacertiostatic not bacteriocidal i.e. it limits growth of bacteria but does not kill them. Except in rare cases where there is very acute and heavy infestation with EFB, there is little point in using antibiotic medicine as symptoms are almost definitely going to show up again once the colony gets stressed.

Bio-technical methods of control involve removal (and destruction by burning) of all the brood combs so that the cycle of infection is stopped (as with TSBV). This often causes absconding however. Caging of the queen combined with removal of brood combs may control the disease. Feeding of bee colonies with the herbal decoction given in appendix 13 can alleviate symptoms so long as the disease is not too far advanced. Keeping colonies well fed can control the level of infection quite effectively.

4.3 Starvation of bees

Lack of food is a major contributing factor to disease susceptibility in bees, but can also result in death of a colony. Starved bees are often found with their heads stuck inside dry combs or dead on the bottom of hives with no honey. The long winter dearth period, cold temperatures, and over-cropping of honey without sufficient supplementary feeding leads to starvation of bees in the winter. In the monsoon, if honey stores have not been sufficiently accumulated before the start of the heavy rains, bees can be unable to go out to collect sufficient food due to rain. Sufficient flowers yielding nectar may also be unavailable.

4.4 Wax moth

The wax moth is a Lepidopteron that specialises on eating beeswax. Two species of wax moth are found in Asia, the greater wax moth (*Galleria mellonella*) and the lesser wax moth (*Achroia grisella*). The commonest species in Nepal is the greater wax moth. The wax moth larvae burrow through combs eating beeswax, pollen and honey, damaging developing bees in the cells through which it tunnels. As it eats the combs it creates a silky trail like spiders web. Eventually whole combs become covered in this kind of 'web' and disintegrate when handled. Usually wax moths are only able to infest empty combs that cannot be covered by bees, so colonies that have become weaker and have left previously covered combs empty of bees are more susceptible than strong colonies that cover all the combs in the hive. The wax moth larvae grow in size up to about 2cm long and then pupate in corners of the hive. The pupae spin cocoons that dig themselves into the wall or corners of the hive. These leave a small distinctive 'scar' on the wood, which can show even after wax moth have stopped infesting a hive.

There is no chemotherapeutic method of controlling wax moth in beehives. Wax moth can be controlled by: maintaining strong colonies, removing combs that the bees cannot cover and containing all beeswax stores and scraps in sealed containers that prevent the moths from entering.

4.5 Phorid Fly

The Phorid fly is a small Dipteran that lays its eggs inside the cells of bee combs. This can damage bee colonies if numbers get very high, but otherwise in temperate climates in Nepal is not usually a cause of colony demise.

The best way to control Phorid flies is to keep colonies strong and to remove old combs that the bees are not able to cover with bees.

4.6 Varroa mite

Varroa is a small mite (about 1.6 by 1.1 mm in size) that attaches to the body of developing larvae and pupae and stays attached through adulthood. It appears that by sucking the haemolymph of bees it spreads bacteria and viruses that destroy bee colonies. Bees heavily infested with *Varroa* may be born with deformed wings and unable to fly. Although *Varroa* mites are the most serious disease organism affecting *Apis mellifera* bees throughout the world it is much less serious a pest of Asian bees. Because the mite is an indigenous pest of *Apis cerana* the host-parasite relationship is further advanced so that the mite rarely kills a colony of bees. *Apis cerana* has a grooming behaviour that prevents the high infestation of mites except in drone cells. This means that *Varroa* is rarely able to kill a colony unless it becomes weakened for some reason.

Treatment for *Varroa* in *Apis mellifera* is usually in the form of chemical acaricides. However, in *Apis cerana* removal and destruction of heavily infected drone brood and smoking of bees with tobacco to knock down the mites, followed by immediate burning of the hive litter from the floor of the hive, is enough to control infections.

4.7 Nosema

Nosema is a protozoan disease of adult bees. Seriously affected adult bees are unable to fly and may be seen trembling and crawling about at the hive entrance. The life span of adult bees is severely shortened by the disease, so colonies may lose strength very rapidly. This is not yet recorded in the Karnali Zone of Nepal.

4.8 Acarine

Acarapis woodi is a microscopic mite that infests the main thoracic tracheal (breathing) tubes of honeybees. There are no specific symptoms of the disease, so it can only be detected by dissection of freshly dead bees. This has not been documented in the Karnali Zone, though it has been detected in *Apis cerana* elsewhere.

4.9 Tropilaelaps

Tropilaelaps clarae is a parasitic mite that lives of the brood of honeybees. It prefers to feed upon drone brood can only survive outside brood cells for one or two days. This means that it is only a problem in tropical areas that have continuous rearing of brood and not in temperate areas like the Karnali Zone.

4.10 Queenlessness and worker laying

Colonies die if they lose their queen for some reason. Reasons for death of the queen could be predation on mating flights, disease or damage by pests, old age, or weakness resulting in usurpation of the queen by the workers. Too much swarming and / or untimely destruction of queen cells by the beekeeper can also lead to queen-less-ness. Worker laying results after a new queen fails to emerge from queen cells (special cups that the workers produce for raising queens once the old queen has gone). The scent of the queen ‘controls’ the worker’s urge to lay eggs so once the queen has died workers ‘try to become queens’ by laying eggs. Since worker bees can only lay drone (male) eggs a queen less worker-laying colony will slowly die unless provided with a new queen (that gets accepted by the bees). The colony only comprises old workers and drones. Drones do no work and do not help the colony to survive and new workers cannot be raised, so gradually the bees die off.

Worker laying can only be remedied completely by replacing the lost queen, but first the laying workers need to be disposed of, otherwise they will kill a new queen or queen cell. All combs of a laying worker colony and all bees need to be shaken out so that all the bees fall to the ground 50-100m from the hive. The laying workers, which are full of drone eggs and thus very heavy, cannot fly back to the hive and so only non-laying workers remain. Once the bees have been shaken a queen may be introduced in a cage a day after shaking off the bees. If no queens are available combs with new eggs, sealed brood, pollen and honey stores (and if possible a comb with a queen cell already formed too) can be given to the colony from a good strong non-diseased colony to help the bees rear a new queen.

4.11 Robbing

Robbing is the term for fighting between 2 or more colonies of bees. Usually it is caused by non-resident bees entering another colony's hive in order to steal honey. The resident bees detect the intruder bees by their smell and fight with them, usually attempting to sting them to death. Once alarm pheromones (smells secreted by the stinging bees) reach a certain level in the air these can stimulate nearby colonies to join in the fight, which means that very large numbers of bees can be killed. If robbing reaches sufficiently high levels weaker colonies can be totally destroyed by stronger ones. Beekeepers can control robbing by never spilling sugar syrup or honey around the apiary and by removing any remaining sugar syrup or honey feed from weak colonies that are unable to consume their entire feed overnight.

If bees from another colony are found to be robbing at the hive entrance sprinkling water on the fighting bees and putting scented herbs such as *Artemisia indica* ('titepati') beside them to break down the pheromone signals can help stop it.

4.12 Absconding

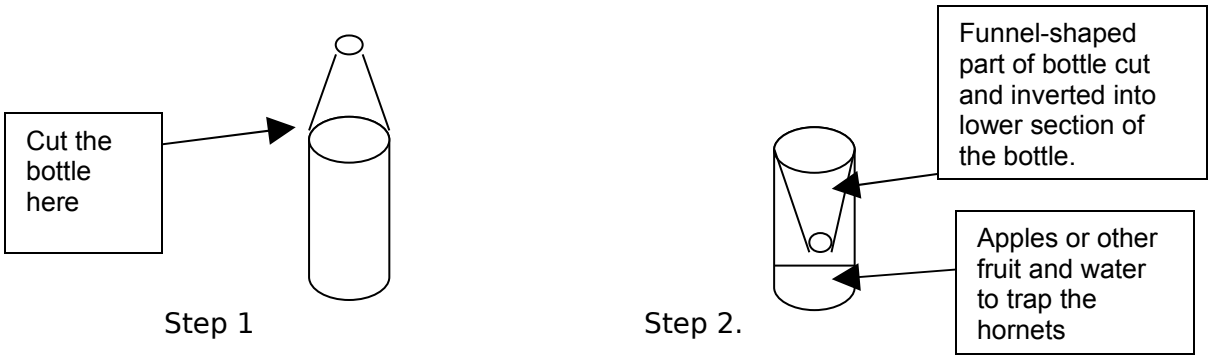
Absconding is the term for when all the bees from a hive leave and desert the combs. Usually absconding occurs as a result of disturbance or attack by pests and diseases. Soaking with rain, excessive smoke, too much human disturbance, jarring of the hive causing combs to fall, attacks by pine martens and bears and other such disturbances, as well as TSBV disease are common causes of absconding.

4.13 Hornets

Hornets are common predators of bees. Two kinds of hornet attack bees in Nepal: a large hornet that makes papery nests in trees (*Vespa magnifica* and other species) called 'oringal' in Nepali and another large hornet that nests in the ground called 'Bacchhu' in Nepali. Oringal usually prey on bees as they fly in and out of the hive, catching them in mid-air. Bacchhu may even make their own nest inside a beehive and feed upon the larvae, causing the bees to abscond.

Other than killing individual hornets or destroying nests, it is hard to control predation by hornets. In the light of the loss of biodiversity throughout Nepal already and the potential positive impacts of hornets as part of the food chain, it is probably best to advise against destroying nests. Simple hornet traps can be made out of plastic bottles with the top cut off and inserted into the cut bottle upside down (see diagram). Apples and water can be used to bait the hornets inside. They cannot escape out of the funnel and fall into the fruity fermenting water and die. However plastic bottles are not available in Humla villages, so an adaptation of this idea needs to be found.

Diagram 1. Design of a simple hornet trap made from a plastic bottle



4.14 Pine martens

Pine martens are major pests of bees in Nepal. They eat honeycombs with honey and pollen and also developing brood and can easily kill a colony overnight. They have very sharp strong teeth that can gnaw through wood, so the thinner and softer the wood of the beehive the easier it is for it to get in. If the end piece or plank that opens in log hives are not secured with heavy stones pine martens may also prise open cracks and attack combs. They will return to an apiary repeatedly once they get a taste for honey, especially during the winter when other foods are less available, and thus can be one of the main causes of winter losses of colonies. Protection of bee colonies from pine martens is provided in the form of spiny plants, which are cut and arranged around the hive to form a barrier. In the winter bee colonies are often brought home to an apiary by the house for protection against pine martens. Keeping a guard dog beside beehives is the best protection available.

4.15 Bears

Bears have a love for honey and will go to some lengths to obtain it. They are relatively untroubled by bee stings and can split a hive open to access the combs. Like pine martens they can destroy several bee colonies in one night or several nights once they get a taste for honey. Bears are a common predator of bee colonies in Humla, especially in the mountainous areas in the North. Although thorny plants may deter them a little, removal of beehives occupied in the forest and on isolated cliffs to the home apiary and keeping a dog by the hives is probably the best form of protection.

4.16 Mice

Mice may invade beehives and eat comb, honey and even developing brood. Generally they cause a problem in winter when the bees are dormant, rather than at times when the bees are very active. If a colony is weak a mouse attack could kill it but usually mice are less likely to destroy a colony than the bigger mammals (pine marten and bear).

4.17 Ants

Ants may infest a bee colony and feed upon larvae and honey stores. Usually ant populations are not high enough to severely damage colonies in the hills of the Nepal but in warmer climates they can damage colonies and / or cause absconding. If ants become problematic a hive may be places on a stand with the stand feet inserted into bowls of water that are not allowed to dry. So long as vegetation or other ‘bridges’ for ants to access the hive are removed the water if kept topped up and clean will stop ants accessing the hive.

4.18 Lizards

In certain areas lizards can be a major predator of bees. Large lizards tend to wait near the hive entrance and prey upon foragers leaving or returning to the hive. Small lizards can occasionally be found inside hives where presumably they prey on bees. Although lizards are a relatively major predator of bees, other than killing them directly, there is no known way of controlling them. Since they only eat individual foragers, they are less problematic than bears and pine martens, which can destroy entire apiaries within the course of a few nights.

4.19 Insecticide poisoning

Insecticide is a very serious cause of bee mortality in Nepal. Whereas in some more developed countries relatively ‘bee-safe’ insecticides are being promoted, in Nepal strong, the government Agricultural Development Office commonly promotes broad-spectrum insecticides. These include ‘metacid’ and ‘nuvan’ which are highly toxic to bees. New users of insecticide are often insufficiently informed of the toxicity of the chemicals to bees, humans and livestock. Instructions, if provided at all, are rarely in a language that users can read and sometimes Agricultural Extension workers themselves are unaware of the danger to bees. As a result of insecticide misuse bee colonies die in large numbers. An entire colony can be killed within 3 hours if feeding close to an area where insecticide is being applied. Aside from killing foraging bees in the field. Nectar carrying the toxin may be carried back to the hive and fed to nurse bees and larvae such that the whole colony is destroyed.

If insecticide is to be sprayed at all in areas where bees forage or where beehives are located it should be applied at just after dark. If this is impossible, then beekeepers should be informed of the day and time of day that sprays will be applied so that they can close up hives from the dawn if that day, using wire mesh or other material which provides ventilation but keeps the bees trapped inside the hive.

4.20 Poisonous nectar

It is common in most places that certain nectars are poisonous or intoxicating to bees (e.g. certain species or varieties of lime flower trees in Europe). In Nepal certain nectars appear to have an intoxicating effect on bees and may even cause mortality (e.g. ‘Khaambu’ or *Prunus communis* according to Humla and Jumla people). Other nectars however are not intoxicating to bees but cause honey to be toxic for humans (e.g. certain *Rhododendron* species in Nepal such as the white flowering ‘chimalo’ / *Rhododendron* at high altitudes in Jumla and Humla and the pink or red flowering *Rhododendron* probably found in lower altitudes in South Humla).

5 Results on Prevalence of beekeeping in Humla & social factors affecting it

5.1 People keeping bees in Humla

5.1.1 Lama (Bhotia) Tibetan language speaking people

Humli ‘Bhotia’ people of the Lama caste have a strong tradition of beekeeping, presumably due to their long history of subsistence farming in the area supplemented by trading. This contrasts with Jumli ‘Bhotia’ people who, being more recent immigrants from Tibet or from the remote corners of Mugu near the Tibetan border, appear to have no tradition of beekeeping. Beekeeping was found in every Bhotia community visited in Humla both this field trip and the previous ApTibeT field trip during April 2000, and the people were skilled traditional beekeepers. In Hepka VDC, the Bhotia farmers were heavily involved in beekeeping and the Lama 'priests' in particular seemed to be most skilled and devoted to the practice.

5.1.2 Hindu Nepali speaking people

Beekeepers were found amongst all the Hindu castes were but most seemed to be concentrated amongst Thakuri and Chettri people rather than occupational castes such as Damai, Kami, Sunar & Sarki (who are treated as untouchable).

5.2 Issues around Caste, ‘untouchability’ and beekeeping in Humla

Only one occupational caste person was interviewed during the survey: Mr. Tulaya Sarki from the one Sarki household in Korka out of the total of 11 households in the village. Tulaya is an enthusiastic beekeeper with 3 occupied hives and 10-12 hives baited in the forest. He said that people would buy his honey and that there was no problem with him touching his own bees. However he was not permitted to touch other ('higher' caste) people's hives. Tulaya appeared to be a relatively well-accepted member of the community, especially amongst the younger generation. In the other communities we visited no occupational caste people took part in the group meetings as far as we could tell.

Data from occupational caste beekeepers were also collected during the ApTibeT Survey in April 2000 as this extract from the report shows:
" Occupational caste people were interviewed in Dandaphaya and in Damai Bada, Lorpata, Madana VDC. In the case of Dandaphaya in North Humla, the Sarki people told us that they were allowed to keep their own bees but not to touch the hives of the ‘higher’ caste Thakuris. Amongst their community of about 35 households there was one beekeeper but he had lost his single colony to ‘disease’ the previous year. They said that they were not lucky in getting swarms....but that the Thakuris have many hives and that they are prepared to sell swarms to the Sarkis for Rs500 each.

In the case of Damai Bada in South Humla, out of 18-20 households of Damai (tailor and musician) caste people only 2-3 households had beehives. In the Chettri community of the adjoining village of Lorpata however, almost all of the 110 households had bees and they estimated about 140-170 occupied hives. When the interviewee Dhane Damai, a beekeeper with 2 hives, was asked why his caste didn’t do more beekeeping he answered that they were ‘lazy and scared of the bees’! He said that there was no problem associated with ritual ‘pollution’ of honey, in the way that other food may be

considered polluted after being touched by occupational caste people. Everyone will buy honey from him and he said there are no rules against taking bees from Damais. Conversely one Thakuri from Dandaphaya who we interviewed said that they would only give honey to respected guests and that they won't sell or give honey to occupational caste people (e.g. Kami caste)."

There is scope in any beekeeping programme in Humla to focus upon expansion of beekeeping amongst occupational caste people with little or no land resources. However, having less experience of beekeeping than Thakuri, Chettri and Bahun castes there may be some problems of confidence in handling bees or associated with beliefs that bees do not favour occupational castes households as a place to stay.

5.3 Gender issues associated with beekeeping in Humla

Women in Humla rank as the most disadvantaged in Nepal according to a ranking of women's empowerment (Banskota et al 1997). Consequently, gender issues are likely to affect beekeeping as they do all other aspects of life in Humla (Hudson 1994, Interface 1991). In several places out of those surveyed in April and September 2000, in particular in Lama communities, we came across women who kept bees. The fact that more women beekeepers of Lama caste were encountered as opposed to Hindu castes is probably associated with the lack of a menstrual taboo amongst the Buddhist Lamas. Also the mobility of the men in Lama communities as they traditionally go on long trading trips outside the district means that Lama women have to take more responsibility for work nearer to home.

Hetuk Lama a leading woman in Hepka village had to take over all beekeeping activities in her household after her husband developed a bee sting allergy. She capably carries heavy hives full of bees along treacherous paths from cliffs across the valley where they baited them to capture swarms. She can extract honey, identify and destroy queen cells and carry out all traditional beekeeping operations on her own. In contrast a man interviewed from Hildum, a Thakuri caste Hindu village only 1 day's walk away, (during the ApTibeT study in April 2000) said that women should not handle bees. Another said women should not be given raw honey to eat only cooked honey. This implies that according to Thakuri beliefs, women are not pure enough to eat the ritually pure raw honey, like occupational caste people. In Humla 'higher' castes believe that giving sacred food stuffs (such as cows milk or ghee or raw honey) to them will anger the local deities by 'polluting' their food.

Hindu women are traditionally forbidden to touch bees or beehives during their menstrual period (from days 1 to 5). Similarly they must not touch other people, food, drinking water, cows, sacred statues and so on. They are also forbidden to enter the house (especially the kitchen) or temples. This means that they must sleep outside in the cowshed underneath the house, together with the livestock. The family bring them food and water, though they are often forbidden to eat any of the foods that are considered sacred such as cow's milk or yoghurt, honey or even in some cases rice. This set of rules, if adhered to, makes it difficult for women to conduct beekeeping activities without assistance from someone who does not menstruate at the same time as they do. Whilst in many parts of Nepal these rules have slowly been relaxed such that women simply refrain from touching deities, entering temples, cooking food and sharing a sleeping space with their husbands, in the Karnali Zone customs have been slow to change. This means that training Hindu women in beekeeping in Humla needs to take this limitation into account. In some cases teaching people that it is not a problem to

touch hives and handle bees when menstruating may be appropriate. However, if the bees subsequently get disease or abscond or if any other misfortune comes upon the family, people who believe in the taboo will be quick to blame the breaking of the rule. A ‘softly softly’ approach slowly introducing the idea of relaxing the rules as trust is built up with the community is probably the best approach.

Aside from the menstrual taboo and its impact upon beekeeping, the issue of time to take on any new activity needs to be addressed if beekeeping is to be encouraged as a form of livelihood enhancement for women. Many women in Humla routinely work 18 hours a day, conducting all the heaviest and most arduous tasks, from agricultural work, cutting and carrying firewood to food preparation and child care. Although beekeeping is relatively not very time consuming in relation to other new activities, it might still add a burden to an already far too heavy work schedule. As a result of this, beekeeping training in Humla, if provided to women who express interest, should always be timed to when women have free time (usually monsoon or winter). Ideally it should also be accompanied by gender awareness training within the community to try to redistribute the balance of work between men and women and give the women more freedom to take part in new activities and in decision-making.

In this sense, due to the social mobilisation programme being implemented by DPP's partner NGOs in Humla, the communities with whom VDP and HCDA are working are ready to take up beekeeping activity combined with gender awareness raising. In Melchham VDC in particular the mother's groups appeared to be particularly active and ready to start new enterprises. In Melchham, Charigaun and Mashidhara many women stayed to participate in PRA exercises and training exercises in beeswax processing and value addition. The women in Melchham were able to speak up and participate much more than in areas where social mobilisation programmes are not currently being undertaken such as communities visited in South Humla during the ApTibeT study (Kalika, Madana and Maila VDCs). In Hepka, social mobilisation was less advanced than in Melchham and hence implementation of a beekeeping programme combined with gender awareness raising is likely to prove slightly more difficult.

5.4 Preference ranking exercises to compare livelihood sources with beekeeping

PRA preference ranking of livelihood sources was undertaken only in those communities where there was sufficient time and enthusiasm from the beekeepers. In Hepka VDC, due to lack of community response there was insufficient time for more than semi-structured interviews with key informants or focus group discussions with people we met. However, data from identical preference ranking exercises conducted with Tangin women and men separately was available from the ApTibeT study conducted by the authors in April 2000. In Melchham, due to the high level of social mobilisation already achieved by HCDA staff, farmers were willing to give up more of their time to take part in activities. Hence preference ranking of livelihood sources was undertaken in 3 communities in Melchham VDC (Charigaun, Melchham and Mashidhara) between 23 and 26 September 2000. A brief summary of results from these villages and from Tangin (during ApTibeT survey in April 2000) is given in Table 1. Complete data from the preference ranking exercises is given in detail in Appendices 5 & 6. Results were similar to those found from similar exercises conducted in Jumla in 1998 (Saville 2000c, Saville, Upadhaya and Acharya in press) and in Humla in 2000 (unpublished report for ApTibeT).

Table 1. Summary of results of PRA preference ranking of livelihood sources with four Humla communities.

Name of village	*Main caste*	*Gender of participants*	*Preferred livelihood source*	*Relative importance of beekeeping*
Charigaun, Melchham VDC	Bhotia-Chettri	Mixed	1st rank: Sheep, wheat 2nd rank: Bees, Horses, Cows 3rd rank: Buckwheat & barley / uwa 4th rank: millet and beans Last ranking: Nettles then foxtail millet and then apricots lowest	High. 2nd out of 10 ranks. Equal to horses and cows.
Melchham, Melchham VDC	Mixed Chettri - Thakuri - occupational caste	Mixed	1st rank: Uwa / Wheat 2nd rank: Sheep 3rd rank: Millet 4th rank: Bees and beans Last ranking: walnut then tobacco lowest	Quite high. 4th out of 10 ranks. Equal to beans.
Mashidhara, Melchham VDC	Thakuri	Mixed	1st rank: Barley / cows 2nd rank: Sheep 3rd rank: Foxtail millet & Millet 4th rank: Nettles Last ranking: herbs then rice & tobacco lowest	Low. 11th out of 13 ranks.
Tangin, Hepka VDC	Lama	Women only	1st rank: Bees 2nd rank: millet & sheep 3rd rank: potatoes 4th rank: yak-cow cross Last ranking: horses, woollen handicrafts, and wild oils then herbs lowest.	Highest 1st out of 7 ranks
Tangin, Hepka VDC	Lama	Men only	1st rank: Bees 2nd rank: potatoes 3rd rank: sheep & woollen handicrafts 4th rank: wild oils Last ranking: buckwheat, then barley then herbs lowest	Highest. 1st out of 9 ranks

5.4.1 General findings from the preference ranking exercises

In most communities staple grains together with livestock (sheep and cows) that provide manure to fertilise the crops were at least as important to the farmers as beekeeping. This is obviously the case for subsistence farmers who grow their own food since honey and other bee products are dietary supplements rather than staple food. However in three out of five exercises conducted, farmers ranked beekeeping highest or joint highest of all. Aside from the influence of the knowledge that we were there to survey beekeeping, which probably led to more positive responses than might have

been obtained otherwise, farmers gave many reasons for selecting beekeeping as a preferred source of livelihood. Multiple benefits from bees / beekeeping that were given by beekeepers included:

- Not much work;
- Low or no capital investment required;
- Easy to do;
- Good source of cash income for buying essentials such as clothes, oil and rice;
- Not time consuming;
- Only have to make the hive and put a swarm in it (no other investment);
- Bees often occupy the hive themselves;
- Low investment of other resources (i.e. don't need to cut grass for them etc.);
- Don't need much looking after;
- Honey is used as medicine;
- Honey is tasty and nutritious.

Clearly, compared to all other work such as cultivation of crops, care for livestock, collections of wild herbs and spinning / weaving cloth, beekeeping takes up far less time. Profit obtained from honey relative to the investment of time and resources is higher than from other sideline activities, such as herbs, handicrafts, oil extraction. This, together with the lack of requirement of land and the lack of need for investment to get started makes it suitable for those with no or insufficient land & no capital (e.g. women, occupational castes and poorest individuals of all other castes).

Most groups participating in preference ranking did not outline problems associated with beekeeping during the listing of reasons for preference. However Mashidhara farmers listed the following problems associated with beekeeping:

- Not productive;
- Lack of bee forage (especially due to lack of rain water or irrigation);
- Not customary;
- Not providing much benefit;
- Lack of bees in the area.

5.4.2 PRA preference ranking result from Hepka VDC as taken in April 2000 survey for ApTibeT: Gender differences in preference in Tangin – a remote Lama village

Only in one community was it possible to conduct a women-only preference ranking exercise. This was in Tangin where many of the women had attended a beekeeping training run by the District Cottage Industries Office a year before. Interesting differences emerged between women and men and their preferences. Although both men and women ranked beekeeping as the best form of livelihood, women ranked millet (the most nutritious and tasty staple food) second and cow-yak cross 3rd. Women ranked handicrafts (spinning and weaving woollen cloth), horses and oils from wild plants of 'dhatelo' (Prinsepia utilis) and walnut (Juglans regia) as lowest. Men on the other hand ranked handicrafts and oils higher than millet and cow-yak cross even lower. Clearly women valued food to feed the family more highly than the men did. They disliked extracting oils because of it being tedious difficult work and because they had to climb trees to collect walnuts. Similarly they found handicrafts too time consuming on top of an already over-loaded schedule. Women said they disliked horses because they were never allowed to ride them, whereas men ranked them equal to millet since

they can earn from using them as transport for tourists (& goods) to Tibet and back."
[Source: ApTibeT Beekeeping Feasibility Study report by the author]

This example shows that women and men differ in their preferences and that as far as possible it is preferable to conduct PRA exercises and focus group discussions in separate stakeholder groups in villages. This may not be merely separation of men and women but also separate groups of elder mothers and young daughter-in-laws and separate groups of occupational castes or other minorities. In this case both men and women ranked bees highly and both groups were enthusiastic to develop beekeeping as an enterprise. This may vary in other communities. Hence we recommend that, prior to starting beekeeping training in a particular community, DPP's partner NGOs work with such groups to discuss and analyse who is interested in participating in different kind of beekeeping activities (e.g. hive-making, catching swarms, handling bee colonies in top-bar hives, bee feeding, honey harvesting and hive product processing). It will be important also to discuss who will benefit from beekeeping (i.e. who handles cash or bartered goods from honey, beeswax and beeswax products and who decides how the money is spent, who consumes raw and cooked honey and pollen, who uses beeswax products and so on). The aim of a new intervention in beekeeping will be to increase the benefits to women and disadvantaged groups such as occupational castes, whilst taking care not to increase their burden of work. This again demonstrates the importance of combining gender awareness raising and change in gender roles together with new enterprises such as improved beekeeping.

6 Results on bee species found in Humla

6.1 Apis cerana

The type of indigenous honeybee kept in hives in Humla is called *Apis cerana*. Since Humla is close to Jumla where the Western Himalayan subspecies called *Apis cerana cerana* is found, it is probable that the Humla subspecies is also '*cerana*'. *Apis cerana cerana* is well known for it's especially high honey yielding capacity and lack of absconding & swarming tendency relative to the lower altitude subspecies *A. cerana indica* (Verma 1998, 2000). As far as could be determined from inspection of foraging bees & bee colonies this species is found in both N and S Humla at most altitudes, though in some cases bees appeared to be slightly smaller than in Jumla. A sample specimen was taken in Melchham area to be sent to Professor Verma in India for confirmation.

It appears that *A. cerana* in South Humla has a more migratory habit compared to *Apis cerana* in North Humla. In Melchham the farmers said that the bees shifted altitude at different times of year. In the hottest months of April-June bees prefer the higher altitudes and in the cooler rainy season and winter they migrate to the lower altitudes. Farmers in Dopka, Madana VDC of SW Humla, described similar migration of *A. cerana*. This village is located above the Karnali River like Melchham. No such migratory patterns were reported for bees in North Humla, presumably because of very long distances necessary to meet warmer climes and their associated bee forage.

6.2 Giant Honeybees *Apis dorsata* and *Apis laboriosa*

It is likely that, due to the very wide altitudinal range in Humla district that both the species of giant honeybee indigenous to Nepal are found. Confirmed sightings of *Apis dorsata* or *Apis laboriosa* colonies was not possible during either of the field trips

conducted by the authors during 2000 and foraging individual bees on flowers were also not detected. Hence we can only guess as to the species found at this stage. Since *Apis laboriosa* is usually found at higher altitudes, it is fair to assume that large colonies of 'rock bees' that are said to come occasionally to the Dozjam area of north Humla are *Apis laboriosa*. In South Humla however, where the shores of the Karnali River are relatively low altitude (below 1700m) giant honeybees that migrate to the area in the summer could be either *Apis dorsata*, the giant honey bee found in the plains of Nepal which migrates to cooler climates in the hottest months or *Apis laboriosa*, which is also migratory in habit but more commonly found at higher altitudes. However to confirm which species is found where and whether *Apis dorsata* is found at all, samples of adult bees need to be taken and given to beekeeping specialists for species confirmation.

From farmer's descriptions gathered during the ApTibeT survey, it is clear that giant honeybee (*A. dorsata* or *A laboriosa*) populations have severely declined in recent decades. Honey hunting is more prevalent in South Humla (we came across honey hunting communities in Kalika and Maila VDCs in particular) than in North Humla, but in both areas farmers said that the bees did not come very often. We concluded from the evidence that populations are declining that the best strategy at this stage would be to try to dissuade honey hunters from harvesting at all for several years to try to give the bee populations a chance to recover. If this is impossible, improvements to harvesting practices so that only honey rather than brood is harvested should be attempted.

For the purposes of the DPP programme however, for the pilot study at least it is probably worth focussing activities with traditional beekeepers and honey hunters of *Apis cerana*, rather than on the relatively rare practice of honey hunting with *Apis laboriosa* or *A. dorsata*.

7 Results on bee populations and changes over time in Humla

7.1 PRA trend analysis of *Apis cerana* bee populations

Trend analysis diagrams were constructed in all four communities sampled in Melchham VDC but not with communities in Hepka, due to lack of group participation. Five cells were drawn indicating this year (2000), last year (1999), the year before last (1998), five years ago (1995), and lastly more than 10 years ago (before 1990) or an arbitrary time 'before disease came'. The latter category was difficult to define as none of the farmers could remember back exactly how many bees they had in which year, so we encouraged them to try to remember the time before disease had damaged bee populations more than 10 years ago. Then beekeepers were asked to show the number of hives occupied by bees they and their neighbours had each year by placing stones in the cells. In Melchham, Korka and Mashidhara, farmers clumped stones by household so that everyone could see the number of households with bees and the total number of bee colonies for each year. Lastly, one farmer counted the stones in each cell and the numbers were compared. Reasons for decreases and increases in bee colony numbers were then discussed in the light of the findings. Results of the trend analyses in Melchham VDC are given in Table 2. These PRA trend analysis data are not sufficient to conduct statistical analysis but give an indication of the probable trends in different communities, assuming that essential information was not omitted.

In Charigaun numbers of households with bees were not obtained for each year but it appears that numbers have decreased since before the disease epidemic of TSBV (around 1985), especially this year. Charigaun farmers said decrease in bee populations

was due to disease, drought (in 1998 and 1999), too much rain (in 2000), and deforestation, though some insisted that lack of forage / deforestation wasn't a problem in their particular area.

In Korka, where the human population and number of households also increased over the period, total numbers of bee colonies have increased in recent years. In the last 5 years a gradual increase in number of colonies per household was indicated. Farmers explained that bees abscond if combs get damaged in transfer of colonies from baiting sites to the home apiary and that some swarms stay in hives and others leave. Too much swarming leads to weak colonies and low honey yields. This year too much rain lead to low honey yield.

In Melchham numbers of bee colonies have increased gradually in the last 5 years. Numbers of colonies per household were highest in Melchham last year but this was because total households with bees were fewer. Farmers said that:

- this year bees fled the excess rain in the forest and occupied hives instead;
- in the previous 2 years forest fires caused a lack of forage for bees;
- bees decline due to shortage of food and die of cold in winter;
- late swarming leads to weaker colonies and less honey.

Although the overall increase in total bee colonies between 5 years ago and now suggests that bee populations are recovering rather than declining, the trend is not clear. Certainly bee populations have been fluctuating recently and this is probably associated with climate more than disease. But comparing more than 10 years ago with now, it appears there has been no change in number of beekeepers and number of bee colonies in Melchham.

In Mashidhara numbers of households keeping bees have increased over the last 10-15 years. Number of bee colonies per household was highest in Mashidhara 5 years ago but as in Melchham, general numbers of bee colonies seem to be showing an increase in recent years. Reasons given by farmers for decreases in numbers of bee colonies were disease, lack of rain or irrigation for bee forage, heavy rain this year, and cold killing bees. Although there may have been a slight decrease in disease levels in the last 10-15 years, the main reason given by Mashidhara farmers for the overall increase in number of households keeping bees and in colony numbers was that people who saw others benefiting from bees became jealous. This encouraged them to take up beekeeping themselves.

Table 2. Results of the trend analyses conducted with reference to occupied beehives for each community surveyed in Melchham VDC, South Humla.

Village	Parameter	2000	1999-2000	1998-9	5 years ago (1995-6)	Before 1990
Charigaun	No. of colonies in total	**64**	**81**	**78**	**83**	**100**
	No. of households (HH) with bees	18				
	No. of colonies per HH with bees	*3.56*				
Korka	No. of colonies in total	**41**	**42**	**31**	**21**	**24**
	No. of HH with bees	9	10	9	8	5
	No. of colonies per HH with bees	*4.56*	*4.20*	*3.44*	*2.63*	*4.80*
Melchham	No. of colonies in total	**82**	**74**	**58**	**52**	**79**
	No of HH with bees	30	21	26	23	30
	No. of colonies per HH with bees	*2.73*	*3.52*	*2.23*	*2.26*	*2.63*
Mashidhara	No. of colonies in total	**39**	**31**	**30**	**20**	**22**
	No of HH with bees	11	10	12	4	8
	No. of colonies per HH with bees	*3.55*	*3.10*	*2.64*	*5.00*	*2.75*

7.2 Comparison of numbers of beekeepers and estimated numbers of beehives in the villages sampled using data from interviews

Summarized data on the number of beekeepers and occupied bee hives as estimated by beekeepers interviewed in the different communities visited in both Hepka and Melchham VDCs is given in Table 3. These data, being estimates generated from individual farmer interviews and not empirical counts, differ from the PRA trend analysis data and probably have a larger error margin. However since the data were collected from all communities throughout the 2 VDCs they allow the different communities to be compared in terms of the prevalence of beekeeping generally. Comparison PRA trend analysis data collection method with key informant interview method suggests that the PRA trend analysis may be more reliable. Estimates are lower in Table 3 than in Table 2, except in the case of Charigaun. Perhaps this is due to underestimates given by interviewees. In the case of the PRA trend analysis data shown in Table 2, numbers of bee colonies per *household with bees* were calculated from counts made by groups of farmers whereas in Table 3 the estimated number of colonies per household was made by individual beekeepers who were interviewed. In villages where not all HH kept bees number of colonies per all households was calculated as well as number of colonies per household with bees (except where numbers of HH were not obtained). The number of occupied beehives per ALL households in the village shows the prevalence of beekeeping in the village as a whole whereas the number of occupied beehives per beekeeper gives an indication of the potential for beekeeping in the area since areas with the most potential have more bees already.

Results given in Table 3 suggest that Lama Gaun and Tangin have the highest density of bees and highest numbers of bee hives per household out of the communities sampled in September 2000. Hepka also has a large number of beehives but a lower number of colonies per household (about the same as Melchham). Beekeeping was not a favoured activity in Dinga but was relatively popular in Gadapaari, though perhaps less so than in Hepka. Out of the Melchham VDC communities, Charigaun has the

highest density of bees, followed by Korka, then Melchham and finally Mashidhara, which was by far the poorest location for bees out of those sampled.

Table 3. Numbers of beekeepers and occupied beehives in villages of Hepka and Melchham VDCs as estimated by farmers interviewed in key informant interviews and focus group discussions during September 2000.

Village	Parameter	Average of responses	No. of responses (n)	No. of Households in the village	% of households with bees
Dinga	No. of colonies in total	**15**	1	*	*
	No. of households (HH) with bees	10	2		
	No. of colonies per HH (HH with bees only)	1.50			
Gadapaari	No. of colonies in total	**15**	2	*	*
	No. of households (HH) with bees	10	2		
	No. of colonies per HH (HH with bees only)	1.50			
Lama Gaun	No. of colonies in total	**60**	1	4	100%
	No. of households (HH) with bees	4	1		
	No. of colonies per HH (all HH have bees)	15.00			
Hepka	No. of colonies in total	**173**	3	84	73%
	No. of households (HH) with bees	61	*4*		
	No. of colonies per HH (HH with bees only)	2.84			
	No. of colonies per HH	2.06			
Tangin	No. of colonies in total	**213**	*2*	37	*99%*
	No. of households (HH) with bees	37	*2*		
	No. of colonies per HH (all HH have bees)	5.76			
Charigaun	No. of colonies in total	**87**	*3*	18	*98%*
	No. of households (HH) with bees	18	*3*		
	No. of colonies per HH (all HH have bees)	4.83			
Korka	No. of colonies in total	**32**	*2*	*11*	*100%*
	No. of households (HH) with bees	11	*2*		
	No. of colonies per HH (all HH have bees)	2.91			
Melchham	No. of colonies in total	**90**	*3*	*45*	*89%*
	No. of households (HH) with bees	40	*3*		
	No. of colonies per HH (HH with bees only)	2.25			
	No. of colonies per HH (all)	2.00			
Mashidhara	No. of colonies in total	**39**	*3*	*41*	*22%*
	No. of households (HH) with bees	9	*3*		
	No. of colonies per HH (HH with bees only)	4.33			
	No. of colonies per HH (all)	0.95			

** indicates that data on the number of households missing*
NB: Averages were taken of all the estimates given by interviewees for each village
n shows the number of interviewees for each village

7.3 Changes in bee populations in the last 10-15 years according to data from two surveys

Farmers interviewed were able to remember roughly how many colonies they had in the last few years but often they could not remember exactly before about 4 years ago. Figure 1 shows changes in numbers of bee colonies and in honey yields over the last 15 years as estimated by farmers interviewed in the questionnaire interviews of the current study. The precision of the averages is lower the further back in time we estimate because only a few farmers could remember that far back. Hence the trend indicated in the graph is not a statistically significant one and must be interpreted carefully.

Although PRA trend analyses in Melchham VDC showed that in 3 of the 4 communities that number of bee colonies have increased in the last 3 years, pooled data from the questionnaire survey show that in general bee populations in both Hepka and Melchham VDCs, pooled over all the farmers interviewed individually, have declined in recent years (Figure 1). If the decline shown in Figure 1 reflects real change in bee populations, then it is probably due to bee disease, drought (in the previous few years), too heavy rains (this year) and possibly also habitat degradation with loss of forage and wild nesting sites. It is possible that the increase in colony numbers that appeared in the PRA trend analyses in recent years is due to farmers remembering more hives in recent years or the difference may be simply due to the sample of beekeepers being different. Unfortunately, instead of triangulation confirming results use of the two methods of estimating change in bee populations in the current study has led to conflicting conclusions.

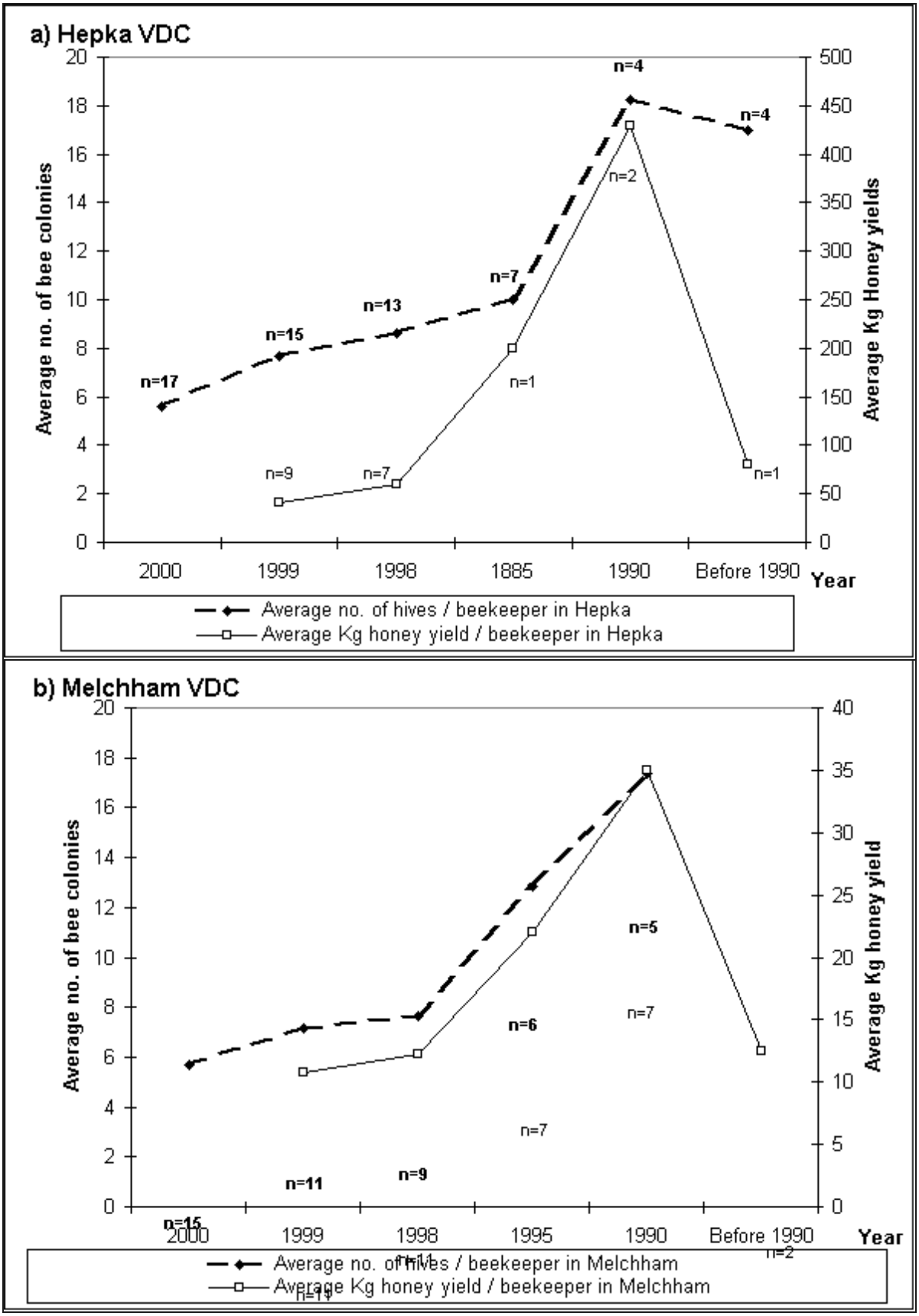
In order to assess which result is most likely to reflect the general trend in Humla, similar data from the ApTibeT survey in April 2000 (given in Table 4) were compared with those in Table 2 and Figure 1. Except in the village of Kargai, which showed an increase this year relative to last year and was encountering a swarming season at the time we visited, most communities showed a decline in numbers of bee colonies this year relative to the previous two years. This may be slightly influenced by the fact that the ApTibeT survey was conducted at the beginning of the beekeeping season (in North Humla), which meant that the effect of winter losses could be seen. The potential recovery that might occur between April and June when the honey flow and swarming season occurs in North Humla could not be estimated.

Taking into account the PRA trend analyses, the current survey questionnaire data and the ApTibeT survey data is probably safe to conclude that bee populations have declined slightly in the last 5 years and may have decreased dramatically since before the first TSBV epidemic in the mid 1980s. However, this trend may not be universal to all villages and cannot be demonstrated statistically with the data available. Inaccuracy and lack of replication in data for estimated numbers of colonies more than 3 years ago makes it difficult to drawn concrete conclusions on changes. Although experiences from Jumla lead us to suspect that there may have been a second outbreak of TSBV (or possibly EFB) in the last 7 years, data from both surveys suggest that populations may have been more healthy 5 years ago than now, which means that there was probably not a disease problem in Humla at the time of the Jumla disease outbreak between 1995 and 1997. In any new beekeeping enterprise started in Humla, technicians need to be vigilant in inspecting for bee diseases and should train farmers about how to identify and control bee diseases.

Table 4. Changes in numbers of occupied beehives in recent years in communities visited during the ApTibeT beekeeping feasibility study conducted in April 2000.

	Total number of colonies							Total number of colonies per beekeepr interviewed					
Year	2000	1999	1998	1997	1995	Before 1991		2000	1999	1998	1997	1995	Before 1991
Dozjam, Thehe VDC	38	112					17	2.2	6.6				
Baiji Bada, Thehe VDC	35	20	35	30	44		1	35.0	20.0	35.0	30.0	44.0	
Thehe, Thehe VDC	4	4					5	0.8	0.8				
Hildum, Simikot VDC	38	39			83		5	7.6	7.8			20.8	
Hepka, Hepka VDC	19	44				48	2	9.5	22.0				48.0
Tangin, Hepka VDC	10	8					1	10.0	8.0				
Dandaphaya, Dandaphaya VDC	6	20					2	3.0	10.0				
Ripa, Sarkedeu VDC	2	4				12	1	2.0	4.0				12.0
Kargai, Kalika VDC	131	86					13	10.1	6.6				
Dopka, Madana VDC	22	25				5	2	11.0	12.5				5.0
Lorpata, Madana VDC	5	8					2	2.5	4.0				
Rama, Maila VDC	18	27	43				6	3.0	4.5	3.9			
Thapa Gaun, Maila VDC	30	34	57				11	2.7	3.1	5.2			
Maila, Maila VDC	51	74	88				16	3.2	4.6	8.0			
	Total number of colonies							Total number of colonies per beekeepr interviewed					
Sum of scores / averages	***409***	***505***	***223***	***30***	***127***	***65***	*84*	*102.6*	*114.5*	*52.1*	*30*	*64.75*	*65*
N (no of villages sampled)	14	14	4	1	2	3	14	14	14	4	1	2	3
	Average no. of hives per village							**Average no. colonies per beekeeper averaged over all villages**					
Average	29.2	36.1	55.8	30.0	63.5	21.7	6.0	**7.3**	**8.2**	**20.8**	**30.0**	**32.4**	**21.7**
Year	2000	1999	1998	1997	1995	Before 1991		2000	1999	1998	1997	1995	Before 1991

Figure 1. Changes in number of hives and honey yields per beekeeper in Hepka and Melchham VDCs.



7.4 Times that bee disease has been most severe as ascertained through interviews

The timing of bee disease on a seasonal basis was mostly said (10/24 respondents) to be during the monsoon in July-Aug. However, 5/24 said that disease also came in the spring in March-April. When asked when the disease first came, most farmers remembered back to the time that TSBV swept across from Bihar in India to Pakistan, seriously damaging bee populations in Nepal.

In Hepka VDC, 1 farmer said the disease came in 1979, 2 farmers said it came between 1988 and 1990, one said it came about 8 years ago, another said 10-11 years ago, 1 said it coincided with the first village election in 1982 and another said that disease had always been there. One farmer said that the disease had been bad again in the last 2-3 years, but this was not the common complaint. Results from the current Hepka study were confirmed during the ApTibeT study in North Humla. Farmers from Bargaon, Dozjam, Baiji Bada, Thehe, Hildum and Tangin remembered the first disease epidemic, which they said came in 1979-80, 1980-1, 1983-4 and 1988. Some farmers also complained about a more recent disease outbreak (e.g. Hetuk Lama in Hepka said that bees absconded in 1999 and Dandaphaya beekeepers said that a predatory insect has been troubling the bees since 1994-5.

In Melchham VDC, one farmer remembered that the disease had first occurred around the time of democracy (1989-1990). Others said 10-15 years ago (1985-1990), 10-11 years ago (1989-90), 1984-5 and 6-7 years ago (1993-4) that a disease epidemic came. In Melchham VDC five farmers said that disease had also become a problem again in the last 5 years. One mentioned 1997-8, another said it has been bad since 1994-5, two said it had come in the last 3-5 years (1995-7) and one said it had come in 1998. This complies with findings from the ApTibeT study in South Humla where farmers of Maila, Madana and Kalika VDCs said that the disease had first come between 1980 and 8-10 years ago (1990-92). In Maila farmers said that disease had also been bad in recent years too.

8 Information on causes of bee mortality in Humla ascertained from the survey

Background information on the potential causes of bee mortality or weakness has been provided in Section 4. This information should assist the reader to interpret the results of key informant / focus group discussion interviews here as well as the results of colony inspections given above.

8.1 Bee disease symptoms described

A list of the all the disease symptoms described by farmers and the frequency that each symptoms was observed are given in Appendix 4a.

8.1.1 General signs of weak or diseased bees

Nineteen out of 24 farmers questioned said that they had noticed bee disease, though not all could provide information on specific symptoms. Generally farmers were aware of the signs of disease from the outside of the hive only. This included:

- bees appearing black (8/24 respondents) which occurs when only old foragers remain and new bees are not produced;
- not foraging well (6/24 respondents), which occurs with all conditions that weaken bee colonies;
- many drones being produced (3/24 respondents)` which occurs as a result of worker laying;
- and failure to swarm (1/24 respondents), another general sign of poor colony condition.

8.1.2 Thai Sac Brood Virus

On the basis of the above finding about severe bee disease in Humla and the well documented outbreak of TSBV found throughout Nepal in the 1980s (ref?), we concluded that at least one epidemic of TSBV occurred in Humla in the last 20 years. The most damaging epidemic in the district occurred between 1980 and 1990. This was recalled by many of the older beekeepers, who remembered that there were almost no bees at all for several years around this time.

During the ApTibeT study the impression gained about TSBV was that the disease may be the cause of the recent decline in bee populations (Figure 1) in the last 5 years. However on reflection and analysis of inspections of bee colonies in the recent study, insufficient data were obtained to confirm this (unless smear samples of larvae and pupae show otherwise).

Symptoms complying with TSBV were given by a small proportion of farmers questioned in the key informant interviews:

- 3/24 described rotten larvae;
- 3/24 described a bad smell from the hive;
- 5/24 said they had seen bees throwing out diseased larvae / pupae;
- 6/24 described absconding; and
- 5/24 described the phenomenon of many colonies absconding all at once and making one cluster, which is common to TSBV in particular.

The extent to which these particular symptoms were observed in the last 3-5 years was difficult to ascertain, but we got the impression that TSBV was currently not a major

cause of bee colony deaths, since farmers only mentioned these symptoms when questioned in depth and many appeared to be unaware of them. Also no confirmed identification was of TSBV infected colonies was possible from the colony inspections conducted. If TSBV were at a seriously damaging level many more farmers should have noticed group absconding, bad smells and larvae being discarded, which are the main symptoms visible from outside the hive, and more colonies with TSBV symptoms should have been located.

Hence, on the basis of supporting data from Jumla district, which confirms the presence of the TSBV virus in Jumla district between 1995 and 1999 (by clinical identification of the virus itself), we deduced that there have may have been TSBV in the Humla bee population in recent years though not at epidemic levels as were found in Jumla.

8.1.3 European Foulbrood

Although the rotten larvae, bad smell and absconding symptoms described by farmers could also fit EFB as well as TSBV, group absconding and discarding of rotten larvae is probably less common in EFB than in TSBV. Inspections of bee colonies led to no confirmed diagnosis of EFB disease. Hence, since no EFB infected colonies could be detected and the symptoms are not different enough from TSBV to be able to distinguish between the diseases on the basis of symptoms, confirmation of the presence of EFB awaits further study during early spring and monsoon seasons, when colonies are most prone to it and diseased larvae are easier to detect. If EFB is present in Humla district at all we suspect that it is found in the South of the district only so far, since the disease is most likely to spread from Jumla.

8.1.4 Death of adult bees

In a few cases farmers described that they had observed adult bees dying in their hives (1/24 respondents) or outside them (1/24 respondents). This was less common than the death of larvae and pupae. One farmer said that the bees appeared ‘drunk’ which could be a sign of *Nosema* or of poisoning. Since no dead adult bees, other than those who died of starvation, were encountered during the survey it is difficult to conclude the reason for death. Starvation and poisoning from various floral nectars or from insecticide are the most likely causes but *Nosema* disease may affect the bees occasionally.

8.1.5 Wax Moth

The most commonly described disease organism recognised by farmers was the wax moth: 3/12 farmers in Hepka and 7/12 farmers in Melchham described a white caterpillar with a red or dark head that destroyed bee colonies. They said that the moth formed a kind of spiders web around the combs and eventually destroyed the combs completely. Interestingly in Gadapaari, one experienced beekeeper linked the spread of wax moth within his village to a colony of bees he bought from Kholse 8 years before.

Usually the wax moth is unable to destroy colonies unless the bees are under stress. However, many beekeepers claimed that this was the single most troublesome pest of their bees. We suspect that it is more likely that the bees were stressed by starvation or brood disease, which allowed the wax moth to actually destroy colonies.

8.1.6 Other miscellaneous disease symptoms

Most of the other symptoms described by farmers could not be linked to any well-known disease or pest organism. 1 farmer said that the bees had a different sound when they were diseased, presumably because they are weak and unable to fly at the same speed. Another farmer in Melchham insisted that the disease affecting his bees caused the combs to turn yellow and then black very quickly. Whilst such yellow coloration was observed by the authors and has been seen in other bee colonies in Jumla and the Kathmandu Valley, this is probably not a sign of disease in itself. Yellow coloration of bee brood combs is more likely to arise from staining by pollen that is stored in the combs or fed to the bees. Blackening of the combs is a natural process that occurs due to the bees emerging from the cells. At the pupal stage of development the developing bee spins a cocoon around itself in which to metamorphose from larva to adult. This cocoon is left behind in the cell when the adult bee emerges and results in giving the comb a darker colour than when newly made by worker bees. As more and more cocoons accumulate in the comb it becomes black and tough compared to new combs. Eventually the cells become reduced in size by the cocoons and bees stop using the comb for brood rearing or honey storage. At this stage the bees chew back the comb to make more space and recycle the wax. Good beekeeping practice involves the removal of old black empty combs (locally called ‘kanna pola’) to save the bees work. These can then be processed to produce beeswax.

Another beekeeper in Hepka said that when his bees were diseased he saw a yellow colour on the upper thorax. This is probably not disease at all but pollen, which rubs from the anthers of certain flowers and makes a mark on the thorax of the foraging bee. Such bees were observed in Tangin, having probably been feeding on *Impatiens glandulifera* or another *Impatiens* species.

8.2 Concepts about bee diseases

Many farmers in both North and South Humla spoke of bee ‘disease’ as a major problem associated with beekeeping. In most cases, except where very specific symptoms were described, it was difficult to determine whether bees died of disease (caused by micro-organisms or parasites) or from starvation. Disease is most problematic to bees in Humla during mid-July to mid-August, which is the time of monsoon forage dearth. Ten out of 24 farmers interviewed said that Mid-July to mid-August was the time of most disease and 2 said that too much rain was the cause of the disease, whereas five farmers said disease also came in Mar-April. Throughout Nepal bees become stressed during the monsoon by the lack of forage or the inability to reach flowers because of continual rain. Other reasons for bee disease given were cold in winter (2/24), lack of food (3/24), drought (1/24) and a black insect that kills the bees (2/24).

Throughout Humla, but especially in the North, there was a common belief that bee disease had come from some incident associated with foreigners. Of the 24 interviews held, 2 farmers in Hepka VDC said that a foreign bee brought the disease, 2 said that a large black insect brought the disease and five (3 in Hepka and 2 in Melchham VDCs) said that foreigners brought the disease. In Bargaon in the ApTibeT study, the people told us that a foreigner had come and picked all the flowers from the forest that the bees foraged upon, which had caused the bees to abscond, they also said that the foreigner brought an insect which took the bees to America! In Dozjam, Thehe and Hildum in North Humla and in Maila in South Humla people believed that foreigners taking photographs of their beehives had caused the bees to abscond. In Dozjam in the

ApTibeT study and in Tangin in the current study farmers said that the foreigners had opened colonies and said that they had come to help with the bees. In Dozjam they said that they smoked the bees with something like and incense stick. Others said that the introduction of apples into the area had caused bee disease, a common belief held by Jumla farmers also.

We interpret this to indicate that the epidemic of Thai Sac Brood Virus disease (TSBV), which swept across the whole of Nepal between 1984 and 1988, coincided with the first influx of foreigners into Humla district, together with the introduction of apples, insecticides and other forms of 'development'. We were told that apples and insecticide use were also both introduced about 1985, coinciding with TSBV disease. Also on discussing this problem with Chakka Bdr. Lama of HCDA we discovered that the foreigner in question was probably a PhD student, who was amongst the first foreigners to come and stay in Humla. Her PhD study took place around 1985, exactly at the time of the TSBV epidemic. She apparently showed interest in beekeeping and one farmer in Tangin said that she opened hives and looked at the queen. Several months or 1 year later all the bee colonies absconded. Hence, due to the very low exposure of Humli people to foreigners at this time and the very strange and sudden epidemic of bee disease, it is not surprising that farmers associated these two unusual events in Humla history with one another. In fact it is not possible that one foreigner could have caused the disease, unless she had introduced colonies of bees that were infected with disease (as occurred in Jumla district when an NGO introduced *Apis mellifera* and with it European Foul Brood disease). As far as we can tell she made no intervention in beekeeping other than to look at hives and take photos, but as a result of this some farmers appeared to be particularly suspicious of foreign visitors taking an interest in their bees. In communities in Hepka VDC there was insufficient time to build-up enough rapport with people such that they would allow us to inspect their colonies. We felt that it was especially important to gain trust of farmers before insisting on opening colonies.

At the time of the TSBV epidemic bees absconded in very large numbers. One beekeeper from Tangin said that they flew as far as Achham and that they had seen the bees migrating south and moving with the shepherds at the time of the most sever TSBV infections. Whether *Apis cerana* actually migrates such long distances as supposed by Humla farmers is difficult to ascertain, especially as there is no information in the literature available about this.

8.3 Results from inspections of bee colonies

In several communities, during both the April 2000 ApTibeT survey and the current DPP survey, farmers were reluctant to allow us to open their hives. In some cases they also forbade us to photograph hives, as this was believed to hurt the bees' 'spirit' in some way and cause absconding. Farmers of Hepka and Tangin villages in particular were most reluctant, whereas in Gadapaari and Lama Gaun farmers appeared to trust us better and allowed us to inspect 2 colonies in each village. In Melchham the CBO members had been well prepared for our visit by the motivators and appeared to be hopeful to be able to learn from us, so in each of the 4 communities we were able to inspect 2-3 colonies. A total of 17 hives were opened and combs inspected: 6 in Hepka VDC; 1 in Durpaa in Kharpunath VDC en route to Melchham from Simikot; and 10 in Melchham VDC.

Hives inspected varied in their state of health. Some were strong and had honey stores whereas others were weak or dying. Full detailed results of colony inspections and a

detailed explanation of how to interpret the results of colony inspections are given in Appendix 8.

Thirteen (12) samples of invertebrates cohabiting hives (some pests and others commensals) were taken for confirmed identification. Disease and pest organisms detected included:

- Wax Moth
- Phorid fly
- Varroa mite and
- Hive beetle (not confirmed to be a pest yet)

Wax moth and Varroa mite in *Apis cerana* tend to destroy only those colonies that have become weak for some other reason, e.g. through shortage of food or brood disease. Phorid fly also usually seems to be most prevalent in very weak colonies, which suggests that it is not usually the only reason for colony demise. Though villagers claimed that the hive beetle eats the bee brood and honey, no information was found in the literature on this beetle.

Other invertebrates sampled, whose role in hive was not determined included:

- a small Dipteran fly whose larvae (maggots) were was feeding on rotting brood that had fallen to the floor of the hive;
- an un-identified thin (possibly Annelid) worm;
- an unidentified Hemipteran bug; and
- an unidentified earwig-type insect.

The commensal 'friend of the bees', a deep red-pink colour Pseudoscorpion that is always associated with *Apis cerana* bee colonies in Nepal, was also sampled for confirmed identification.

One queen less colony with 'worker laying' was found in Charigaun (see explanation of queenlessness and its consequences in section 4.10).

At least four colonies had condensation inside the hive. This common problem in the log hive could be contributing seriously to disease susceptibility in bees, but studies on the affect of high humidity of bees in log hives have yet to be conducted.

Brood disease symptoms were not confirmed in any of the colonies sampled. Although certain colonies could be suspected of having had brood disease during the middle of the monsoon, only one colony had dying brood that we inspected. This could possibly have been infected with Thai Sac Brood Virus but confirmed symptoms were not seen. Slightly yellow larvae were observed in 4 cases, the larval tracheal system was visible in one case, pointed pre-pupae in one case and slightly too much water around the larvae in one case, but clear symptoms of advanced brood disease were not seen. It is possible that such symptoms as were detected could also result from starvation of larvae as much as from brood disease itself. Larval and pupal material was sampled despite the lack of clear symptoms in the hope that low levels of disease might be able to be detected under lab conditions.

8.4 Pests of bees

Farmers listed the following as pests of bees:

- Pine marten -14/24 respondents;
- Bears – 15/24 respondents;
- Hornets / Nepali name 'oringal' (*Vespa magnifica* and other *Vespa* spp.) 16/24 respondents;
- 'Bacchhu' hornet (*Vespa* sp.?) 6/24 respondents;
- Lizard – 9/24 respondents;
- Ants - 7/24 respondents;
- Mice - 6/24 respondents;
- Birds - 2/24 respondents;
- Jackals (in Tangin) – 1/24 respondents;
- Large black insect (possibly a hive beetle)– 3/24 respondents;
- Water (i.e. soaking and condensation)– 3/24 respondents.

In North Humla both in the ApTibeT survey and the current study, some beekeepers attributed the decline of bees in the last 20 years (which may have been associated with TSBV) to the new influx of a giant hornet or 'bee' species. In Bargaon they spoke of an enormous hornet or bee that caused the bees to abscond. In Maila in S. Humla the farmers said a large black insect entered hives and ate combs. In Hildum the beekeepers described two kinds of hornet that preyed upon their bees. One was the *Vespa* species that makes large paper nests in trees, locally called 'Oringal'. This is usually orange or brown in colour. The other lives in the ground and is darker in colour and larger, this is locally known as 'Bacche' or 'Bacchhu' is likely another *Vespa* species, (though they do not usually live underground).

8.5 Other causes of bee colony damage or demise

8.5.1 Starvation

Three farmers described symptoms of starvation of bee colonies in detail, 1/24 saw dead bees with their heads inserted into dry combs which is a confirmed sign of starvation, 1/24 saw dead adults on the floor of the hive, another farmer described how the bees became gradually weaker and weaker and died in February or March. Other beekeepers seemed to have problems with bee starvation too, but surprisingly most farmers seemed to be unaware that the reason for the colonies dying was lack of food. Similarly in the ApTibeT study several farmers described similar signs of bee colony starvation.

In the ApTibeT study the following observations were made.
Several colonies of Apis cerana inspected in Dozjam village had died of starvation. Other beekeepers also told of colonies that had died in the early spring (Feb – March) in a way that sounded like starvation. Few beekeepers could recognise that the bees had starved by the appearance of combs containing dead bees with their heads inserted into empty cells. In the monsoon the common local belief is that bees have plenty of flowers to feed upon. Experience in Jumla however has shown that monsoon feeding of bee colonies with sugar syrup can control disease and prevent starvation.

We concluded that bee starvation is probably a major cause of bee colony death in Humla, but because people rarely opened their colonies at the time that bees were starving, symptoms were not very often described.

A main limitation to production lies in starvation of bees in dearth periods (monsoon and winter). The only means to maintaining bee colonies at these times (at least until forage resources that flower at these times can be regenerated or planted) is to feed with sugar syrup or use up precious stores of honey. Experiences with communities in Jumla showed that farmers find it difficult to afford sugar and are usually not willing to invest in enough sugar at the crucial times to keep their colonies strong. If bees are fed in dearth periods the investment in sugar can be repaid several times in increased honey production once the honey flow starts. This is because colonies contain healthy populations of forager bees ready to go out and collect nectar in large numbers as soon as it becomes available. If bees are weak at the beginning of a honey flow the first week to month may be utilised in building the colony to a sufficient strength to be able to collect large quantities of nectar, which inevitably leads to lower yields.

A major challenge of any beekeeping programme in Humla would be to influence farmers' behaviour in relation to bee feeding and to address issues of sugar availability to the poorest of the poor. This is very difficult to attain though since sugar is not grown in the area and most people cannot even afford it to make tea or sweet breads for festivals. In addition to supporting the use of honey and other natural sweet substances fed to bees traditionally, DPP's partner organisations could test the formation of 'sugar banks' where beekeepers groups raise money regularly to buy sugar for bee feeding. Anyone who borrowed sugar from the bank would have to repay it with some extra sugar or honey as interest, thus maintaining the bank for communal use.

8.5.2 Robbing

Certain beekeepers interviewed in the ApTibeT survey mentioned robbing as a problem. In some cases they had come across it between two colonies of *Apis cerana* when one was much weaker than another, or if two colonies were combined together. In one case in South Humla however, they described a bee that is larger and more yellow than *Apis cerana* but not as large as *Apis dorsata* or *Apis laboriosa*, which enters bee colonies and fights with their bees. The bee fit the description of *Apis mellifera* but no records could be found of any introduction of this exotic species into the district. It remains to be discovered what species of bee has been robbing. Farmers also mentioned another large black bee-like insect in both the ApTibeT survey and the current study. This was also said to enter beehives and either cause robbing by the bees (between themselves) or to rob bee colonies by taking up residence inside hives.

8.5.3 Climatic effects upon bee populations

In recent years drought has been a serious problem in Humla, causing large-scale food deficit for much of the population. Lack of rainwater or irrigation also affects the availability of bee forage and thereby the health of bee populations. Between 1997 and 2000 drought has certainly had a major negative impact upon bee populations throughout the Karnali Zone. The stress upon bees from lack of water leads to absconding (in search of forage) and to susceptibility to diseases. Conversely too much rain, as in the heaviest monsoon seasons as occurred this year (2000), is also very bad for bees. If rainfall is too heavy and prolonged, nectar may become washed from flowers and even if there is nectar available the bees are unable to leave the hive and forage upon it. This means that the bees may starve and / or become susceptible to disease.

8.5.4 Bee mortality from poisonous nectar

Beekeepers in several communities mentioned that bees may die or be found knocked out from consuming poisonous nectar, especially from the less common apricot species known as ‘Khaambu’ by the Lamas and ‘Aru’ by the Hindu Nepali speakers (*Prunus communis*). Seven out of 24 respondents mentioned this as a reason for bees dying in the spring and for disease susceptibility. *Prunus communis* is said to kill bees by certain Jumla beekeepers also. The actual impact of *Prunus communis* nectar upon individual foraging bees and its impact upon bee populations needs to be investigated.

Interestingly, the nectar from the highly poisonous *Aconitum* species found at high altitudes that are deadly poisonous to humans and livestock (e.g. cows) appear not to affect bees. Indeed it is a common belief that the collection of these ‘poisons’ from high altitude flowers is what makes nectar from high altitude areas so highly medicinal.

8.5.5 Insecticide use and incidence of bee poisoning

Despite the remoteness of Humla, the Agricultural Development Office (ADO) has quite successfully transferred the practice of using insecticide to a proportion of the farmers. From the point of view of beekeeping development this is a tragedy. Farmers are often unaware of the toxicity of the chemicals to bees or indeed to humans and so health and safety practices are severely lacking. Out of the 24 questionnaire interviews, 16 farmers (2/3rds) said that they had used insecticide. Eleven said that they bought it from the ADO and 1 said they bought it from local traders, who provided stronger more effective chemicals. The insecticide is used particularly on apples (6/24 respondents) and on vegetables such as cauliflower, cabbage and spinach (15/24 respondents). It is rarely applied to grain crops, partly because of the expense involved in treating such large areas. The time of application varied but was usually between April and September, probably mostly in spring and monsoon. Seven farmers (6 in Hepka and 1 in Melchham) said that they had seen bees poisoned by insecticides and at least 12 colonies were reported to have been lost. Only thirteen out of 24 farmers appeared to be aware of the toxicity of insecticide to bees. One farmer from Tangin said that they discovered the toxicity once they started using insecticide and that 4 colonies died and the rest (8) didn’t swarm that year. No one had warned respondents about the toxicity of insecticide to bees.

Although large numbers of poisoned beehives have not been reported in this study the potential for insecticide severely damaging bee populations in Humla is quite alarming. Should a beekeeping programme be undertaken awareness raising of the danger of insecticide and guidance on improving safety of application is necessary. A major thrust of any beekeeping programme should be to investigate, test and promote organic pesticides made from local herbs or materials that are non-toxic to bees or humans. There are several herbs that are traditionally used that could be used more widely.
Three farmers said that they did not use chemical insecticide but that they used their own homemade mixture. One respondent in Mashidhara (Gorkha Bdr. Shahi) uses nettles, chillies and ashes, whilst another (Hangsa Bdr. Shahi) uses ashes alone. Hetuk Lama in Hepka uses nettles, soap and tobacco.

Companion planting in integrated mixed vegetable plots, combined with use of ‘jol mal’ or liquid ‘compost-cum-insect repellent’ could help to control insect pests of vegetables without any cost to the farmer. Training of motivators and lead farmers from CBOs in Permaculture methods by the Jajarkot Permaculture Programme in Gumi, Surkhet could

provide various ways to control pests and diseases, increase soil fertility and agricultural productivity whilst enhancing forage resources for bees and livestock.

9 Indigenous knowledge of beekeeping in Humla

9.1 Indigenous bee disease treatment

Out of 24 interviews, 10 respondents (5 each in Melchham and Hepka VDCs) said that they treated their bees with indigenous bee medicine. This usually took the form of smoking the bees with particular herbs or 'dhoop' used for religious purposes.
The herbs used to smoke bees were as follows:

- Root of Jantamansi (*Nardostachys grandiflora*) and 'paati' (*Artemisia indica* / *Artemisia* sp.) – 1 respondent in Hepka;
- 'Gokhul' dhoop – a mixture of herbs used for religious ceremonies that is available in Kathmandu – 1 respondent each in Hepka and Melchham;
- 'Dhoopi' (*Juniperus indica* / *Juniperus* sp.) – 2 respondents in Hepka and 5 in Melchham;
- 'Prasad' or blessed food from Buddhist monasteries is sometimes added to 'dhoopi' when smoking – 1 respondent in Hepka;
- butter and flour may also be added to 'dhoopi' – 1 respondent in Hepka;
- Chinia jurro (a small white 2-pronged lichen or fungus found at high altitudes at or above the tree line) mixed with 'dhoopi' (and in one case also mixed with snake skin) – 3 respondents in Melchham.

The frequency of application varied. Two farmers said they smoked their bees once, whereas 4 others said that they gave smoke from 2 to 4 times. Three (3) farmers said that the medicine sometimes worked and sometimes did not, whereas five (5) claimed that it worked. If a hive becomes 'polluted' by the touch of a menstruating woman farmers in Korka (Melchham VDC) said that they smoked the bees with Gokhul dhoop mixed with chillies. Sprinkling hives with cow's urine is also said to rid them of pollution. Mantras (religious chants) may also be used in combination with smoking bees to cure disease. Three farmers in Hepka said that they fed their bees debris from cooked honey when diseased. However in general in Humla it appears the custom of feeding bees honey or sugar substitutes as a result of disease is quite uncommon.

Information on bee disease treatment used by farmers from the ApTibeT survey is given below: 'Although in many areas we were requested to provide information as to appropriate bee medicines or to give out bee medicine, some older beekeepers also provided us with their own remedies. These may be summarised as:

- *Honey from Apis dorsata / laboriosa;*
- *Bread or candy made from buckwheat flour and honey;*
- *Concentrate of wild pears applied around the hive entrance in spring;*
- *Old honey;*
- *Cooked honey;*
- *Bitter herbs (Chiraiti or Swertia chiraiti) combined with old honey and cow's urine applied to the mouth of the hive'*

9.2 Indigenous bee feeding practices

Since the practice of bee feeding is very highly relevant to the health of bee populations, data on feeding practise were gathered and analysed.

At honey harvest, most farmers will leave their bees with several honeycombs to feed upon during the winter. The proportion of combs left for the bees varied from 1/3 (6/24 respondents) to ½ (6/24 respondents) or 4-6 combs (4 respondents). In Kargai, Kalika VDC and Dopka, Madana VDC in S. Humla during the ApTibeT survey, farmers said that they took all the honey from colonies located in the forest and very weak colonies and forced them to abscond. They said that the bees would flee to lower altitudes where forage would be available in the winter and that they would migrate back again in the following spring. In Rama, Maila VDC the farmers said that the amount of honey left for the bees depended on whether the colony was harvested early of late. If honey is cut early (i.e. in May or Sept) only 1 comb is left but if the honey is cut late (Jun-July or Oct-Nov) 2 combs are left. This is sensible because if honey is cut late the bees have no time to collect nectar and make honey before the dearth period.

In addition to leaving honey for the bees some farmers (8 farmers interviewed in each of Hepka and Melchham VDCs) also provide food for the bees in winter. This varied between Hepka and Melchham. In Hepka, 3 farmers said that they applied honey to a thin buckwheat pancake cooked with holes in it like a bee comb, and placed this in the hive like a comb. In Melchham however, 7 farmers said that buckwheat flour and honey are mixed together to make a comb-sized ‘roti’ or candy called a ‘desu’. This is par-cooked on one side to harden it slightly and then placed in the hive for the bees to chew upon. In Hepka, the pollen and debris that collects between the beeswax and honey is used as food for bees in dearth periods (by 5 respondents out of 12). In Melchham VDC 3 farmers said that they made a concentrate of ‘Mehel’ fruit (*Pyrus pashia*) by squashing the fruits, making them into a ‘roti’ or comb-sized cake and drying them in the sun. The resulting cake (called ‘mehel ko pota’) is placed in hives like a comb. This custom contrasts with the Jumla and Maila VDC practice of boiling ‘mehel’ fruit down into a concentrate like jam (called ‘mehel ko butun’), which is applied around the mouth of beehives in spring. One farmer in Melchham said that he fed his bees by boring a hole in a ripe sweet red pumpkin and placing it in the hive. The bees eat out the pumpkin from the inside leaving only the hard outer skin.

Spring feeding is usually practised to counteract the effect of the poisonous nectar of ‘Khaambu’ (*Prunus communis)* upon the bees. Two (2) farmers in Hepka and (7) in Melchham said they fed their bees in spring. This usually comprised provision of honey inside the hive but sometimes was merely the application of honey around the mouth of the hive. Only one farmer in Hepka VDC said that he gave his bees debris from cooked honey when they appeared diseased in Mid-July to mid-August (July-August).

9.3 Indigenous hive baiting and hive sanitation practices

The practice of baiting hives and placing them on cliffs where they are not damaged by rain is common throughout the Karnali Zone. In Hepka VDC 9/12 interviewees said they had hives baited out in the forest and pasture habitats, amounting to a total of 30 hives. In Melchham VDC 6/12 interviewees had baited hives, amounting to a total of 44 hives. Those beekeepers who have large apiaries (e.g. in Lama Gaun) tend to bait less hives in forest sites since they concentrate on catching swarms from their own colonies.

One major route for the spread of bee disease in traditional beekeeping is the use of old hives for new colonies of bees. Bacteria, viruses and pest and disease organisms may lurk in the cracks and crevices of old hives, even if old combs from absconded or dead colonies have been removed. If honey from diseased hives has been kept raw from previous years, this could spread bacteria or viruses to baited hives when used as hive

bait. Whilst it might be desirable to sanitise beehives thoroughly by scorching them (or applying boiling hot water), this is contrary to traditional practice, which relies upon the scent and the imprint of the old combs to attract swarms from the wild. In Jumla a district-wide programme of encouraging farmers to scorch the inside of beehives was conducted in 1997, but farmers complained that the scorched hives did not attract swarms. Nearly all the farmers questioned (20/24) said that they never scorched the inside of beehives. Two farmers in Hepka VDC said that they used a red-hot rice paddle to scrape clean hives that had been infested with wax moth. This is a practice that could be encouraged with other farmers.

In order to assess the potential risk of disease spreading through poor hive sanitation, farmers interviewed were questioned on the way that they prepared hives for baiting on cliff sites in forest and pasture habitats. It was found that, as in Jumla (Saville and Upadhaya 2000), a number of different herbs are used to clean and sanitise hives and create a sweet smell to attract bees. It is likely that the phytochemicals that give the plants aromatic properties are bactericidal or insecticidal, though this has yet to be investigated. Plants used to clean hives included the following:

- Walnut leaves (*Juglans regia*) (9/12 respondents in Hepka and 9/12 in Melchham);
- Leaves of a hedgerow shrub with rough serrated leaves and long white clustered spike of inflorescences about 10 cm long and 7mm in diameter (very attractive to bees) locally called ‘bigreti’ in Nepali and ‘yertakpa’ in Lama language (2/12 respondents in Hepka);
- Gallapani (*Salvia nubicola*) (10/12 respondents in Melchham);
- Chutro (*Berberis aristata* or *Berberis chitria*) flowers.

Often walnut leaves are used first, followed by other more scented leaves or flowers.
One farmer in Hepka VDC said that he smoked the hive with dhoopi before baiting it.
Some farmers said that they only cleaned the hive if it seemed dirty inside and that if the bees had only very recently died or left that it was not necessary to clean and bait them. Unfortunately this means that bee colonies that have absconded from infectious brood diseases may not get sanitised.

Hive baits varied between N and S Humla. In Hepka, cooked honey or the pollen and debris that collects below the beeswax in cooked honey is most commonly used (10/12 respondents in Hepka and only 1/12 respondents in Melchham). Raw honey is used more commonly in Melchham (9/12 respondents in Melchham and only 1/12 respondent in Hepka). Wax (separate from honey) is rubbed on the inside of hives less often (3 farmers in Melchham and 1 in Hepka). Usually farmers seal baited hives with cow-dung and mud to stop pests and predators from getting inside (11/24 respondents). One farmer in Melchham said that he mixed cow-dung and ashes to make a hive plaster for sealing the hive against insects.

Generally it was found that traditional practices of hive baiting are likely to reduce the probability of diseases being transferred from the lost bee colony to the new swarm. However, there is still some chance that disease could be spread through use of raw honey or from ineffective / lack of cleaning of the hive.

9.4 Types of traditional hive in use

Of the 24 questionnaire interviews, all farmers used square cross-section log hives that open from one long side. In Hepka VDC, many hives seemed to open from the front (4/12 respondents) whereas in Melchham VDC all the hives opened from the back (12/12 respondents). In some cases, especially in South Humla the hives were also

inserted into the walls of buildings to become ‘wall hives’. In answer to the question of whether their own hive type was easy to use, most farmers replied that it was (22/24 respondents) though several farmers qualified this by saying that since they had no experience of any other kind of hive they couldn’t make a fair comparison. One farmer in Charigaun said that it was difficult to see disease and to extract honey from traditional hives and another complained that many bees died during honey extraction.

When shown pictures of Jumla top-bar hives and upon hearing how to adapt their own hives to use top-bars many of the farmers we spoke to were enthusiastic about the idea and said that training in making and using the hive would be useful.

9.5 Indigenous hive inspection and colony management practices

Hive inspection by opening the hive is not a common practice in traditional beekeeping. Usually beekeepers are good at telling the condition of the bee colony from the activity of bees at the hive entrance, but are reluctant to open hives. This is presumably because of fear of being stung, the risk of the colony absconding lack of time and lack of awareness of the value of doing so.

Some beekeepers said that they expand their hives for honey production (called ‘supering’ in modern beekeeping) by joining an empty beehive to the occupied beehive, plastering the join with a mud-cow dung mixture. This allows the bees to make their honey in the empty hive and helps to control swarming.

Most beekeepers interviewed (16/24) said that they only inspected their bees at the time of honey harvest (in June and September / October). Several (6/24) inspected the colony at swarming time to look for queen cells and check when swarms might emerge. Only 2 farmers opened their bees in spring and 1 in winter. Five farmers (4 in Hepka and 1 in Melchham) said that they opened their colonies when they got diseased in Mid-July to mid-August (July-Aug). Two farmers specifically said that they only inspected from outside the colony.

Three farmers said that they destroyed queen cells after the bees had swarmed too many times already. One farmer in Melchham said that he clipped the wings of the queen if the bees swarmed too much, however he said that this also reduced honey production. This practise of destroying queen cells and clipping the queen is advantageous so long as the colony has a mated queen. However, if the queen is unmated or the mated queen has already swarmed leaving a new queen to develop from the queen cells, this practise will render the colony queen less. Unfortunately it is usually impossible to see whether there is a mated queen in the colony without looking closely at the combs for the presence of eggs or by locating the queen herself. This is very difficult in fixed comb log hives. Management of bees in movable comb top-bar hives would allow farmers to detect the presence of the queen and selectively destroy queen cells as necessary. Swarming could also be avoided by dividing colonies once they have produced queen cells.

According to modern beekeeping practice the frequency of hive inspection by Humla farmers is too low to be able to ascertain the condition of the colony at crucial times of bee disease and swarming. However, since combs cannot be removed from fixed comb log hives, most of the time the condition of bee brood, the presence of eggs, larvae, pupae and food stores is difficult to ascertain even if the hive is opened. The only way to improve the inspection of bee colonies is to introduce appropriate top-bar technology

for movable combs. This would be relatively simple in Humla since the traditional square log hive design needs no other change than to rotate the hive by 90 degrees, make a new hive entrance by boring a hole and to make and insert top-bars to the existing hive. A pilot study to see the success of using the top-bar hive in both N and S Humla is suggested as an activity for 2001.

10 Honey and beeswax – production, processing, marketing and usage

10.1 Honey harvesting

Findings on honey harvesting and processing practices from the key informant questionnaire data (provided in full in a report supplement) and from informal focus group discussions are summarized as follows. Traditionally honey from colonies of *Apis cerana* is usually harvested at night in order to avoid bees flying at people. This may result in large numbers of bees being killed in the extraction process as the hive is full of bees and the beekeeper is not able to see clearly to avoid squashing bees. Smoke is blown into the opened hive so that the bees desert the combs. Out of 24 interviews, 10 used a roll of cotton cloth (locally called 'kangreto"), 7 used dried cow or horse dung for smoke and 3 used 'dhoopi' (*Juniperus indica* / *Juniperus* sp.). Cow dung is more commonly used in Hepka VDC and the 'kangreto' in Melchham VDC. Combs are cut out of the hive with a 'khukuri' knife. Bees are brushed from the combs with a brush made from dried grasses dampened with water. 8 out 24 interviewees mentioned using warm water to brush the bees off the combs and to maintain wet hands while handling the combs. This is practised to stop the bees sticking to the hands and brush and to reduce the numbers of bees that die. Unfortunately this is also likely to introduce water to the honey harvested.

Honey from *Apis cerana* may also be harvested from colonies living wild in hollow trees in the forest. Honey hunting from *Apis cerana* tends to be opportunistic, and is often practiced by groups of villagers who join up to harvest from wild bees together. Often the colony is destroyed in the process of harvesting, though some expert beekeepers will hive the bees and carry the colony to their home apiary.

10.2 Poisonous honey, especially from rock bees

In most of the communities we visited during the ApTibeT study farmers spoke about poisonous honey, especially in South Humla where rock bee (*Apis dorsata* / *Apis laboriosa*) honey is harvested more regularly. It appears that the honey from the rock bees when consumed fresh at the time of harvest causes diarrhoea, vomiting, dizziness, numbness in the limbs, headaches and even temporary loss of vision in most people. Some people pass out from the effect and have to be carried home! The people said that usually the toxicity declines as the honey ages and that it is safer to eat it a few days after harvest rather than fresh. In Kalika they said that you could only eat it in the cold season. Others said you could only eat it once it was cooked. Toxicity is probably from the nectar of one or two *Rhododendron* species R. ? and R. ? and perhaps from species in the *Aconitum* family. Allelopathic (i.e. substances toxic to other plants in the vicinity of the *Rhododendron*) and anti-grazing secondary plant products must become mixed into nectar in the nectarines of the flower, and this makes the nectar toxic.

Although this honey should not be marketed without a warning about its effects and should be tested so that its effects are known before selling it, there is a special niche market specifically for poisonous honey amongst Koreans. Apparently poisonous honey

is considered to be a powerful medicine and is used as a purgative. Koreans in Kathmandu will pay Rs 7,000 / kg of poisonous honey and there is a demand for exports to South Korea.

10.3 Honey processing practices

Having cut the honeycombs from the hive, most farmers separate out sealed white combs of honey first to be kept for medicinal and / or religious purposes as raw honey ('kaacho maha'). All those interviewed separated out 'red' or dark combs with liquid unsealed honey and sealed honey in old combs to be cooked and sold as cooked honey ('pakkeko maha'). Old black empty combs are usually discarded. Pollen in the comb is either mixed with the honey or discarded. Humla farmers are generally unaware of the nutritious and medicinal value of pollen.

Although cooking honey destroys many of its medicinal properties and Humla farmers are well aware of this, the practice of boiling up honey is found in almost every community. Reasons for cooking honey listed by farmers were:

- To make clean honey with no wax (12/24 responses);
- To make the honey easy to use and eat (6/24 responses);
- To extract wax (9/24 responses);
- To prolong storage life of the honey and prevent fermentation (5/24 responses);
- To increase honey volume (3/24 responses).

Only in one or two places during the ApTibeT survey did farmers say that they did not believe in cooking honey (e.g. 1 man in Lorpata, Madana VDC and farmers in Kargai in Kalika VDC). Some farmers claimed not to add water to the honey for cooking but 10/24 respondents said that they added water that had been used to rinse the knife and hands after cutting. One said that if you didn't add a little water as the honey was boiling, that it would boil over. The honey is cooked directly in a pot on the fire until all the wax melts and the honey boils. Then the honey is allowed to cool so that beeswax separates out and forms a layer on the top of the honey as it cools. The pollen and debris from the old combs settles out to form a layer at the bottom of the wax. This debris and pollen mixture is often used as hive bait in Hepka VDC but less so in Melchham VDC where the farmers favour use of raw honey as hive bait. The honey forms a dark liquid below the beeswax and debris.

The practice of cooking honey may allow beekeepers to earn more from their honey harvest since all the honey is extracted from the combs and volume also increases if sufficient water is added. Liquid cooked honey, though nearly useless as medicine, has advantages of often remaining liquid and not crystallising quickly so that it is more useful for making the special sweet fried breads (sel roti) which are made at festivals, weddings etc. Humlis also say that cooking the honey neutralises the toxins in poisonous honey such that it no longer causes nausea, vomiting, headaches or diarrhoea. However direct heating of honey destroys all its valuable properties and flavour.

Honey from *Apis dorsata* and *Apis laboriosa* tends more often to be poisonous than *Apis cerana* honey (presumably because of the foraging preferences of the bees). This means that in certain areas (Kalika, Maila and Madana VDCs) beekeepers and honey hunters insist that all honey harvested from these species should be boiled. It appears that some people prefer to buy cooked honey for these reasons though, because of its medicinal value, raw honey is generally preferred and can be sold at a higher price.

There is scope for the improvement of honey quality and thereby honey prices by discontinuing the practice of cooking honey. If beeswax is extracted by boiling combs in water instead of by boiling honey, increased benefits can be gathered from honey and from beeswax too. In preference to cooking, a system of sorting sealed and unsealed honey should be introduced. Sealed honey can be processed by squeezing through a clean dry cloth. Alternatively honey that is not hand squeezed can be produced by allowing finely cut sealed honeycombs to settle in bucket (or other wide-mouthed container with a cover) in a cool dark place for 7 days. The wax rises to the surface and the honey sinks so that pure honey can be obtained by skimming wax off. The wax with honey mixed can be given to bee colonies at times of food dearth and then processed to obtain pure wax. Immediate consumption of unsealed honey at the time of harvest would be the best way to use the unsealed honey combs harvested, especially since there are always many people wanting a taste of honey at the time of harvest. Pollen in the comb should be separated, cut into small pieces and preserved in honey from sealed combs. This mixture can then be fed to young children, nursing and pregnant mothers, old people and convalescents as a protein, vitamin and mineral supplement.

Methods of detoxifying poisonous honey needs to be investigated. If farmers feel that it must be heated to neutralise the poisons, it should be possible to reduce the temperatures and length of time that the honey is heated, thereby retaining more of its valuable properties. If possible though all cooking of honey should cease. We recommend that poisonous honey is harvested and processed very carefully using the principles of separating out sealed and unsealed honey outlined above and then NOT COOKED. The resulting poisonous honey with the correct water content (less than 19%) can be kept for special niche marketing to Koreans, with the assistance of HCDA or another local NGO that is able to make market connections. The Beekeeping Shop in Kumaripati in Kathmandu has been selling such honey and may agree to buy it to sell on, however for maximum profits to producers and direct connection to a Korean dealer would be preferable. If poisonous honey that is too high in water (i.e. from unsealed cells) ways of drying honey effectively without excessive heating need to be developed. If poisonous honey cannot be sold in specialist niche markets and farmers insist that it needs to be heated to be edible by everyone, then small quantities of this honey could be heated as necessary. However in this instance the practise of directly cooking honey on the fire should be replaced with indirect heating by placing the container of honey in a pot of boiling water.

10.4 Honey productivity from *Apis cerana*

Production of honey appears to be variable from *Apis cerana* in Humla. Certain farmers claim quite impressive yields while others quote very low figures. Full details of the honey yields claimed by farmers can be found in Appendix 4b for the current study and Appendix 11 for the April 2000 ApTibeT study. Figure 1 shows data on average honey yields per beekeeper per year pooled over Hepka and Melchham VDCs, as obtained from key informant interviews and focus group discussion. Data suggest that honey yields have declined in recent years but there is no statistically significant evidence to confirm this. As with the bee population data there is a problem of lower precision in the means the further back in time that farmers made estimates. This is because few farmers could remember that far back so replication is lacking. Also farmers themselves may be likely to exaggerate when looking back with nostalgia or may have quoted their highest yields. The very low average yield for this year (2000) (found in Appendix 4b) was due to the fact that the honey harvest season had not come and most farmers did

not extract honey in June (when certain beekeepers extract honey in S. Humla). For this reason Figure 1 does not include any figure for honey production for 2000. Honey yields this year were expected to be low because of the very heavy rains during the monsoon, which destroyed bee forage plants and prevented bees from making foraging trips. Drought may have been a problem in the previous 2 years. Without sufficient rain, plants cannot secrete nectar or may be unable to produce flowers. The low yield more than ten years ago is probably due to TSBV disease.

Data suggest that yields of honey are higher in Hepka than Melchham VDCs. Table 5 shows that the average yield per beekeeper (calculated over all years for which estimates were given in questionnaires) was much higher in Hepka than in Melchham for the period between 1999 and before 1990 and within the last 5 years. However, the very large standard errors for Hepka mean that the difference is probably not statistically significant.

Table 5. Average per year of average honey yields per beekeeper for years 1999, 1998, 1997, 1995 and more than 10 years ago (before 1990).

	Hepka & Melchham VDCs	***Hepka VDC***	***Melchham VDC***
Average of before 1990, 1990, 1995,1998 and 1999	***51.3***	***162.0***	***18.5***
SE mean (<1990, 1990-9) n=5	20.3	81.1	5.1
Average of last 10 years (1990, 1995,1998 and 1999)	***55.4***	***182.5***	***20.0***
SE mean (1990-9) n=4	26.4	103.7	6.5
Average of last 5 years (1995,1998 and 1999) n=3	***33.0***	***100.0***	***15.0***
SE mean (1995,1998 and 1999) n=3	7.3	61.6	4.3
Average of 1998 and 1999	***27.4***	***50.0***	***11.5***
SE mean (1998-9) n=2	50.5	38.7	1.1

The estimates given in Figure 1 and in Table 5, gathered in the current study, can be compared with figures for honey production gathered in the ApTibeT study in 2000. The last two years' yield in South Humla shown in Table 6 appears to be very low compared to the averages including estimates from 5-15 years ago shown in Table 5. This is probably partly due to most of the data coming from S. Humla, where number of hives per beekeeper are fewer and honey production is lower, and partly because the last two years were particularly bad. The difference may also be explained by the fact that only the most enthusiastic and experienced beekeepers could quote honey yields from further back than a couple of years. These beekeepers relatively high yield estimates bring the average up noticeably.

Table 6. Averages of honey production estimates given by farmers in Kalika, Madana, Maila VDCs of S. Humla and Hildum, Tangin and Dandaphaya of N. Humla during the ApTibeT survey in April 2000.

Estimates of honey production given by farmers in the ApTibeT survey in April 2000	Total Kg prod'n per bee-keeper in 1999	Total Kg prod'n per bee-keeper in 1998	Kg prod'n per large colony	Kg prod'n per small colony	Total Kg prod'n per bee-keeper in good	Total Kg prod'n per bee-keeper in a bad year

					year	
Average of all answers	**8.6**	**11.3**	**16.4**	**9.9**	**156.6**	**31.9**
n	28	14	14	7	8	4
Standard error of mean	*4.0*	*4.3*	*2.9*	*1.6*	*65.6*	*11.2*

NB: since measures varied from manna, litre to gaagro the figures are only approximate.
According to the authors estimates 1 litre honey weighs about 1.6 kg & 1 manna = 0.685kg.
It is assumed that 1 gaagro holds about 28 kg of honey on average. Averages of production were calculated for farmers who harvested some honey (i.e. zeros were not included in the averages).

Estimates of individual honey yields per hive were also gained from key informant interviews and focus group discussions in the current study. In Hepka VDC estimates of honey yields from large hives varied as follows: 5 litres, 6-7litres, 10 kg, 30-35 kg and 40kg. The last 2 figures appear higher than expected for *Apis cerana* colonies, but since empirical measures of honey production were impossible in this study, it is hard to estimate to what extent these may be over-estimated. Estimates for small hives varied from 4-5kg, 10-12 kg, 10-15 kg, 3 litres and 2-3 litres. Smallest colonies yield nothing at all. In Melchham VDC estimates of production from individual hives were much more modest. In Charigaun and in Korka large hives were said to yield 1.5-2 dhaarni (up to 5 kg) and small hives 1 dhaarni (2.5 kg). Largest hives in Korka were said to give up to 3 dhaarni (7.5 kg).

A case study with a beekeeping expert in Baiji Bada near Dozjam, Thehe VDC during the ApTibeT study showed an average of 8.4 kg of honey per colony, if the ’gaagro’ water container quoted holds 22 kg of honey. If the gaagro is larger (34kg) then the estimate increases to 13 kg per colony. These figures are higher than found with *Apis cerana* at lower altitudes.

Table 7. Honey yields, number of colonies and approximate yield per colony in the last 5 years for Bhum Lama in Baiji Bada.

Year	1999	1998	1997	1996	1995	Average	SE of mean
No. of colonies	*35*	*20*	*35*	*30*	*44*	***33***	*4.4*
No. of 'gaagro'* of honey produced	10	6	18	7	25	**13**	4.1
No. of 'gaagro' per colony	0.29	0.3	0.51	0.23	0.57	**0.38**	0.08
Approx. Kg honey produced per colony if gaagro holds 32 manna = 32 x 0.685 = 22 kg	6.38	6.6	11.22	5.06	12.54	**8.4**	1.7
Approx. Kg honey produced per colony if 1 gaagro holds 50 manna = 50 x 0.685 =34 Kg	9.86	10.2	17.34	7.82	19.38	**13**	2.6

*A 'gaagro' is a water container traditionally made of brass or copper but now more often made of aluminium. It is necessary to calibrate the 'gaagro' and the manna used North Humla to be certain of the accuracy of these calculations but it is likely that the honey yield lies in this range.

Other information gathered during the ApTibeT survey on honey productivity was as follows: *"Hetuk Lama a woman beekeeper from Hepka claimed to harvest 35 litres of honey from one colony (56 kg) and that this earned her Rs7000. She said that she felt hat beekeeping was a better source of income than setting up a hotel in Simikot and that more women should concentrate upon it for income generation. She also claimed that in her area it was possible to make a very rapid increase in bee colonies if swarms were captured. According to her estimates one colony is likely to swarm around 4 times and there may be two bouts of swarming per season, one from the initial colony and then from the first 3 swarms that are captured. This means that from one starter colony she estimated that it would be possible to increase to 8 or even 17 colonies in one year! Although the latter estimate is probably slightly over-optimistic these figures are impressive nevertheless. In Tangin (a few hours walk above Hepka) 3 years ago the total honey yield was 100 kg for Paldin Tschering Lama. However last year production dropped to 30-35 Kg due to disease."*

Such high honey yields as quoted in Hepka VDC are probably due to abundance of forage for bees associated with relatively low levels of environmental degradation / deforestation, the lack of cultivated land, and low levels of human habitation relative to other areas, as well as the nature of the *Apis cerana cerana* sub-species.

As in all parts of the world certain years give 'bumper crops' of honey whilst in other years there is almost no honey to be harvested. Last year in Maila was an example of a very poor year. Low yields are usually associated with weather conditions such as drought and with the health of the bee population. In years that disease reaches epidemic proportions, honey harvests are correspondingly low.

Generally, especially in South Humla, honey yields from Apis cerana are low. These could be improved by management of bee forage resources, irrigation, feeding bees in dearth periods and management for the control of bee disease and, if training and extension services could be provided, by improved management of bees in movable comb hives as opposed to traditional fixed comb hives. The change from traditional log hives to appropriate technology log top-bar hives (such as the Jumla hive tested in Jumla) is only effective in increasing honey productivity if farmers are trained how to use the hive to make stronger, better fed bee colonies. If training and extension is

insufficient to support the farmers in the transfer from traditional to appropriate technology hives and to improve bee colony management in the new hives there will be no perceptible change in honey production."

10.5 Honey quality

The quality of honey samples taken directly from hives and from farmer's stores of honey for sale and home consumption was analysed by Maha Laxmi Shrestha of BEEDECO a Nepali beekeeping NGO located at The Beekeeping Shop in Kumaripati, Kathmandu. Seven samples were taken in the current DPP study during September 2000 by cutting sections of honeycomb directly from the hive, 3 during the ApTibeT study (2 stored samples and 1 fresh from the hive) and 3 at the time of the beekeeping workshop held by the authors in November 2000. The latter 3 samples were taken from cooked honey, squeezed honey with comb still mixed (both harvested and processed by farmers from the Simikot area) and from honey harvested during the DPP beekeeping workshop and processed by skimming off the wax and filtering / squeezing the honey through a clean dry cloth. The point of comparing these three samples was to give an indication of the relative honey quality resulting from these three methods.

Details of the analyses conducted and their significance in terms of assessing honey quality are given in Appendix 12, together with full results of the analyses.

Generally, with the exception of the cooked honey sample, the honey sampled was of very high quality and would probably meet international CODEX standards for honey. Most of the samples had water content below the designated 19% required to ensure that fermentation of honey cannot occur. Of the 12 samples of raw honey, 7 had less than 19% water content and 5 had between 19.5 and 21% water, the overall average being 18.6%. The cooked sample had a high water content of 25%, which confirms that farmers do indeed add water during the cooking process.

HMF is the substance detected to assess whether honey has been overheated or stored for a long time. All the raw honey samples had acceptable levels of HMF (hydroxymethylfurfural): 10 samples were below 40ppm of HMF (as required in international standards) and in 2 samples HMF was absent. Since only the cooked honey had HMF levels as high as 40ppm it is clear that the traditional practice of harvesting and processing *raw* honey does not cause the honey to be damaged by heat. In fact even the levels of HMF in the cooked honey were surprisingly low. This suggests that the practice of adding water to prevent the honey from boiling over decreases the temperature of the cooking process. The cooking process however definitely spoils the quality of the honey.

The high levels of peroxide activity (average 16.9 µg/g/hr) in the raw honey samples and the absence of peroxide activity in the heated honey further demonstrated how cooking honey destroys its beneficial qualities. Peroxide activity is an indication of the activity of the glucose oxidase enzyme, which is denatured by heat. Glucose oxidase is one of the enzymes found in honey that gives honey antimicrobial properties. The levels of the enzyme in these samples is unusually high for *Apis cerana* honey (25 µg/g/hr in 6 of the samples) and matches figures found for *Apis mellifera* honey, which are usually higher than those for *A. cerana* (Shrestha 2000). This indicates the high medicinal value of Humla honey relative to other honeys found in Nepal, confirming the common belief in Nepal that honey from the higher altitudes (like Humla and Jumla districts) is of higher medicinal value than that of the mid-to low- hills and plains.

Levels of pH (average pH 4.9) are higher than those found for Nepali honeys in Chitwan area (Joshi et al 2000) suggesting that the honeys may contain a proportion of honeydew (Joshi 1999). Levels of reducing sugars /monosaccarides (average 69.1%) are also acceptable. The low levels of sucrose (average 3.3%) confirm that there is no sugar adulteration of honey in Humla.

Microscopy on the honey samples confirmed the high levels of pollen in raw honey from Humla. This again confirms the medicinal and nutritional value of the honey. However, lack of systematic pollen collection from Humla plants makes it difficult to ascertain the exact plant species that make up the honeys. Labiatae, Euphorbiacae, Balsaminaceae and Polygonaceae families were all identified but individual species could not be confirmed in the time available and with the lack of reference pollen slides. Since samples of honey were taken directly from one small section of honeycomb when samples were cut, several samples appear to be unifloral. This is because the honey stored in that section of comb was all from a source flowing at a particular time close to that of the survey.

The only serious contamination in Humla raw honey samples was with carbon particles and dust. The carbon comes from heavy smoking of the bees during harvest and from the general level of smoke and soot in the air in villages, especially inside farmers' houses where honey is stored. Most of the samples may have honeydew as a component of the honey since the honeys have high peroxide activity. Usually honey that is high in honeydew has a reddish colour. Bees collect honeydew from plant-sap sucking insects such as aphids. In Jumla the aphid species *Cinara pintera* and *Cinara comater* are found on *Pinus wallichiana* and *Pinus smithiana* respectively (Joshi 1999). These are probably also found on conifers in Humla along with other species that are probably associated with *Quercus* and others.

Comparison of the honey sample harvested during the beekeeping workshop with the honey sample from Baraunse harvested just prior to the workshop by a local beekeeper, clearly shows the advantage of using the improved harvesting and processing methods suggested as a major part of a new beekeeping programme in Humla. The honey harvested with dry clean hands and subsequently sorted into sealed and unsealed honeycombs and pollen combs and finally skimmed and filtered with a clean dry cloth resulted in a honey that was very low in water (17.8% as opposed to 20% in the Baraunse squeezed honey sample). It was also clean with no dust or carbon particles present in contrast with the other stored honey samples, which had high levels of carbon and dust.

Observing the very high quality of honey already achieved by farmers who sell raw honey, there is scope for niche marketing of Humla honey harvested from traditional hives as a specialist 'exotic' honey. It's exquisite floral flavour, combined with its high pollen content, high glucose oxidase activity and low water content give it enormous potential to compete with other commercial beekeepers' honey in national and international markets.

10.6 Honey markets

The local market for honey appears not to be saturated. Most beekeepers we came across did not have stocks of honey left for sale during March or September. Generally prices quoted for honey were slightly higher in North Humla than in South Humla according to data from both the current study and the ApTibeT study. Data on the prices of honey from the current study and the ApTibeT study are given in Tables 8 & 9 respectively and in appendix 11 in detail for the ApTibeT study. In Melchham VDC the average price was Rs 136 per kg of cooked honey and Rs 144 per kg of raw honey (cf. Rs 108 / kg for cooked and Rs 112 / kg for raw according for South Humla to the ApTibeT study). In Hepka VDC the average price was Rs 118 per kg of cooked honey which and Rs 148 per kg of raw honey (cf. Rs 169 / kg for cooked and Rs 226 / kg for raw for North Humla according to the ApTibeT study). NB: all calculations were made at the rate of 1 manna = 0.685 kg and 1 litre = 1.6 kg but the whether the size of the litre measure used is actually a full litre or a Chinese alcohol bottle that is less than a litre needs to be investigated.

The range of prices given by farmers for the various honey measures (given in full detail in Appendix 11) are included to allow the reader to see the actual prices and measures used. In the ApTibeT study the average price in North Humla was Rs 169 per kg for cooked honey and Rs 226 per kg for raw honey. South Humla prices were much lower, especially south of Muniya Lekh in Kalika, Madana and Maila VDCs. The average was Rs 108 per kg for cooked honey and Rs 112 per kg for raw honey, though the difference between cooked and raw honey prices is not significant. The high price quoted in Ripa (North of Muniya Lekh and only 1-2 days walk from Simikot) brings the average for cooked honey up, but in most villages in South Humla cooked honey was usually cheaper or in some cases the same price as raw. In Melchham VDC in the current study cooked honey was often the same as or even more expensive than raw honey. One farmer said that the honey lost volume from cooking and so was more expensive. In South Humla the measures used for honey are manna (c. 0.685 kg) and dhaarni (c. 2.5 kg) whereas in N. Humla farmers quoted litres and kg rates more commonly, as well as manna.

Many farmers appear to sell their honey from home, but in some areas farmers carry honey long distances to sell it. In North Humla prices may be higher in Simikot than in the villages but are best in Limi near the Tibetan border. This place is said to be too high to keep bees and has several monasteries where there is a demand for honey and beeswax. In the Tibetan border town of Taklakot honey is apparently not in much demand nor highly valued due to the ready availability of cheap sugar from China. Even if honey is sold there usually cooked honey is preferred because it looks clean and stays liquid longer. In South Humla, amongst the Hindu castes, honey is most important as part of a girl’s dowry when getting married. Sales of relatively large volumes are common for weddings but otherwise there sales appear to be in small volumes between neighbours.

Barter systems with honey appear to have been more common in the past than now, but still exist in some areas. In Simikot there has been a custom of exchanging cooked honey for oil on a 1:1 volume for volume exchange rate with farmers from Hepka. One farmer said that since the price of cooking oil fell, this exchange is less desirable than before. In S. Humla, farmers exchange honey for non-spun wool (weight for weight) with

Lama villages in North Humla and for ghee (volume for volume) with villages of Maila VDC.

Table 8. Prices of Honey quoted by farmers in the current September 2000 study in Hepka and Melchham VDCs

	Hepka & Melchham			Hepka VDC Only				Melchham VDC only			
	Mean	SE mean	n	**Mean**	*SE mean*	n	Range of prices	**Mean**	SE mean	n	Range of prices
Rs Price of Cooked Honey per manna (c.685g)	76	*12*	5	70	*13*	4	50-90	100	-	1	100
Rs Price of Cooked Honey per Kg	**129**	*10*	19	**119**	*19*	8	63-200	**136**	12	11	80-200
Rs price of cooked honey per Litre (c.1.6kg)	100	-	1	100	-	1	100	**-**	-	0	-
Rs price of cooked honey per dhaarni (2.5kg)	333	*35*	9	**-**	-	0	-	333	35	9	200-500
Rs Price of Raw Honey per manna (c.685g)	97	*7*	8	98	*7.4*	7	60-120	90	-	1	90
Rs Price of Raw Honey per Kg	**146**	*10*	22	**148**	*15*	11	50-200	**144**	13	11	80-200
Rs price of raw honey per dhaarni (2.5kg)	350	*41*	9	**-**	-	0	-	350	41	9	200-500

Table 9. Prices of honey quoted by farmers in the ApTibeT study in North & South Humla in April 2000.

	North and South Humla communities combined			North Humla communities only				South Humla communities only			
Prices for different measures / qualities	**Mean**	*SE Mean*	n	**Mean**	*SE Mean*	n	Range of prices	**Mean**	*Se Mean*	n	Range of prices
Rs per manna cooked or raw	115	*14*	20	145	*20*	11	100-300	77	*5*	9	60-100
Rs per Kg cooked or raw	175	*17*	25	211	*22*	16	125-292	112	*7*	9	88-146
Rs / kg cooked honey only	**149**	*13*	15	**169**	*16*	10	**146-292**	**108**	*12*	5	**88-146**
Rs / kg raw honey only	**177**	*20*	21	**226**	*28*	12	**125-438**	**112**	*7*	9	**88-146**

Although information on *Apis dorsata* and *Apis laboriosa* honey was not collected in the current study, in the ApTibeT study farmers were questioned about these species as well as bees kept in hives. *"In Dopka, Madana VDC, VDC chairman Mr. Jai Bahadur Budha said that 'bun mauri' or forest bee (Apis dorsata / laboriosa) honey was more expensive than Apis cerana honey because of it is especially effective in the treatment of asthma (or other forms of breathlessness). He would charge Rs 140-200 per litre (Rs 224 – 320 / kg) for forest bee honey but only Rs 60 /manna (Rs 88 / kg) for Apis cerana*

honey. He said that it was important to cook the honey so that it was less poisonous." In other areas it seemed that *Apis dorsata / laboriosa* honey was valued less highly than *Apis cerana* honey.

Markets for bee colonies and hives were not encountered much. However, in Charigaun farmers have a custom of exchanging 1 sheep for a colony of bees in a hive. This demonstrates the high vaue of bees in this community. In another village a price of Rs1200 was quoted for one colony of bees in a hive.

10.7 Beeswax markets

Formal cash markets for beeswax are not common in the Karnali Zone. Barter systems were very common in the past but appear to be on the decline in recent years. In North Humla only 2 out of 12 respondents in the current study claimed to sell beeswax whereas in South Humla 8/12 respondents said that they traded beeswax. In the past honey was carried to Achham with the sheep from Hepka VDC and traded there weight for weight with 'thetuwa', hand-spun rough cotton to make clothes such women's hand-died 'dhotis'. Some farmers in Hepka said that they give beeswax to the Buddhist monasteries for making 'diu' or votive lamps (these are like the traditional butter lamps but use beeswax instead of oil). Some others said that they give beeswax away to people that ask for it.

One farmer in Tangin (Paldin Tschering Lama) who we had interviewed and trained in beeswax processing in the ApTibeT survey in April 2000, said that he was making contacts with beekeepers in Dozjam in Thehe VDC and Lekh Gaun in Chipra VDC to buy their beeswax after the honey harvest. He is planning to make beeswax skin cream from apricot oil and put them in small 'phuru' hand-made wooden pots (like those used for drinking salt tea) for sale to tourists. He claimed that the price for the beeswax would be Rs 200-300 per kg. It would be useful if the Village Development Programme in Humla could follow-up this enterprise idea and see whether Mr. Lama succeeds in carrying though his objective.

In South Humla and amongst the Hindu communities in North Humla, the traditional trade in beeswax has been with metal workers of Kami, Sunar, Tamata (occupational) castes who use it in lost wax casting processes to make pots, jewellery and religious statues. In Melchham occupational castes visit villages and ask for small quantities of beeswax, which they receive for free or in exchange for doing some odd jobs for the beekeeper. If the beekeeper has larger quantities of beeswax this can be taken and traded in Nepalgunj with metal workers there. The exchange rate quoted varied.

- 3 farmers exchanged iron & aluminium pots at a rate of 1:1 weight for weight;
- 4 farmers exchanged 2 parts beeswax to 1 part iron, steel and aluminium pots (weight for weight); and
- in 1 case 3:1 beeswax to pots exchange rate was used.

Only 1 farmer in South Humla gave a cash price of Rs100 per Kg for the cakes of beeswax traditionally used. Traditionally nobody except occupational caste people bought beeswax and value addition (in the form of candles, medicinal skin creams, polishes etc) was unheard of.

During the ApTibeT survey a few other farmers claimed that they sold beeswax for cash. "The rates were:

- *About Rs 100 per Kg or Rs 1 for a small piece about 4 cm in diameter in Bargaon;*

- *Rs 100-150 per thick cake of beeswax (locally called 'desu') or even up to Rs 200 per cake if it was especially big in Dopka;*
- *Rs 100-150 for 1 'desu' of wax in Ripa;*
- *Rs 5-10 per small cakes of wax called 'tata' in Lorpata*
- *Rs 2-3 / tola to copper workers in Thapa Gaun in the past (now they don't barter it)."*

10.8 Market potential for honey and beeswax

Clearly there are good local markets for honey in Humla, but less profitable markets for beeswax. However, there appear to be several unexplored markets for the sale of honey both inside and outside Humla. The tourist market is an obvious one. If Humla beekeepers could process raw honey from *Apis cerana* (i.e. not the poisonous type) so that it was strained or skimmed without dead bees, bee legs or wax and package it in plastic jars that did not leak, tourists trekking on the Simikot -Tibet route would probably purchase it. Similarly if such honey could be marketed in Simikot, tourists flying in and out, development and government workers and other affluent sub-sectors of Humla society might buy it at relatively inflated prices. Experiences with producing strained and bottled honey in Jumla have been that there is a large market for honey amongst these groups and that so far production has not been able to meet demand. If market linkages could be developed with specialist outlets in Kathmandu or elsewhere, there may be potential for small amounts of Humla honey to be sold at high prices in a 'fair trade' or health food niche market. The honey is of exceptional flavour and some people are prepared to pay more than the average price to obtain it.

The (unheated) poisonous honey from *Apis dorsata / laboriosa* has market potential with traders from Korea and other parts of the Far East. People from this area use poisonous honey as a medicine and are prepared to buy it at high prices. In Kathmandu such honey may be sold at Rs 1000 per Kg or even more!

In Jumla, a beeswax and honey-processing small industry in Jumla bazaar called the "Main Prashodhan Kendra" (Beeswax Processing Centre or BPC) has been set up for marketing of honey and beeswax produced by Jumla farmers. The industry is associated with Surya Social Service Society (4S) NGO in Jumla and a proportion of its profits go to running 4S. Because of the traditional links between Humla and Jumla, trade between South Humla and Jumla may work out to be profitable for those who have previously been obtaining only Rs 60 / manna for their honey in Maila and Madana VDCs. BPC has been buying honey from farmers at Rs144 – 150 per kg and may be able to extend its area of activity to include Mugu and South Humla. For the people of North Humla though, marketing of honey in Simikot is probably most profitable.

Beeswax is severely under-exploited throughout Humla and wide scale training in improved processing and value addition to beeswax is called for. In North Humla there is potential for making beeswax candles for sale to tourists and other affluent people working in Humla. Beeswax skin creams or lip balms made from apricot (*Prunus* spp) or 'dhatelo' (*Prinsepia utilis*) oil and pure beeswax could also be marketed if appealing packaging could be devised and hygiene and cleanliness in wax and oil production improved. However, on the basis of experience in Jumla, advertisement of the product and awareness raising as to its value is called for. Alternatively if trade links between Humla and Jumla can be maintained in the current political climate (i.e. in the face of the Maoist insurgence and the police response to it), sale of Humla beeswax to the Jumla BPC for processing may work out to be profitable. Alternatively there may be

scope for Humla entrepreneurs to develop micro-enterprise with beeswax and honey for themselves. These are issues that would need to be addressed in depth through participatory action research if a beekeeping programme in Humla were to be initiated through DPP and its partners.

10.9 Uses of honey

Many beekeepers in Humla (in both the ApTibeT and the current study) talked of the value of honey as a medicine, especially raw honey harvested in 'Kaartik' Nepali month (between September and November). In Bargaon they said that honey was not food but medicine. Many people attributed the value of high altitude honey to the 'poisons' that the bees collected from the high altitude plants.

Examples of the medicinal application of honey were given as follows:

- Chest pains;
- Snake bites;
- Poisoning of humans and livestock;
- Stomach ache;
- Eye problems;
- Headache;
- Asthma / altitude sickness;
- For dehydration ('khoro utheko' in local language) with symptoms of thirstiness, burning feet, dry mouth, red burning eyes, and sometimes stopped urination;
- For too much heat in the body;
- For diseases of cows, buffaloes and sheep, especially dehydration (or the symptoms combined for the condition of 'khoro utheko');
- Urinary tract infections;
- For women immediately after childbirth;
- Shaking of the body (through exhaustion?);
- Diarrhoea;
- Heartburn and burning pains in the stomach;
- Falls and bruises;
- Fevers, cough and colds (though this was only mentioned by one farmer in Gadapaari and not in other areas);
- For coughs in combination with the medicinal herb kutki or katuki.

In many cases honey is considered by Nepalis to be bad for coughs and colds despite its use in other parts of the world for these conditions.

In Dozjam one old man told how his father had cured a serious snakebite by applying honey to the affected area & feeding honey to the victim and applying a bee sting to the snakebite. He said that the bee venom immediately caused the swelling from the snakebite to go down.

Other non-medicinal uses of Honey included:

- As part of the dowry from the girl's family at weddings, even carried to far away areas such as Bajhang and Doti in the Seti Zone.
- For making 'honey roti' or sweet fried breads for festivals.
- For making honey and buckwheat breads called 'desu' for carrying on long journeys. These have the value of providing concentrated nutrition and also of keeping without going mouldy even for weeks on end.

10.10 Honey storage

Honey in Humla is traditionally stored in clay pots known as ‘gadia’ in North Humla or ‘gaito’ in South Humla. These are bought or exchanged with makers of the pots in Kalika VDC in south Humla or in Achham district, where the farmer take their sheep for the winter. In Tangin village they trade grain for the pots by measuring out grain in the pots to evaluate them. Other storage containers include copper or brass water containers known as ‘gaagro’ (‘gaagri’ in plural). Nowadays people use plastic gallon containers quite frequently, though they say these are much less suitable than the clay gadia.

10.11 Traditional uses of beeswax

In North Humla amongst the Lama communities there seemed to be generally less diverse uses of beeswax than amongst the Hindu communities. Use of wax and debris (produced from cooking honey) for hive bait was common throughout the district. However, in most villages old combs were discarded and not used, unless they were cut out of hives at the time of honey harvest and cooked together with the honey. A woman beekeeper (Hetuk Lama) in Hepka in North Humla made beeswax lights for lighting as an offering in the Buddhist temple. These were made in the same way as the Buddhist butter lamps that are traditionally offered using brass or clay holders to form the base. In Hildum a beekeeper said that they made small ‘batti’ like very thin candles by hand-moulding beeswax around cotton threads and that these were useful when they ran out of ‘jharro’ (pine resin rich sticks used for lighting) or paraffin.

Farmers listed traditional uses of beeswax as:

- Hive bait (called ghosard);
- Lost wax casting by goldsmiths who make copper and brass pots;
- To wax threads to make them strong for sewing leather etc.;
- Mending clay, wooden and metal pots that have holes;
- Lubricant in spinning cotton;
- Lubricant inside the moving parts of water mills;
- Making lights for offerings or for lighting.

10.12 Trials of candle and skin cream making with beekeeping communities

The majority of people in Humla seemed unaware that beeswax could be used for the preparation of medicinal skin creams or candles, uses of beeswax that have proved to be very successful in Jumla district. So, in order to test people’s response to these ideas, demonstrations were given in the communities of Lama Gaun, Charigaun, Korka, Melchham and Mashidhara in the current study and in Dozjam and Tangin in North Humla and in Maila village in South Humla in the ApTibeT study. Generally beekeepers were delighted to find out about how to make candles and beeswax creams using their own hand-squeezed apricot kernel (*Prunus* spp) and ‘dhatelo’ (*Prinsepia utilis*) oils. It was clear from the 8 communities where we tested training in beeswax creams and candles, that this could be highly beneficial throughout the district for all traditional beekeepers and their families.

11 Comments made by farmers about a potential beekeeping programme

Farmers asked to give their comments at the end of the key informant interviews usually thought of things that they wanted from the DPP partner NGO or from donor organisations:
13/24 requested bee medicine or methods of bee disease control;
19/24 requested training in means of improving traditional beekeeping methods;
9/24 requested beekeeping equipment most frequently bee veils or other protection from stings.

In Melchham VDC, 6 farmers specifically said that they wanted to know how to make and use modern hives (having seen photographs of top-bar hives in use). Other specific requests by farmers included: market facilitation, better ways to control swarming, better ways to catch swarms and a way of cutting honey that doesn't kill so many bees. In Hepka, Hetuk Lama of Hepka village said she thought that training in beekeeping should be given to the children's group in the village. Others asked for medicine to stop their bees dying from poisonous *Prunus communis* nectar and also from dying during harvesting. In Tangin and Hepka two farmers said that the women had learnt from the training given by the 'Gharelu' office but that because they didn't get any equipment they had been unable to put the training to good use. They said that the women were afraid of the bees and needed protection from bee stings.

Most of the requests of farmers could be satisfied by the introduction of Jumla Top-bar hives so long as appropriate training and extension support can ensure that they are properly managed: swarming could be controlled through division of bee colonies; bee disease could be controlled by regular inspection of brood combs and practice of feeding; number of bees killed in the honey harvesting process can also be reduced by improved harvesting practices from top-bars during daylight hours.

12 Bee forage species in Humla

12.1 Bee forage in North Humla

It was observed that the vegetation in North Humla between 2,300 and 3,500 m was very similar to that found in Jumla district. This means that data collected by the consultant on the bee forage species and the medicinal plants of Jumla will be applicable to Humla (Saville in prep). There is a wide diversity of bee forage available to bees between April and October in North Humla. However time constraints in the two studies did not allow for detailed documentation of plants species by species.

Generally higher altitude areas that were still heavily forested and uncultivated provided the best bee forage. Villages that predominantly grow buckwheat (*Fagopyrus* spp.) as their staple, such as Lama Gaun and Tangin in Hepka VDC and Dozjam in Thehe VDC, provide excellent bee forage from their cultivated areas also. The area of North Humla with the best bee forage was undoubtedly the Hepka-Tangin valley and the valley in which Lama Gaun is situated. Just outside Hepka a large stand of Sea Buckthorn (locally known as Tare Chook) and *Berberis* sp. (locally known as 'Chutro') were important forage resources and other numerous herbs and shrubs of the Labiatae, Balsaminaceae and other families were also found. Apple and apricot / peach are also important as demonstrated by the high levels of Rosaceae pollen in the honey samples.

The villages surveyed in Hepka VDC may be ranked in terms of forage availability and beekeeping suitablilty as follows:
1st – Lama Gaun and Tangin;
2nd – Hepka;
3rd – Gadapaari;
4th – Dinga.

12.2 Bee forage in South Humla

As in N. Humla, the higher altitude, more remote and less populated areas had the best forage resources for bees and thus the best potential for beekeeping expansion. Geographical location in relation to water resources also affects forage availability severely. Of the 4 communities surveyed in Melchham VDC the ranking of bee forage availability was as follows:
1st – Charigaun;
2nd – Korka;
3rd – Melchham;
4th – Mashidhara.
However comparing Hepka and Melchham VDCs with one another and judging by the honey yields quoted by farmers, Charigaun ranks probably about equal to Gadapaari in Hepka VDC, in terms of bee forage availability.

Charigaun has excellent forest and pasture resources above the village leading to the passes and peaks to the north. However we were concerned with the complacency of the villagers there about the condition of their forest and its sustainability. One lead farmer had ideas for developing goat keeping in the forest area but there seemed to little interest in developing tree nurseries and reforesting areas that had been cut.

Korka, though slightly lower than Charigaun and further from high altitude forest and pasture still appears to have good bee forage despite being located on the ridge of a hills. In contrast Mashidhara on the ridge above Melchham has a severe water resource problem because of its ridge-top position. The slopes around Mashidhara were similarly dry and lacking in forage for bees, and this was the main complaint of the farmers themselves. Melchham, being more populated and lower in altitude has less forage than Charigaun and Korka but the water resources on the slopes meant that bee forage was available on uncultivated areas and buckwheat fields. The developing community apple orchard being managed by the Youth Club has potential as a spring bee forage resource and will need the services of the bees for pollination.

Findings from the ApTibeT study on bee forage in south Humla were as follows:
“The vegetation in South Humla is very similar to that found in Jumla in the higher altitudes, but quite distinct once below c.2000m. Vegetation at these altitudes, being more semi-tropical, was less familiar to the researchers so less detailed information could be gained in the time available. Certainly there is a wide diversity of forage in the area but drought / lack of irrigation limits production of honey in the lower attitudes of Maila VDC relative to the higher altitudes Madana and Kalika VDCs. This was clear from the fact that Maila people have a tradition of trading honey for ghee with people from the higher altitude VDCs. In Ripa, just above the Karnali River at about 2000m, honey yields were much high in the high altitude forest apiary sites than in the village. Similarly in Kargai beekeepers tended to keep their bee colonies in the forest year round rather than carrying them home, because of the greatly increased honey yields of bee colonies placed there.

One species with enormous economic value as a honey plant that is found on the shores of the Karnali River below Jaira, Sri Nagar and to a lesser extent Maila is 'Chiuri' or the Indian Butternut Tree. This species is probably the most copious nectar producer in Nepal and areas where it is prevalent have a thriving honey industry (e.g. Jajarkot lower hills). There is potential to explore the placing of apiaries or for migratory beekeeping into 'Chiuri' areas in order to boost honey production from the southern-most areas of South Humla. Increased production of mustard and placing of bee colonies nearby flowering mustard fields is also advisable to those who want to increase their honey production."

12.3 Pollen analysis of honey samples (Mellisopalynology) as a means of identifying forage sources

If more detailed analysis of the honey samples already taken can be conducted and a pollen slide library established for Humla by collecting flower samples and identifying their pollen, more detailed information on the pollens found in honey could be collected. The slides of honey produced for identification of Humla honeys closely resembled slide of Jumla honey analysed by BEEDECO. This means that the findings of Joshi (1999) on the pollens in Jumla honey may well be applicable to Humla. Joshi found that there were 6 presominant pollen types in Jumla honey. These included:

- Rosaceae including *Malus* type (apple) and *Prunus* spp. – apricot / peach etc, and *Prinsepia utilis, Pyrus pashia, Pyracantha crenulata*,
- Labiatae (especially *Salvia* and *Mentha* species),
- *Brassica* (especially mustard and other wild relatives),
- *Rubus* spp.,
- *Impatiens* spp. and
- Acanthaceae.

Other pollen types identified in Jumla honeys include: Asteraceae, *Taraxacum officinale*, *Rhodoendron* spp., *Pinus* spp., Cucurbitaceae and Zygophyllaceae (Joshi 1999). The pollen from pine species is probably collects on the bees' bodies from the air as they forage in pine forested areas and when they collect honeydew from aphids on pine trees.

12.4 Forage resources as a limitation to beekeeping productivity

Although calculations on the exact number of bee colonies that can be supported by the wild and cultivated forage resources available are impossible to make, we suspect that there is scope to increase the number of bee colonies quite dramatically in both Hepka and Melchham VDCs before forage becomes a limiting resource, particularly in the 1st to 3rd ranking villages. Dinga & Melchham may or may not suffer with lack of forage if beekeeping were to expand very rapidly. However, forage limitation is unlikely to occur in the near future bearing in mind the relatively slow rate at which bee colony numbers are likely to increase even in the face of beekeeping development. Since increases in bee colonies are likely to occur over several years, there is time for programmes of management of bee forage resources with forestation and / or agroforestry to be undertaken together with beekeeping. This could alleviate any shortages of bee forage were these to occur. Mashidhara was the only location with insufficient forage to support development of beekeeping on a medium to large scale. Tree planting and

irrigation programmes in this village would improve its potential for beekeeping enormously.

13 Results relating to local NGOs and CBOs in Hepka and Melchham VDCs

Although it was only possible to spend a few days in each of the VDCs surveyed impressions about the NGOs and CBOs with whom we worked were gained and have relevance to the implementation of a beekeeping programme in Humla through DPP. Generally we were impressed by the level of organisation and the step-wise social mobilisation process being undertaken by DPP and its partners. The two areas of Humla district differed starkly in the nature of the community and the potentialities for community based programmes. This was partly caste-related since in Hepka Bhotia-Lamas are the main caste and in Melchham the dominant castes are (Mongolian-) Chettri (that mainly follow the Buddhist / Lama religion), Hindu Thakuri and occupational castes.

13.1 Hepka VDC as a location for a beekeeping programme

In Hepka VDC there was a strong difference between the villages. In Dinga farmers were relatively uninterested in beekeeping but treated us with respect and were willing to talk to us. In Gadapaari we encountered a high level of social unity and organisation. Unfortunately, due to the death rites for a community member, followed by a village meeting to organise agricultural activities, farmers were too busy to spend much time talking to us. However, we observed the village meeting and the way they organised to manage feeding of guests in the village and were impressed with their level of social mobilisation. As far as we could tell, these village meetings were not the result of the VDP social mobilisation programme but a traditional system already in place. It seemed due to this existing system that social mobilisation in Gadapaari should be easier than in the other communities we came across in Hepka VDC. Lama Gaun, rather than being a separate community, is really the collection of 4 brother's households. The monastery for the community is located with these brothers and, being educated in the Lama teachings, they are responsible for religious rites in the community. Since the farmers of Lama Gaun are particularly respected members of the community it seemed that beekeeping activities concentrated with them would be easily transferred to other members of the community.

In Hepka village most farmers seemed indifferent towards visitors, directing us to the house of the leading woman figure Hetuk Lama. She welcomed us and talked with us but most villagers kept away from the activity. Having visited this village twice and talked in depth with Hetuk on both occasions we found that as one of the richest and entrepreneurial members of the community, that villagers were jealous of her. She complained that they stole the vegetables she grew and tried to spoil any efforts she made to develop the community. We wondered whether, in preference to always liasing with Hetuk if contacts could be made with some of the more 'ordinary' villagers. This might provide more inroads to social mobilisation with Hepka villagers. However problems of alcoholism in the village may still make the social mobilisation process particularly slow and difficult.

In Tangin village, farmers came to talk to us when we arrived in the evening, but were not prepared to give up time to talk to us in the morning, nor to allow us to inspect bee colonies. This contrasted with our reception during the ApTibeT survey where we met

with very cooperative and enthusiastic farmers. One young farmer (Paldung Lama) became quite hostile in the middle of an interview and said that there was no point to our questions and that we never gave any practical help when it was needed. He said they needed medicine for bee disease and proper information about it, not to be asked questions. He also said that he personally believed that it was the fault of foreigners that bee disease had come in the first place. When shown photographs of bee combs demonstrating the various bee brood disease symptoms he got even more impatient. He said that this was also no help and that we obviously knew nothing about bees and the problems facing beekeepers. The interview ended very negatively and unfortunately the farmer with whom we were most interested to talk (a beekeeper called Kaitup Lama with many colonies) walked away, not wishing to be caught up in the discussion. We felt that in the light of this experience and also having met several very drunk men along the road in the middle of the day, that Tangin and Hepka villages would perhaps be a very risky place to start a pilot programme of beekeeping development, despite the very good potential for beekeeping in the area. If any intervention linked with our visit were to fail, such as bees absconding from top-bar hives (which could easily happen in the course of establishing an apiary), this would probably be linked to the visit of the consultant, furthering the bad impression about foreigners and beekeeping development. However when we mentioned the hostility of the farmer to Paldin Tschering Lama (former ward president) he asked us not to mind the behaviour and not to assume that everyone in Tangin was of the same opinion as him. He said that many of the community would be very interested in a beekeeping programme and prepared to participate in it.

13.2 Melchham VDC as a location for a beekeeping programme

In Melchham VDC, the HCDA motivators and the community / CBO members had been well prepared for our visit. In each village we were welcomed with flower garlands and fruit by the mother's group members and in Charigaun, Melchham and Mashidhara a large crowd of villagers collected to introduce themselves to us. Clearly the CBO members had high hopes of learning or benefiting in some way from our visit. Women were much more ready to participate in Melchham VDC compared to other areas of Humla we had visited, presumably because of the social mobilisation work conducted by the 2 female motivators of HCDA in the villages. In each community we were impressed by how much time the villagers gave up to talk to us, conduct PRA exercises, show us beehives and learn candle and cream making, despite the fact that it was harvest time and an extremely busy season.

In Charigaun, certain male beekeepers were extremely interested in beekeeping and wanted to learn as much as possible from us. They were obviously quite experienced and yet ready to take up new ideas.

In Korka, although the CBOs appeared less active than in Charigaun and Melchham, the small group of farmers we worked with were interested and enthusiastic also. We were particularly encouraged by the fact that one male beekeeper from the single occupational caste household was very much encourages to take part in the discussions by the other young men in the village. There seemed to be scope for addressing some of the caste issues in relation to beekeeping with this community.

In Melchham the mother's group and the youth group appeared to be most active of all the CBOs we encountered. The development of a youth club organised apple orchard on community land (around the temple below the village) seemed to be a good precedent

for establishing a community-based beekeeping resource for the purpose of everyone to experiment and learn about top-bar beekeeping. Indeed the orchard site itself might be a good location for a CBO-managed apiary. However, if such a resource were to be developed, arrangements for the care of the bees would have to be carefully made. One or two individuals should be given the responsibility for the colonies in return for payment in honey otherwise nobody would invest time or resources in seeing to them. An alternative idea is to work with developing beekeeping with individual members of CBOs in preference to a community-managed resource.

In Mashidhara the CBOs appeared to be almost as active as in Melchham but were generally less interested in beekeeping.

13.3 Village Development Programme (VDP) local NGO

The VDP is a relatively new local NGO that has only been working with DPP since 2000. Although we did not have time to explore in depth the nature of their programmes and the progress of their social mobilisation programme, we got the impression that the NGO is in a stage of development rather than maturity. The programme coordinator Phunjok Lama is able and enthusiastic but inexperienced in community level work. He was only persuaded to accompany us into the field after some pressure from the DPP staff. The field motivator Ram Chandra Jaisi is a helpful and cheerful individual who is able to get along with community members. However due to caste and language barriers we felt that it was probably difficult for him to really make inroads into Hepka and Tangin village communities. Due to the social problems in Hepka village in particular we felt that VDP is in need of plenty of support and guidance from DPP, if its social mobilisation programme is to be successful.

13.4 Humla Conservation and Development Association (HCDA) local NGO

HCDA has been established longer than VDP and the staff at both the Simikot office level and the field level appeared to be more experienced. The programme officer Dala Rawal had prepared the field motivators for our arrival through a series of letters and everyone we met from the NGO was very enthusiastic about our visit. We observed that despite the remoteness of Melchham from Simikot (3 days walk) that there appeared to be relatively frequent communication between the managers and field staff. The field motivators had a good relationship with their managers and seemed empowered to speak up and explain problems they were facing in the field. As a team the 4 field motivators we met seemed to work quite well, though there was some pressure created by the fact that the two female motivators are both nursing small babies, which renders them slightly less able to undertake strenuous field activities than the men. The two male motivators both have potential to become good beekeeping trainers, especially Dharma Raj Shahi who is already a fearless and quite experienced beekeeper. Relations between the HCDA and motivators in all the villages we visited seemed to be excellent and the extent to which the communities are already socially mobilised is quite impressive. In this sense, especially in allegiance to the aims of HCDA as a conservation organisation HCDA is ready to undertake new beekeeping activities and has the human resources to do so successfully.

14 Discussion

14.1 Problems facing the development of apiculture in Humla at present

On the basis of findings detailed above in section 5 from both the current study and the ApTibeT beekeeping survey, the following main problems can be outlined as affecting production from beekeeping (and honey hunting) in Humla:

i) Starvation of bees during winter and monsoon forage dearth periods.
ii) Declining availability of forage resources associated with deforestation, drought and conversion of forest to agricultural production.
iii) Occurrence of bee diseases (including Thai Sac Brood Virus (TSBV) and perhaps European foul brood), wax moth, Phorid fly, Varroa mite and pests such as hornets, pine martens, bears, lizards and so on.
iv) Declining populations of bees, both those kept in hives (*Apis cerana*) and the wild giant honeybees (*Apis dorsata* and *Apis laboriosa*) that are traditionally harvested by honey hunters (in connection with points i) to iii) above).
v) Inappropriate training and technical support (especially promotion of the movable frame Newton hive which is poorly suited to the conditions in Humla) provided by development organisations that are poorly informed about appropriate technology for and diversified benefits from apiculture.
vi) Lack of awareness of the importance of bees in pollination of fruit, mustard, buckwheat, vegetable seed, beans, etc. with possible resulting yield limitation due to shortage of pollinators.
vii) Lack of awareness about toxicity of insecticides upon bees and resulting bee poisoning from inappropriate insecticide use.
viii) Lack of a market for beeswax and value-added products and unrealised potential in the marketing of honey from Humla (e.g. to tourists visiting Humla or as export from Humla to specialist 'niche markets').

14.2 Ways that apiculture problems could be addressed in a beekeeping programme:

Although not all the problems facing apiculture can be solved by DPP with its broad mandate for addressing developmental issues in Humla, it is useful to look at each of the problems discovered through these studies and think how they could be solved in the ideal situation should the opportunity to do so arise. Hence potential means of alleviating each of the problems listed i) to viii) above is given here below. [Detailed recommendations for DPP's course of action in the near future, whilst overlapping slightly with the section below are provided in the separate and more specific section 9.]

14.2.1 Feeding bees

More important than improving beekeeping technology in the Karnali Zone is the issue of enabling farmers to feed their bees sugar during winter and monsoon forage dearth and periods of disease. Feeding of sugar to prevent bee colonies from becoming too weak can prevent disease and can keep a colony strong such that it gives more honey more quickly once a 'honey flow' starts. This simple management practice can be done equally easily in log as in movable comb hives and the encouragement of farmers to take up bee feeding could dramatically improve the health and productivity of colonies. Since lack of availability and extremely high costs of sugar make it difficult to promote sugar feeding of bees, innovative 'sugar banks' could be initiated with community-

based beekeepers groups to enable beekeepers to feed their bees during periods of disease infestation or starvation. For those who cannot afford sugar and who prefer not to use 'sugar banks', saving of honey, *Pyrus pashia* fruit concentrate (mehel), apple concentrate and sweet pumpkin and limited quantities of tree sap (*Betula*, *Salix* and others) for bee feeding could be promoted.

14.2.2 Agroforestry and forest conservation measures, combined with management of bee forage crops

Agroforestry combines production from trees with cultivation between the alleys of trees or in the tree under storey. If fruit trees and other bee pollinated crops are planted, beekeeping combines extremely well with agroforestry, leading to increased yields from the trees and crops as well as increased honey yields. In areas of forest plantation or where forest is being conserved, placement of bee colonies could provide revenue from the land when no other benefits can be gained. If a wide diversity of flowering trees and shrubs are grown in the agroforestry system a seasonal succession of bee forage can be provided in areas that were previously less valuable to bees. A list of suggested tree species to grown in agroforestry systems at altitudes above 2500m is given in Appendix 12. In addition to or in combination with agroforestry, buckwheat, mustard and other honey yielding crops can be grown around apiaries in order to improve honey production.

14.2.3 Awareness raising / education about bee diseases and ways to control them

Although currently bees probably die more from negligence than from disease in Humla, diseases such as TSBV and European Foul Brood could become increasingly problematic, as experiences from Jumla have shown (Saville in press[2]). Bee diseases can be ameliorated greatly by the maintenance of strong, well-fed colonies of bees. Simple management practices combined with feeding can lower incidence of disease greatly. Training farmers how to detect and diagnose disease and how to prepare herbal decoctions of locally available herbs, which can be mixed with sugar to treat brood disease, would be a crucial component of any beekeeping programme in Humla. Details of a herbal decoction for treating bee disease is given in Appendix 13.

14.2.4 Multiplication of selected disease resistant and high yielding colonies of Apis cerana

Introduction of appropriate technology log top-bar hives and providing training in colony multiplication could lead to production of strains of Apis cerana with high honey yielding and low disease susceptibility characteristics. This is the best long-term solution to problems facing beekeepers and may lead to a market for bee colonies from outside the district as well as within it. However, changes in honey harvesting and processing should take priority to this with most beekeeping communities at first. Specialist beekeeping of this kind being reserved for local beekeeping entrepreneurs and NGO staff rather than farmers who may be too busy or not sufficiently motivated to undertake such activities.

14.2.5 Changes in honey hunting practices with Apis dorsata and Apis laboriosa

Although indigenous honey hunting practices with giant 'rock bees' or 'forest bees' in the past may have been sustainable, now populations are declining. Current honey

hunting practices in S. Humla usually involve destruction of the entire nest including brood combs and result in absconding of colonies. Promotion of methods that harvest small quantities of honey without destroying the brood (as practiced by Bhum Lama in North Humla) amongst hunters in S. Humla might be appropriate. Alternatively, a programme of awareness raising could be conducted on the importance of protecting the few colonies that still migrate into Humla such that production can be again increased in future.

14.2.6 Introduction of appropriate technology that Humla farmers accept

Interviews with Humla farmers showed that all those who had received training in movable comb beekeeping using Newton hives (boxes with frames inside) considered the hive too expensive, difficult to build and use, and lacking in insulation and protection for the bees. Most are happy with their fixed comb log hives that open by removing a plank from the rear side. When the concept of the Jumla Top-Bar Hive (that Jumla farmers prefer) was introduced many Humla beekeepers responded positively to the idea.

If movable comb hives are to be introduced, demonstration resources with bee colonies being managed properly in the hives need to be established as a first priority. This could be done by local NGOs in their field areas or by lead beekeepers. The latter would be trained as farmer-trainers to train other members of the community as the programme progressed. Training in improved management of bees in JTB hives with regular farmer-led extension support in the first years of colony establishment would be needed to ensure successful uptake of this technology in Humla. However this should only be attempted after groups of entrepreneurial beekeepers are enthusiastic about changing their technology having seen demonstration hives working.

14.2.7 Training and extension for farmers and development organisations in diversifying benefits from apiculture

In addition to training and extension support to entrepreneur beekeepers that want to take up improved bee colony management in top-bar hives, training and extension in how to diversify benefits from apiculture should also be a focus of beekeeping development in Humla. This could start with simple improvements to traditional harvesting practices so that honey quality can be maintained without having to boil honey as is currently practised.

Health benefits from apiculture could be promoted through ‘apitherapy’ or the therapeutic application of bee products. Owing to the enormous application of bee products in general first aid and treatment of common ailments there is scope for institutionalising apitherapy in the form of community based health clinics. These could be organised on the basis of using traditional healers and or beekeepers as practitioners. Training in medicinal application of honey, beeswax & pollen, and in bee sting therapy, could make a positive impact on the health of Humla communities. In the case of bee sting therapy, training in how to deal with allergic responses, especially anaphylaxis would need to be prioritised. However, on the basis of responses of Humla and Jumla farmers to the technique there is a very strong case for promoting this form of alternative medicine (Saville in press[1]).

14.2.8 Introduction of managed crop pollination together with vegetable seed, fruit, oil seed and buckwheat production

Specialists have proved that global economic benefit from pollination is higher than that from honey production. This benefit of beekeeping is often neglected or undervalued. In Humla, vegetable seed, apple, peach and apricot, mustard, buckwheat, maize and other flowering crop production depends on bee pollination. Whilst to date pollination has not been limiting in the area, yield and quality can be increased by managed crop pollination using bees (Partap 1999, Partap and Partap 1997).

Farmer participatory action research into the benefits of managed crop pollination could be conducted by organising simple trials in farmers' fields with and without extra bees provided to plots of buckwheat, mustard, apples and peaches. Yields of the crop and of honey could be compared between areas and the effect of managing pollination assessed together with Humla farmers. Should the trials suggest that crop yields are indeed increased, a district-wide farmer-led extension system to support the promotion of managed crop pollination could be initiated.

14.2.9 Introduction of organic pest control management methods that are safe for bees yet help to ensure agricultural production

Before chemical insecticides are introduced into Humla on a large scale, alternative organic pesticides that use locally available herbs should be developed and promoted that are safe to apply near bee colonies.

14.2.10 Market facilitation

Aside from producing honey and beeswax candles and creams for home consumption, these products have enormous potential for micro-enterprise. Being non-perishable, low in volume and high in value, bee products have potential as export produce from Humla as well as in local markets. Demand for honey is higher than production in most of Nepal and prices can be good even on local markets. Value addition to beeswax can greatly increase the profit from it (Saville 2000b).

Any beekeeping intervention in Humla should facilitate marketing of bee products to deal honey, beeswax and value-added products to tourists and office workers within Humla and to fair-trading dealers / exporters in Nepalgunj and Kathmandu. With improvements in packaging and product hygiene, larger profits for Humla producers should be possible to guarantee, which could impact on the poorest sectors of Humla society. However, since currently traders with power and influence in Humla society tend to control markets, co-operative marketing may be difficult to achieve and would need to be handled very sensitively to be successful.

15 Conclusions

The general conclusions of both the current September 2000 DPP study and the April 2000 ApTibeT feasibility study may be summarised as follows:

- Beekeeping with *Apis cerana*, using square cross-section traditional log hives that open from one long side is very widely practised throughout Humla district and is concentrated amongst Thakuri, Chettri and Lama caste people.

- Women beekeepers are quite common, especially amongst the Lama caste, and there is generally interest amongst Humla women in expanding beekeeping as a form of livelihood. Menstrual taboos, lack of time, and gender inequity in Hindu communities have limited women's participation in beekeeping to date.

- Occupational caste people generally keep bees less than Thakuri, Chettri, Brahmin and Lama castes, but are not entirely excluded from beekeeping.

- In the remote corners of the district where bee forage resources have not been too depleted as yet, beekeeping ranks as one of the most economically beneficial livelihood sources for Humla people. Areas such as Dozjam in Thehe VDC, Lama Gaun, Tangin and Hepka in Hepka VDC and Nepka in Sri Masta VDC are renowned throughout the district for their high honey productivity. These areas are all located in secluded relatively high altitude valleys with low population density, high natural pasture and forest to cultivated land ratio and abundant water resources for bee forage.

- Honey hunting from *Apis dorsata* or *Apis laboriosa* is not practiced widely in North Humla but has a strong tradition in South Humla. Harvesting practices are generally destructive to colonies and the honey harvested is often poisonous (probably from *Rhododendron* sp.).

- Bee populations and honey yields of all bee species found in Humla have probably declined since more than 5 years ago and continue to do so. However, populations have probably increased since the Thai Sac Brood Virus epidemic, which wiped out most of the bees in the district between 1985 and 1990. There is little reason to believe that there has been any serious epidemic of bee disease in Humla since the TSBV epidemic between 1985-1988.

- The local *Apis cerana cerana* subspecies is higher yielding in honey than the low altitude subspecies and there is a call for its conservation.

- Bees die of starvation in Humla during winter and monsoon periods. Although feeding practices exist for over-winter survival and to boost bees in spring, the quantities of sweet substances may be too small for bees to survive. The lack of feeding practice during monsoon dearth periods probably limits honey production and bee population growth quite severely.

- Bee diseases, such as wax moth, *Varroa*, *Phorid* fly and perhaps also Thai Sac Brood Virus, are found in Humla and may destroy colonies already weakened by lack of food. The relative importance of disease as opposed to bee starvation was hard to determine, but since no severe outbreak of disease was detected it was

concluded that most bee colony deaths and disease probably result from poor nutrition first, followed by invasion of pest and disease organisms.

- Local NGOs and governmental organisations have failed to make positive changes to beekeeping practice so far due to use of inappropriate technology and approach. The Newton frame beehive commonly promoted by governmental and non-governmental organisations has been proven to be too cold and too expensive for Humla beekeeping conditions and follow-up technical extension support to farmers that have tried to manage bees in frame hives has been insufficient for the technology to be successfully used.

- Beeswax and pollen are under-exploited resources with potential in livelihood enhancement and micro-enterprise.

- Traditional honey harvesting and processing practice, especially mixing sealed & unsealed honeycombs and also sometimes brood combs and subsequent boiling of honey, leads to low quality honey.

- However, the traditional practice of harvesting and processing raw honey comb (separate from that which is cooked) leads to honey woith low water content and high enzyme activity. If carbon particles and dust contamination can be controlled, traditional raw honey harvesting and processing can lead to superb honey quality.

- Indigenous knowledge as to the use of honey for medicine, and about management of bees in the local conditions, is rich.

- Local markets exist for honey and to a lesser extent for beeswax, but these are under-exploited to date. Prices for honey are higher in North than in South Humla and market outlets to workers in Simikot and to tourists coming on trekking routes are numerous.

- A rich diversity of bee forage exists throughout Humla and in certain areas appears lead to exceptionally high honey yields from *Apis cerana cerana* (e.g. Hepka VDC). However drought, deforestation and environmental degradation has led to such severe loss of bee forage that certain areas that were previously good for beekeeping have become less so (e.g. Bargaon in N. Humla and Maila in South Humla).

- Humla people were open to and enthusiastic about diversification of benefits from beekeeping such as candle- & medicinal skin cream- making from beeswax and application of bee stings to treat arthritis.

- Several local / international NGOs and governmental institutions are interested in assisting Humla communities to develop beekeeping as a form of livelihood enhancement. These include: USSCN, DPP, Nepal Trust; Local NGOs such as Women's Welfare Society, Humla Conservation and Development Association, Snow land Integrated Development Centre; and Village Development Programme. Also governmental organisations such as the Cottage Industries Office and the District Forestry Office (DFO) have an interest in promoting beekeeping and may implement programmes in future.

- Existing local institutions in Humla currently appeared to lack capacity to manage without outsider support in the form of funds and managerial guidance. 'Bottom-up' farmer–led organisations that are based on participatory processes were not encountered outside DPP field areas and even those in Hepka and Melchham are at a very young stage. Of all the areas surveyed, Melchham VDC farmers had the highest degree of social mobilisation, whereas in Hepka VDC social problems (e.g. alcoholism) lead to problems in the social mobilisation process.

- Inappropriate spending / utilisation of DDC and VDC resources was a common complaint amongst Humla villagers.

Conclusions with specific reference to the DPP programme and its partner NGOs Humla Conservation and Development Association (HCDA) and Village Development Programme (VDP) and their respective field areas of Melchham and Hepka VDCs, with respect to implementation of beekeeping activities, may be summarised as follows:

- Hepka VDC has very high productivity of honey and numerous bee colonies as well as relatively high honey prices. Beekeeping appears to be a very important income generating activity in the area.

- Melchham VDC has lower honey productivity, fewer bee colonies and lower honey prices. However beekeeping ranked as a very important activity for farmers, especially in Charigaun and Korka and to a lesser extent Melchham.

- HCDA appears to be a relatively mature and experienced organisation out of the local NGOs found in Humla. The state of their social mobilisation in Melchham VDC is more advanced and showed more positive signs of progress than in Hepka VDC. Their experience in marketing of NTFPs could be valuable in making market connections for beekeepers.

- The HCDA field motivators in Melchham, Mimi and Darma VDCs seemed relatively experienced and enthusiastic about their work and the Mother's groups in each village we visited in Melchham VDC seemed to be particularly active and empowered relative to other areas, so they are ready to start a new enterprise like beekeeping. In Melchham village the youth club has made impressive progress in developing a community orchard, which has potential as a village apiary site.

- VDP appears to be a very new and inexperienced organisation with a tough task ahead of it, if it is to make progress in Hepka VDC. Problems of alcoholism and theft are a problem in Hepka VDC, especially in Hepka village itself. This and the placing of a Brahmin field motivator with little working knowledge of the Lama language makes it difficult for the social mobilisation process to proceed. However, beekeeping indigenous knowledge is very rich and may mean that beekeeping is worth developing in the area in preference to other enterprises.

- VDP management appeared to be less experienced and less enthusiastic than HCDA management. This meant that data collection was much easier in Melchham then in Hepka VDCs.

- Within Hepka VDC however the village of Gadapaari with the associated Gompa (Lama Gaun) appeared to be quite advanced in terms of social mobilisation and community unity and organisation.

16 Recommendations

The authors suggest that DPP takes the following actions with reference to beekeeping development in the field areas of their partner NGOs.

i) Focus activities in the following villages:

Hepka VDC - Lama Gaun (and Gadapaari) 1st choice;
- Tangin 2nd choice (but only if responsive farmers can be motivated to take part)
[- The community in Dinga has little interest in beekeeping and despite excellent beekeeping habitat in the area of Hepka village, problems of alcoholism and lack of social mobilisation are likely to lead to problems.]

Melchham VDC - Charigaun 1st choice in terms of beekeeping habitat, especially forage resources;
- Korka 1st choice in terms of having a small coherent community and occupational caste participation;
- Melchham 1st choice in terms of social mobilisation, the mother's group and youth club are active and enthusiastic to take up new activities.
[- The community in Mashidhara has less interest in beekeeping and due to shortage of water resources is lacking in available forage for bees.]

If only one VDC is to be selected, DPP and its partners should decide whether social factors or natural resources are more important to the success of the initiative. If beekeeping potential is evaluated on the basis of bee forage resources, current bee populations and their productivity then Hepka VDC has more potential than Melchham VDC as a beekeeping centre for Humla district. However, if farmer's attitude and the state of social mobilisation are considered to be most important to the success of any new initiative, then Melchham VDC has far more potential than Hepka. If proximity to Simikot for supervision purposes is the priority, then Hepka VDC must be selected in favour of Melchham, but this decision should only be taken if support of VDP in social mobilisation of Hepka communities can be provided.

ii) Having selected which communities to focus upon, identify traditional beekeepers and amongst them which are entrepreneurial farmers or local 'experts' in beekeeping (names of farmers, the numbers of bee colonies they have and the kinds of honey yields they achieve are provided in Appendix 4b for reference).

iii) Having divided beekeepers into a large group of traditional beekeepers and a smaller group of beekeeping entrepreneurs, provide training on 2 levels:
Basic level = improvement of traditional beekeeping practice;
Expert level = improvement of beekeeping through use of top-bar technology.

iv) Having identified expert beekeepers, who have a strong interest in beekeeping and already devote time to it, select demonstration apiary sites and

host beekeepers for pilot trials of Jumla Top-bar hives. Suggested locations on the basis of the current study are:

- Hepka VDC: *Lama Gaun* (and Tangin if budget constraints and staffing allow);
- Melchham VDC: i) *Charigaun* with experienced and enthusiastic traditional beekeepers; ii) *Korka* (especially with Tulaya Sarki and other young men); [iii) Melchham Youth Club – on their apple orchard site, if budget constraints allow.] Since villages are close together in Melchham VDC and HCDA field motivator Dharma Bahadur Shahi already has experience of beekeeping, staffing should not be a problem. A strategy of 50% women's participation and priority for occupational castes should be adopted, in line with DPP's priority target women and disadvantaged groups.

v) In order to ensure that 50% of the people involved in new opportunities associated with beekeeping are women, gender awareness activities will need to be linked to the beekeeping programme. Care will need to be taken to select interested women who can make time for extra activities. To start with women from households that already have bees or women who express particular interest to start beekeeping as a new enterprise should be given priority. Women can enlist the help of the men of their households to help look after the bees at times when other duties have to take priority (e.g. rice planting, weeding of crops, harvest, etc.). It is important to discuss with women only groups to help them identify their main interest. Some may choose to undertake beekeeping work at every stage (including hiving swarms, inspecting and feeding colonies and other management) but others may prefer to let the men manage the bees and work on bee product processing and value addition during the less busy winter months instead. Lama women may be more interested to take full responsibility for beekeeping because of the high levels of migration amongst their men folk, but Hindu caste women, already overloaded with too much to do, might prefer the men to continue their role as main practical beekeepers. Certainly hive-making could remain a male domain and save women the burden of more work.

vi) Topics to be included in the two training levels are listed as follows:

BASIC LEVEL TRAINING IN IMPROVEMENT OF TRADITIONAL BEEKEEPING PRACTICE:

- Improved harvesting from log hives;
- Improved processing of honey (without cooking);
- Improved processing and value addition with beeswax (including candle-making and skin cream preparations);
- Methods of using pollen as a nutritional supplement;
- Medicinal applications of bee products (including uses of honey, pollen and beeswax and bee venom therapy);
- Marketing ideas for honey, beeswax products and beekeeping equipment;
- Feeding of bees – using honey, sugar syrup and other local alternatives- including discussion of the feasibility of 'sugar banks';
- Recognising bee disease;
- Herbal medicines for bee diseases;
- Work division within the bee colony – role of workers, queen and drones;
- Understanding bee lifecycle and reproduction;
- Control of swarming;
- Control of absconding;
- Understanding queenlessness and its implications

- Pests of bees and their control;
- Hygienic beekeeping practices;
- Principles of pollination.
- Managed crop pollination methods;
- Organic pest control methods;
- Health and safety with regard to insecticide use.

IMPROVEMENT OF BEEKEEPING THROUGH USE OF TOP-BAR TECHNOLOGY

- Adaptation of local square log hives to top-bar hives by addition of top-bars;
- Transfer of bee colonies from log hives to top-bar hives;
- Swarm catching and hiving of swarms in top-bar hives;
- Fearless handling of bees;
- Management of bee colonies in top-bar hives;
- Inspection of bee colonies to assess the health and condition of the bees (this includes recognition of worker, drone and queen brood, identification of eggs, larvae, pupae, pollen and honey);
- Division of bee colonies (to avoid swarming);
- Control of worker laying;
- Bee diseases – recognition of symptoms of major diseases found in Humla;
- Control of diseases through use of bio technical methods; herbal medicines and appropriate application of antibiotics;
- Bee feeding including discussion of the feasibility of ‘sugar banks’;
- Honey harvesting from top-bar hives.

vii) Training should NOT only be in the form of a 5-day or 7-day course in Simikot. Training of this kind outlined above needs to be practical with ongoing extension support in relation to the problems that may arise for beekeepers through the beekeeping season. Where possible training courses should be held in the communities where the beekeepers live using locally available resources, rather than in Simikot, where practical work would be difficult.

viii) The issue of giving incentives to farmers who attend training is a difficult one. It appears that all NGO and GO training courses in Humla provide farmers with allowances of around Rs200 per day. Whether this practice should be continued, especially in the field when training is given within the farmers’ own village, is a contentious issue. Where possible, incentives in terms of beekeeping equipment, sugar for bee feeding, seed for vegetable growing or vegetable seed production should be given in preference to cash. Suggested items of beekeeping equipment to be distributed are: bee veil - cum - swarm bag, queen gates, top-bars for fitting in existing hives, honey and beeswax processing materials such as knives, straining cloths / bags, buckets for honey and so on. In order for the training to be really appreciated, a farmers’ contribution could also be demanded from every training participant. This could be a commitment to contribute a proportion of their honey harvest to starting a ‘sugar or honey bank’ for feeding bees in their community. Additionally, a labour contribution could be given by making hives for a community apiary (e.g. to be established at Melchham Youth Club’s apple orchard).

ix) A suggested suitable programme of training and extension for a pilot beekeeping programme would be as follows:

- *Late Feb 2001:* Expert beekeepers' training in top-bar making and conversion of old hives to top-bar hives with a sub-set of beekeeping entrepreneurs (with whom demonstration apiaries are to be established);
- *Early Mar 2001*: establish contracts for the preparation of top-bar hives for demonstration apiaries with expert beekeepers;
- *Mar 2001*: Basic beekeeping training for both traditional beekeepers group(s) and entrepreneurs group(s);
- *Apr 2001:* Expert level training in improvement of beekeeping through top-bar technology to entrepreneurs group. Preparation of demonstration apiary sites and transfer of bee colonies from traditional to top-bar hives should be included at the demonstration apiary sites as part of this training;
- *Apr – May 2001*: Entrepreneur beekeepers' field visit to Jumla to view Jumla Top-bar hive, beeswax processing enterprise and apiaries of active beekeepers' groups. [If budget and time constraints allow it combine this Jumla visit with a trip to Jajarkot Permaculture Programme site in Gumi, Surkhet and a 3-5 day training in sustainable pest management and agroforestry methods there.]
- *May – June 2001*: Hiving of swarms, division of colonies and routine inspection and bee disease control in top-bar hives in demonstration apiaries;
- *June 2001*: Exchange visits of farmers between apiary sites to compare progress of demonstration apiaries;
- *Mid-July to late August 2001*: Supervisory visits by beekeeping technicians to beekeepers, especially demonstration apiary sites to detect and treat bee disease and starvation;
- *Sept – Nov 2001*: Practical training in improved honey harvesting, honey hunting, honey and beeswax processing and storage with all traditional beekeepers and expert beekeepers;
- *Nov-Dec 2001*: Practical beeswax processing and value addition (candle making, skin cream preparation, shoe polish and furniture polish making) with all traditional beekeepers and expert beekeepers;
- *Dec 2001*: Market exposure tour for selected female and male beekeepers to Kathmandu with their products and associated training on marketing activities.
- 2002 onwards - repeat activities of 2001 with new groups as appropriate;
- continue to provide regular extension support to all beekeepers involved in the previous year's programme, especially demonstration apiary holders.
- From 2002 onwards a phase over of the DPP organised programme in beekeeping would need to be done to ensure more sustainable technical support in beekeeping after the end of DPP. For this government line agencies such as the District Agriculture Development Office (DADO) with their new Karnali Special Project and the Cottage Industries Office should be involved from the beginning of the programme, as well as the 4 local NGOs that are working with DPP. If various organisations can be trained in improved honey harvesting and processing as well as beekeeping using thre Jumla Top-bar Hive, they can continue to support Humla communites after DPP withdraws. It may be necessary for these local organisations to seek extra funding for a longer-term beekeeping programme for the district with other donor organisations. Currently such a beekeeping project to be conducted by ApTibeT is under appraisal by DFID. However, to date no guaranteed funding for any other organisation to promote beekeeping in Humla district has been located.

x) Involving female motivators in beekeeping activities

Although women farmers in Humla expressed interest in taking up beekeeping, currently there are no women within the DPP partner NGOs experienced enough to provide training and extension to women beekeepers. This is a problem since women to women training and extension is usually most effective. Hence we recommend that the two female motivators in Melchham and any other women motivators in the DPP partner NGOs in Humla are involved in the Nov 2000 workshop in Simikot and also in subsequent beekeeping programme activities in 2001. Experiences in Jumla showed that if women motivators can lose their fear of bees and handle them with confidence, women trainees are quick to follow step.

xi) Human resources for training and extension in Beekeeping in Humla.
Because of the 5 years activity of the consultant in Jumla, experienced and well-trained human resources exist there for the promotion of beekeeping methods outlined above. Through collaboration with the ICIMOD beekeeping extension worker Satananda Upadhaya (previous counterpart to the consultant), the current research associate Narayan Acharya and the president of Surya Social Service Society (4S) Jumla Mr. Karma Budha and his staff, experienced trainers and extension workers in beekeeping should be accessible. It is suggested that for theoretical training and supervision one or two out of the three named individuals be used (they are listed in order of preference). For motivation of women-only beekeepers groups the lead woman trainer Ganga Pande (currently employed by NARMSAP in Jumla) could be used on a short-term consultancy basis. She is familiar with the dialect used in South Humla and would be able to assist the female motivators of Melchham to become fearless beekeepers. For extension support on a week-by-week basis during this first season of top-bar beekeeping in Humla it is suggested that one junior yet experienced beekeeping extension worker from Jumla be employed each for Hepka and Melchham programmes (assuming pilot programmes are taken up in both VDCs) for 7 months from April – October inclusive. The consultant could assist in training and make supervisory visits to the field sites at crucial points if budget constraints allow.

xii) Provide HCDA motivators (especially JTA level qualification staff) and possibly also motivators from VDP in Hepka with training in Permaculture methods (at the Jajarkot Permaculture Programme training centre in Gumi, Surkhet). This will provide practical answers to improving bee forage, bee habitat management, and organic methods of pest control and limitation of insecticide use, thereby improving the chances of increasing beekeeping production. At the same time, motivators would acquire knowledge in new sustainable agricultural methods for improving soil fertility and increasing / diversifying production, thereby strengthening their agricultural support programme. In November a 15-day Permaculture Design course is usually run by JPP in Gumi (suitable for JTA educational level motivators, female motivators and more experienced educated farmers) and a 5-day Farmer’s Permaculture course (suitable for less educated farmers) is usually run in February.

xiii) Assist farmers to solve the problem of sugar supply for feeding bees by one or a combination of the following:

- Encourage farmers to save honey remains, cooked honey and any other poorer quality honey and to feed this to bees as necessary, especially in the monsoon when traditionally no feeding is practised.

- Encourage farmers to harvest honey selectively and in limited quantity from the strongest colonies of bees in June and to feed this to weak colonies during the monsoon. This honey may need to be heated if the water content is too high.
- Encourage beekeepers to collect 'mehel' fruits in larger quantity than before and prepare plenty of fruit concentrate for feeding bees, also persuade them to keep some of this concentrate until the monsoon so that bees can be fed then as well as in winter and spring;
- Encourage farmers to keep sweet pumpkins aside and to feed them to the bees in winter more frequently than before.
- Encourage farmers to collect limited amounts of silver birch and possibly other tree sap for feeding bees. This can be collected by making a gash in the tree bark and arranging a container to collect the sap that seeps out. However, this practice should be limited such that the trees are not damaged.
- Establish 'sugar banks' amongst beekeepers groups so that sugar is available to beekeepers when they need it. This would involve beekeepers raising say Rs5 per week for the sugar bank and sugar being purchased with the money raised. Then if a beekeeper needed sugar they could borrow it on a per cup basis but would have to repay it with interest of 1 handful of sugar per week, or some such similar system. It would be sensible if the NGO field motivators had a sugar store to assist farmers in obtaining sugar as necessary, however it is suggested that the sugar is dyed a bright colour and that it is said to be toxic to humans, to avoid loss of the sugar in other purposes. This system was used in Tanzania with some effect (Svensson pers. comm.).

xiv) In order to help beekeeping entrepreneurs to make more economic gain from beekeeping, establish market facilitation for honey and beeswax products. HCDA, with its associated Herbal Processing Industry is in a good position to take up this role with farmers. It would be useful if HCDA in Humla and The Beeswax Processing Centre (BPC) small industry in Jumla could join forces to create market support for Karnali Zone farmers. A Karnali zone store-cum packaging unit for bee products, herbs and herbal products could be established in Nepalgunj and jointly run by HCDA, BPC and potentially other Karnali Zone organisations.

xv) Guidelines for improved marketing of bee products from Humla are as follows:
- Train farmers to improve harvesting by reducing use of smoke and not harvesting brood combs;
- Train farmers to improve processing and storage of honey by separating sealed and unsealed honey combs, pollen and brood, only using sealed raw honey combs for honey to be sold. All containers must be dry and clean and all sources of dust and soot contamination should be minimised.
- Clean and non-breakable plastic honey jars should be acquired by local NGOs or by beekeeping enterprise entrepreneurs who buy raw honey from farmers at a good price. Honey should be filtered and bottled in clean dry jars away from soot and dust contamination.
- For each beekeeping enterprise or for a Humla honey cooperative organisation that might arise from the programme an attractive and informative label should be designed and every jar of honey should be labelled.
- Samples of the bottled honey should be analysed and checked for water content and other indicators of quality, perishability and purity and then a 'certificate of excellence' drawn up on ths basis of this evidence.

- Market outlets should be established in Simikot and along the Simikot-Hilsa trail for North Humla beekeepers. Similarly, Market outlets in Kolti (Bajura), Ghumgadi (Mugu) and with the Beeswax Processing Centre in Jumla should be explored for South Humla beekeepers.
- If niche market buyers can be accessed, who will but Humla honey at inflated prices, there may also be scope for HCDA or another beekeeping cooperative organisation to sell honey outside the district in Kathmandu or even in international markets. [This should only be attempted however if fair trade standards can be maintained such that increased profits reach the Humla beekeepers and if honey production can be increased.]
- A similar process could be undertaken with beeswax products such as skin creams and candles as outlined above for honey but market research is more necessary in this instance since there is not a well established market for beeswax products as there is for honey. We strongly recommend that Humla beekeepers work together with or learn from the Jumla BPC if beeswax enterprise is undertaken, since BPC is working hard at developing market outlets for Karnali Zone beeswax products and may be able to buy Humla raw materials or ready made products in bulk to sell on.

xvi) A step-wise guide for establishing a beekeeping enterprise could be taken up by the programme as follows:

- If the enterprise is being undertaken by a new beekeeper the first step is to acquire hives. The entrepreneur should learn to make top-bar hives by adapting old hives or building new ones and should acquire at least one log hive for baiting. Two top-bar hives are needed at the outset so that the beekeeper is ready to divide their initial colony.
- The beekeeper should take training in beekeeping around the time of acquiring their first colony or just before the start of the beekeeping season.
- Old log hives and new top-bar hives should be baited and placed strategically according to the indigenous knowledge of the area to catch swarms during the swarming season. Once a swarm has been captured the beekeeper needs to care for it by inspecting it regularly and feeding it at times of forage dearth.
- If the entrepreneur has the capacity buy or exchange a swarm or colony of bees s/he should try to get a colony in March or early April as a starter colony and this should be placed in a top-bar hive if possible. If top-bar hives are used the beekeeper can later divide the colony without allowing it to swarm. If traditional log hives are used the beekeeper must know how to identify the signs of swarming and how to catch and hive swarms. Colonies should only be divided if they show readiness for swarming. If divided colonies are too weak during the monsoon they should be reunited to form one strong colony in preference to two weak ones.
- During the monsoon period beekeepers should learn to recognise when the bees are starving and to feed their bees with honey, sugar syrup or sugar substitutes.
- At the end the end of the autumn honey flow honey should be harvested only from those colonies that are strong and can spare honey and still survive the winter. The beekeeper should be trained in improved harvesting and processing as a first priority and should follow the guidelines on NOT cooking honey and of reducing water, soot and dust contamination very strictly.
- Market outlets for honey are likely to be available locally, but if possible new entrepreneurs should be encouraged to look for means of increasing their

profit margins by selling clean, strained honey in jars if possible, keeping the filtered wax to make skin creams and candles either for home use or for sale.

- The entrepreneur should be encouraged to realise the importance of having few strong bee colonies in preference to many weak colonies. Strong colonies are much more likely to yield honey than weak ones, are less susceptible to disease and more likely to survive over winter.
- During the winter the entrepreneur should ensure that her / his bees are well fed and insulated against the cold.
- Also during the winter and following spring, preparations for the coming beekeeping season need to be made. New hives should be built ready to increase the apiary in the coming season and hive bait and bee feed should be prepared in advance when the materials are available.

17 References

Allen, M.F. 1994. A practical manual for the diagnosis of honeybee pathogens. (Unpublished report of Rothamsted Agricultural Station UK.)

Banskota, M.; Sharma, P.; Sadeque, S.Z.; Bajracharya, B., 1997. Districts of Nepal – indicators of development. Kathmandu: ICIMOD.

Central Bureau of Statistics, 1995.

Evans, Chris. 2000. Report of a Field Visit to Humla 6-17 March 2000.

Gregory, P. 1999. A beekeepers guide to foul broods or healthy bees are happy bees. Paper published in a British Beekeeping Magazine.

Hudson, K.; Roos, B., 1994. Kharpel Village Humla District. A baseline study. SNV / WID Survey. 39 pp.;

INTERFACE, 1991. Socio-economic baseline study of the project area of Women in Development at Humla (Baraunse and Piusa). Report submitted to SNV-Nepal and TBBP, SNV-Nepal. 67 pp.;

Joshi, S.R. 1999. Physico-chemical and melissopalynological characteristics of Nepalese honey. Ph.D. Thesis submitted to the University of Agricultural Sciences, Vienna, Austria.

Joshi, S.R.; Pechhacker, H.; Willam, W.; von der Ohe, Werner, 2000. Physico-chemical characteristics of *Apis dorsata, A. cerana* and *A. mellifera* honey from Chitwan district, central Nepal. Apidologie 21, 367-375.

Kharel, B.P.; Thapa, R.B.; van Dijk, N.; Laats, H.; Basnyat, B.B. 1996. Learning from people. Natural Resource Management Systems in Humla and Kalikot districts. Nepalgunj: Karnali Local Development Programme SNV- Nepal. 91 pp.

Partap, U. 1999. Managed Crop pollination – a trainers' manual. ICIMOD;

Partap U. and Partap, T. 1997. Managed crop pollination: the missing dimension of agricultural productivity in the mountains. ICIMOD discussion paper series no. MFS 97/1.

Pongthep, A. 1987. Honeybee diseases and enemies in Asia: a practical guide. FAO Agricultural Services Bulletin 68/5.

Saville (in prep.) Bee forage and medicinal plant species of Jumla district.

Saville (in press[1]) Apitherapy in community based health care in remote West Nepal. In Proceedings of 7th IBRA / 5th AAA conference held in Chang Mai Thailand 19-25 March 2000.

Saville (in press[2]) Battling with bee brood disease in Jumla, West Nepal. In Proceedings of 7th IBRA / 5th AAA conference held in Chang Mai Thailand 19-25 March 2000.

Saville, Naomi M., 2000a. "Farmer-participatory extension in Jumla, Western Nepal." In *Asian Bees and Beekeeping: Progress of Research and Development.* pp. 230-236;

Saville, Naomi M., 2000c. Getting a buzz out of participation. Participation Vol. 1. (1) pp. 3-8. (NEPAN, Kathmandu, Nepal);

Saville, Naomi M., 2000b. “Small-scale beeswax processing in Remote Western Nepal.” In *Asian Bees and Beekeeping: Progress of Research and Development.* (Eds: Matsuka, M. et al.) pp. 155-158. New Delhi: Oxford and IBH

Saville, Naomi M., Upadhaya, S.N. and Acharya, N.P. (in press) Farmer-Participatory Action Research into Bee hive design in the remote area of Jumla, Nepal. ICIMOD.

Saville, Naomi M.; and Upadhaya, S.N., 2000 “Indigenous knowledge of beekeeping in Jumla, Western Nepal.” In *Asian Bees and Beekeeping: Progress of Research and Development.* (Eds: Matsuka, M. et al.) pp. 248-251. New Delhi: Oxford and IBH.

Saville, N.M.; Upadhaya, S.N.; Shukla, A.N.; and Pradhan, Sushil, 1999. “Effect of hive design on internal hive temperature: a new application of data loggers.” In *Asian Bees and Beekeeping: Progress of Research and Development.* (Eds: Matsuka, M. et al.) pp. 248-251. New Delhi: Oxford and IBH.

Shimanuki, H., Knox, D.A. 1991. Diagnosis of honey bee diseases. US Department of Agriculture. Agriculture Handbook no. AH-690. pp 53.

Shrestha, M. 2000. Physical and chemical propoerites of Nepalese honey. .” In *Asian Bees and Beekeeping: Progress of Research and Development.* (Eds: Matsuka, M. et al.) pp. 137 - 139 New Delhi: Oxford and IBH

Shukla, A.N. 2000. Beekeeping Trainers’ Resource Book (in Nepali). ICIMOD. Kathmandu.

Verma, L.R. 1998. Genetic diversity of Himalayan Honeybee *Apis cerana* F. ICIMOD.175 pp.

Verma, L.R., 1992. “Declining genetic diversity of *Apis cerana* in Hindu-Kush Himalayan region.” In Asian Apiculture. (Ed. Connor L.J. et al.) pp. 81-88.

18 Appendices

18.1 Appendix 1. Terms of Reference

Bee health study and workshop
Humla district

Introduction
During MA&D held in Melchham, bee keeping was identified as a possible source of income for local people. A similar MA&D is planned in Hepka VDC.
Based on this interest expressed by local people, DPP has decided – following expert advice from Naomi Saville 'The Consultant', - that a health survey of the bee population is necessary before the real potential for bee-keeping can be assessed. The Consultant also expressed a willingness to share her findings from an earlier assignment with an INGO in Humla and her experience with a beekeeping programme in Jumla district during a workshop, organised by DPP in Humla during November.

Bee disease has been a problem in Nepal since the early 1980s when the first epidemic of Thai Sac Brood Virus disease swept across the country and severely damaged indigenous *Apis cerana* populations. More recently since the widespread introduction of the exotic European honeybee *Apis mellifera*, European Foul Brood disease has been increasingly responsible for death of indigenous bee populations, even in areas as remote as Jumla, where *Apis mellifera* was unsuccessfully introduced in the early 1990s. In addition to these 'brood diseases', which affect developing larvae, other diseases, parasites, pests and other environmental factors have also caused the decline of bee populations. Before a successful and appropriate beekeeping programme can be introduced to Humla for the enhancement of the livelihoods of local people, analysis of the impact of diseases, pests, predators, environmental degradation, insecticide poisoning and other factors upon bee populations is called for. Recommendations as to how to tackle these such that beekeeping production can be improved through a beekeeping programme can then be drawn up.

Consultants:
The study and workshop will be conducted by Naomi Saville, with support from her Associate Mr. Narayan Acharya.

Objectives
To analyse the health of the bee population and share knowledge on causes of bee decline in:

- Melchham VDC: Charigaun, Korka, Melchham, Mashidhara
- Hepka VDC: Tangin, Hepka, Dinga

To disseminate knowledge on bee diseases and other causes of bee colony death and means to prevent and control them.
To conduct a workshop for DPP staff and partner NGO staff to:

- feedback on previous experience with AP-Tibet (0.5 days)
- presentation of study findings and feedback from the field plus recommendations (1.5 days)
- appropriate beekeeping in the Karnali (one day)

Activities
1) Conduct PRA type exercises with beekeepers in some or all of the selected areas as follows:

- Semi-structured interviews with farmers in selected areas with questions particularly referring to beekeeping, bee diseases and other problems associated with beekeeping;
- Complete survey questionnaire, using semi-structured interview process;
- Trend analyses (using trend diagrams or charts where possible) of changes in bee colony numbers and in honey yields in recent years;

2) Diagnose bee diseases or reasons for bee colony death or decline

- Discuss in depth with knowledgeable beekeepers the nature of the symptoms observed in previous diseased colonies;
- Inspect bee colonies in as many communities that beekeepers will allow us to do so and complete questionnaire on appearance of larvae, pupae and adult bees;
- Collect disease samples in cases that bee disease is detected;
- Collect honey samples to check on honey quality and pollen variation;
- Arrange for analysis of bee disease and honey samples in the Beekeeping Shop, Kathmandu or other appropriate location

3) Train beekeepers and NGO workers to understand the causes of bee colony death better and share beekeeping knowledge and skills, by discussion and demonstration, with traditional beekeepers and also NGO staff, especially with reference to:

- bee disease diagnosis and control,
- starvation and feeding of sugar syrup to prevent it,
- insecticide poisoning,
- ways that management of bees in movable combs can improve bee health and honey / beeswax production;
- Jumla top bar hive and other beekeeping appropriate technology; and
- bee forage management.

Report on findings

- Present data and findings on bee disease and causes of bee demise from questionnaires / interviews and analyse in the context of appropriate beekeeping intervention by NGOs in Humla;
- Discuss findings from this survey in the context of findings from similar studies in Jumla and other parts of Humla.

Inputs SNV Nepal

- Assistance by DPP/DPM-Humla and staff if required
- Advice by DPP/SNV Nepal's Advisor NTFP, where required
- Logistical support and finance, as per budget

Outputs of the study

- Increased understanding of the factors limiting production from beekeeping in Humla district amongst local NGO staff and DPP field staff and managers and local beekeepers;
- Diagnosis of bee diseases in selected communities (either symptomatic or by lab analysis as appropriate).

- A detailed document giving information on the beekeeping situation in Humla with particular reference to bee disease and other factors limiting productivity.

Outputs of the workshop:
1) Increased understanding and knowledge on:
- Reasons for bee colony death & decline;
- How to recognise reasons for bee colony death (disease symptoms, parasites, pests and predators, starvation, poisoning, etc.);
- Appropriate technology for improving beekeeping management and productivity in the Karnali zone;
- Improved harvesting, processing of- and value addition to bee products;
- Indigenous beekeeping systems in the Karnali zone, their advantages and disadvantages;
- Recommendations for a beekeeping programme in Humla

2) Action plan for a Humla beekeeping programme

Supervision
- First responsible is DPM/Humla, to whom the Consultant is accountable in the first instance
- Advice can be obtained from the DPP/SNV Nepal advisor NTFP and Regional Manager DPP, if required

Time-frame

Dates	Activity	Days
8 – 11 Sep (+2)	Preparation overall	6
12 Sep	Arrival Nepalganj	1
13 Sep	Flight to Simikot	1
14 – 27 Sep	Health study	15
29 Sep	Flight to Nepalganj & Kathmandu	1
30 Sep – 2 Oct	Report writing	3
2 days November	Travel KTM – S'kot	2
3 days November	Workshop	3
1 day November	Travel S'kot - KTM	1
2 days November	Report writing	2
Total:		35

18.2 Appendix 2. Introduction on the consultant and her associate research assistant

About the Consultant

Naomi Saville is a specialist on bees and beekeeping with 14 years experience. Having trained in biology / ecology at Cambridge University between 1985 and 1993, completing a BA in Zoology and a PhD on the ecology of bumblebees, Naomi turned to beekeeping and development work in preference to ecological research. She was apprentice to the beekeepers of Trinidad and Tobago for 9 months 1993-1994 and worked with beekeepers in Sierra Leone for 3 months 1994-1995. Since April 1995, Naomi has lived and worked in Nepal, working mainly with beekeepers in the remotest region of the country known as the Karnali Zone. From July 1995 to October 1999 (employed first by DFID and then by Austroprojekt Austrian Technical Co-operation Agency), she managed a programme of participatory action research (PAR) into beekeeping with communities in Jumla district as a component of ICIMOD beekeeping project. This involved PAR into appropriate beehive design, appropriate technology for beeswax and honey processing, value addition and micro-enterprise with bee products, farmer-led extension in beekeeping, bee disease control, institutional capacity building, and project management. Through use of participant observation method in Jumla for more than 4 years, Naomi is very fluent in spoken Nepali, capable in written Nepali and able to communicate in the local Jumli dialect. Through in depth study of indigenous technical knowledge in beekeeping in Jumla, Naomi has deep understanding of the people and conditions of the Karnali Zone, which enables her to work with any aspect of development in the region.

Since November 1999, Naomi has been working as a volunteer technical adviser to Surya Social Service Society (4S) a Jumla-local NGO and their small industry that provides funding to the organisation called The Beeswax Processing Centre Jumla. Currently she is investigating fair trading opportunities for beeswax products from Jumla and elsewhere in the Karnali Zone. She also works as a Freelance Consultant in beekeeping and development for development organisations active in Nepal and particularly the Karnali Zone. In November 1999 she was trained in Permaculture Design in Gumi, Surkhet District, Nepal and intends in the future to combine beekeeping with Permaculture methods in remote and resource poor areas of developing countries.

About the research assistant and the Karnali zone local NGO 4S

Narayan Prasad Acharya is the founder secretary of Surya Social Service Society (4S) a Jumla local NGO founded in 1994 by a group of young volunteers from the Jumla community. Narayan was born and brought up in Jumla and received education there to School Leaving Certificate (SLC pass). He studies part time at Jumla Campus for Intermediate Level in Education. As with many people native to the Karnali Zone who have been educated there rather than outside, Narayan’s practical skills and experience far outreach his paper qualifications. Through 5 years experience of grassroots community development work in Jumla Narayan is skilled in project management at the field level, fieldwork with communities (PRA, group formation and group supervision, non-formal education, income generation, savings and credit and beekeeping). During the ICIMOD beekeeping project phase of action research managed by Naomi (May 1997 – October 1999), Narayan worked as her second counterpart, particularly developing the micro-enterprise in beeswax called ‘The Beeswax Processing Centre Jumla’. This organisation buys beeswax, honey, oils and herbs from farmers at fair prices and

processes them into products for retail. Products include beeswax candles and medicinal skin creams as well as jars of high quality honey. Narayan also has experience in managing teams of farmer-extension workers, keeping project accounts, managing revolving funds for income generation, training trainers for non-formal education and managing non-formal education classes, practical and theoretical beekeeping, reporting to donors, preparing funding applications, use of Appreciative Inquiry Approach, and so on. Narayan works best in the Nepali language but has a working knowledge of English and is aiming to improve his skills through English courses and visits to UK. He is fluent in Jumli language, and also in Hindi and Sanskrit. Narayan has also been trained in Permaculture design.

Prior to working with 4S Narayan worked as a volunteer to the UMN community forestry project in Jumla. Before and since Narayan’s employment by ICIMOD, he has been working as an unpaid volunteer for 4S. Currently he seeks work as a local consultant / research assistant to organisations working in the Karnali zone and elsewhere in Nepal, especially concentrating upon beekeeping & Permaculture.

18.3 Appendix 3 Sample questionnaire forms in Nepali and English as used in Key Informant Interviews in Melchham and Hepka VDCs

Excel file – App 3 –questionnaire
Nepali sheet – 2 pages

English sheet – 2 pages

18.4 Appendix 4

18.4.1 Appendix 4.a) Compiled data from the Humla Bee disease Survey forms used in the DPP study during September 2000 in N and S Humla

Compiled responses from the Humla Bee disease Survey forms used in the DPP study during September 2000 in N and S Humla

n indicates the number of farmers who responded to the question (whether +vely or -vely)

Sum indicates the total no. of positive responses given by farmers

% of all responses that were positive is calculated for yes/no answers (i.e. for Hepka and Melchham the number of positive responses out of all 12 interviews in each VDC; for both VDCs the number of positive responses out of all 24 interviews).

HONEY / WAX PROCESSING	Hepka and Melchham Sum	*Hepka & Melchham % of +ve responses*	n	Hepka Sum	*Hepka % of +ve responses*	n	Melchham Sum	*Melchham % of +ve responses*	n
Throws out old combs	**2**	*8.3*	2	**1**	*8.3*	1	**1**	*8.3*	1
Cuts honey at night	**8**	*33.3*	8	**3**	*25.0*	3	**5**	*41.7*	5
Cuts honey with khukuri knife	**16**	*66.7*	16	**5**	*41.7*	5	**11**	*91.7*	11
Uses dried cow dung for smoke	**7**	*29.2*	7	**7**	*58.3*	7	**0**	*0.0*	0
Uses Dhoopi (*Juniperus* sp.) for smoke	**3**	*12.5*	3	**2**	*16.7*	2	**1**	*8.3*	1
Uses cloth to make 'kangreto' smoker	**10**	*41.7*	10	**1**	*8.3*	1	**9**	*75.0*	9
Uses warm water to brush off bees & to rinse hands	**8**	*33.3*	8	**3**	*25.0*	3	**5**	*41.7*	5
Separates out white combs to keep raw for medicine	**22**	*91.7*	22	**10**	*83.3*	10	**12**	*100.0*	12
Cooks darker (old) combs	**24**	*100.0*	24	**12**	*100.0*	12	**12**	*100.0*	12
Adds water to honey for cooking	**10**	*41.7*	11	**8**	*66.7*	9	**2**	*16.7*	2
Cooks to make clean honey with no wax bits	**12**	*50.0*	12	**4**	*33.3*	4	**8**	*66.7*	8
Cooks to make honey easy to use / eat	**6**	*25.0*	6	**4**	*33.3*	4	**2**	*16.7*	2
Cooks to extract wax	**9**	*37.5*	9	**3**	*25.0*	3	**6**	*50.0*	6
Cooks to increase volume	**3**	*12.5*	3	**3**	*25.0*	3	**0**	*0.0*	0
Cooks to make easy to store for long time i.e. doesn't go off.		*0.0*		**1**	*8.3*	1	**4**	*33.3*	4
Uses wax for 'diu' (votive lights)	**4**	*16.7*	4	**4**	*33.3*	4	**0**	*0.0*	0
Uses debris from cooked honey as hive bait	**2**	*8.3*	2	**2**	*16.7*	2	**0**	*0.0*	0
Sells wax or not?	**10**	*41.7*	20	**2**	*20*	10	**8**	*80*	10

HIVE DETAILS	Hepka and Melchham Sum	*Hepka & Melchham % of +ve responses*	n	Hepka Sum	*Hepka % of +ve responses*	n	Melchham Sum	*Melchham % of +ve responses*	n
Square log hive (don't know if opens front or back)	**5**	*20.8*	5	**5**	*41.7*	5	**0**	*0.0*	0
Square log hive opens from front	**4**	*16.7*	4	**4**	*33.3*	4	**0**	*0.0*	0
Square log hive opens from back	**15**	*62.5*	15	**3**	*25.0*	3	**12**	*100.0*	12
Finds own hive easy to use	**22**	*91.7*	22	**10**	*83.3*	10	**12**	*100.0*	12

DISEASE SYMPTOMS DESCRIBED	Hepka and Melchham Sum	*Hepka & Melchham % of +ve responses*	n	Hepka Sum	*Hepka % of +ve responses*	n	Melchham Sum	*Melchham % of +ve responses*	n
Has seen bee disease	**19**	*79.2*	24	**9**	*75.0*	12	**10**	*83.3*	12
Wax moth described	**10**	*41.7*	10	**3**	*25.0*	3	**7**	*58.3*	7
Black bees described	**8**	*33.3*	8	**4**	*33.3*	4	**4**	*33.3*	4
Bees not foraging well	**6**	*25.0*	6	**4**	*33.3*	4	**2**	*16.7*	2
Seen bees throwing out larvae	**5**	*20.8*	5	**3**	*25.0*	3	**2**	*16.7*	2
Rotten larvae	**3**	*12.5*	3	**1**	*8.3*	1	**2**	*16.7*	2
Bad smell described	**3**	*12.5*	3	**1**	*8.3*	1	**2**	*16.7*	2
Bees abscond	**6**	*25.0*	6	**3**	*25.0*	3	**3**	*25.0*	3
Many colonies abscond together	**5**	*20.8*	5	**2**	*16.7*	2	**3**	*25.0*	3
Bees make different sound	**1**	*4.2*	1	**1**	*8.3*	1	**0**	*0.0*	0
Many drones when diseased	**3**	*12.5*	3	**1**	*8.3*	1	**2**	*16.7*	2
Bees don't swarm	**1**	*4.2*	1	**1**	*8.3*	1	**0**	*0.0*	0
Bees die outside hive	**1**	*4.2*	1	**1**	*8.3*	1	**0**	*0.0*	0
Bees look 'drunk'	**2**	*8.3*	2	**2**	*16.7*	2	**0**	*0.0*	0
Described dead bees with heads in combs and on floor of hive (starved)	**1**	*4.2*	1	**0**	*0.0*	0	**1**	*8.3*	1
Adult bees dead on floor of hive	**1**	*4.2*	1	**0**	*0.0*	0	**1**	*8.3*	1

REASONS FOR DISEASE	Hepka and Melchham Sum	*Hepka & Melchham % of +ve responses*	n	Hepka Sum	*Hepka % of +ve responses*	n	Melchham Sum	*Melchham % of +ve responses*	n
Disease comes when there's lots of rain	**2**	*8.3*	2	**1**	*8.3*	1	**1**	*8.3*	1
Big black insect kills bees	**2**	*8.3*	2	**2**	*16.7*	2	**0**	*0.0*	0
Kaambu (*Prunus communis*) nectar	**7**	*29.2*	7	**4**	*33.3*	4	**3**	*25.0*	3

affects the bees badly									
Bees die in winter	**1**	*4.2*	1	**1**	*8.3*	1	**0**	*0.0*	0
Bees die of lack of food	**3**	*12.5*	3	**1**	*8.3*	1	**2**	*16.7*	2
Bees die of cold in winter	**1**	*4.2*	1	**1**	*8.3*	1	**0**	*0.0*	0
Bees die of lack of rain	**1**	*4.2*	1	**1**	*8.3*	1	**0**	*0.0*	0
Disease seen in March - April	**5**	*20.8*	5	**4**	*33.3*	4	**1**	*8.3*	1
Disease comes in July – August	**10**	*41.7*	10	**8**	*66.7*	8	**2**	*16.7*	2
Large bee-like insect came and brought the disease	**2**	*8.3*	2	**2**	*16.7*	2	**0**	*0.0*	0
Foreign bee came in 1979 and brought disease	**2**	*8.3*	2	**2**	*16.7*	2	**0**	*0.0*	0
Foreigners brought disease	**5**	*20.8*	5	**3**	*25.0*	3	**2**	*16.7*	2

DISEASE TREATMENT	Hepka and Melchham Sum	*Hepka & Melchham % of +ve responses*	n	Hepka Sum	*Hepka % of +ve responses*	n	Melchham Sum	*Melchham % of +ve responses*	n
Treat bees with local medicine or not?	**10**	*41.7*	20	**5**	*41.7*	10	**5**	*41.7*	10
Uses Jantamansi root and 'paati' (*Artemisia*) to smoke bees	**1**	*4.2*	1	**1**	*8.3*	1	**0**	*0.0*	0
Use Gokhul dhoop to treat bees	**2**	*8.3*	2	**1**	*8.3*	1	**1**	*8.3*	1
Use dhoopi (*Juniperus* sp.) smoke to treat disease	**8**	*33.3*	8	**2**	*16.7*	2	**6**	*50.0*	6
No. of times that medicine is given	**2**	*8.3*	2	**0**	*0.0*	0	**2**	*16.7*	2
Medicine sometimes works, sometimes not	**3**	*12.5*	3	**2**	*16.7*	2	**1**	*8.3*	1
Medicine works or not	**5**	*20.8*	5	**2**	*16.7*	2	**3**	*25.0*	3
Combines ‘china jurro’ (lichen or fungus) and dhoopi (*Juniperus* sp.) & gives smoke.	**3**	*12.5*	3	**0**	*0.0*	0	**3**	*25.0*	3

FEEDING PRACTICES	Hepka and Melchham Sum	*Hepka & Melchham % of +ve responses*	n	Hepka Sum	*Hepka % of +ve responses*	n	Melchham Sum	*Melchham % of +ve responses*	n
Feed debris from cooked honey when bees are diseased	**3**	*12.5*	3	**3**	*25.0*	3	**0**	*0.0*	0
Feed bees by leaving about 1/3rd of combs	**6**	*25.0*	6	**4**	*33.3*	4	**2**	*16.7*	2
Feed bees by leaving 1/2 of combs	**6**	*25.0*	6	**1**	*8.3*	1	**5**	*41.7*	5
Feed bees by leaving 4-6 combs	**4**	*16.7*	4	**3**	*25.0*	3	**1**	*8.3*	1
Feed bees by putting honey onto	**3**	*12.5*	3	**3**	*25.0*	3	**0**	*0.0*	0

thin 'logger' (buckwheat bread) with holes									
Feeds with cake (‘desu’) of buckwheat & honey mixed and par-cooked	**7**	*29.2*	7	**0**	*0.0*	0	**7**	*58.3*	7
Feed bees with debris from cooked honey (pollen and honey mix)	**5**	*20.8*	5	**5**	*41.7*	5	**0**	*0.0*	0
Feeds with 'Mehel ko pota' – a cake made of the fruit of *Pyrus pashia*	**3**	*12.5*	3	**0**	*0.0*	0	**3**	*25.0*	3
Feed bees with sweet pumpkin	**0**	*0.0*	0	**0**	*0.0*	0	**1**	*8.3*	1
Feed bees in winter (i.e. extra to combs left)	**16**	*66.7*	16	**8**	*66.7*	8	**8**	*66.7*	8
Feed bees in July – August	**1**	*4.2*	1	**1**	*8.3*	1	**0**	*0.0*	0
Feed bees in Spring	**7**	*29.2*	7	**2**	*16.7*	2	**5**	*41.7*	5

INSECTICIDE USE & BEE POISONING	Hepka and Melchham Sum	*Hepka & Melchham % of +ve responses*	n	Hepka Sum	*Hepka % of +ve responses*	n	Melchham Sum	*Melchham % of +ve responses*	n
Use insecticide or not?	**16**	*66.7*	23	**7**	*58.3*	11	**9**	*75.0*	12
Get insecticide from ADO	**11**	*45.8*	11	**4**	*33.3*	4	**7**	*58.3*	7
Get insecticide from private traders	**1**	*4.2*	1	**1**	*8.3*	1	**0**	*0.0*	0
Insecticide used on apples	**6**	*25.0*	6	**5**	*41.7*	5	**1**	*8.3*	1
Insecticide used on sag, cauli etc	**15**	*62.5*	15	**6**	*50.0*	6	**9**	*75.0*	9
Insecticide used between Mar - Apr and May - June	**2**	*8.3*	2	**2**	*16.7*	2	**0**	*0.0*	0
Applied between July and October	**1**	*4.2*	1	**0**	*0.0*	0	**1**	*8.3*	1
Insecticides has poisoned bees	**7**	*29.2*	10	**6**	*50.0*	8	**1**	*8.3*	2
No. of colonies lost through insecticide poisoning	**4**	*16.7*	2	**4**	*33.3*	1	**0**	*0.0*	1
Aware of toxicity of insecticide to bees	**13**	*54.2*	17	**6**	*50.0*	7	**7**	*58.3*	10

HIVE SANITATION PRACTICES	Hepka and Melchham Sum	*Hepka & Melchham % of +ve responses*	n	Hepka Sum	*Hepka % of +ve responses*	n	Melchham Sum	*Melchham % of +ve responses*	n
Clean hives inside with walnut leaves	**18**	*75.0*	18	**9**	*75.0*	9	**9**	*75.0*	9
Uses 'Bigreti' / yertakpa to clean inside hives	**2**	*8.3*	2	**2**	*16.7*	2	**0**	*0.0*	0
Clean hives inside with 'Gallapani' (*Salvia nubicola)*	**10**	*41.7*	10	**0**	*0.0*	0	**10**	*83.3*	10

Smokes hive with dhoopi (*Juniperus* sp.) before baiting	**1**	*4.2*	1	**1**	*8.3*	1	**0**	*0.0*	0
Use cooked honey debris for hive bait	**11**	*45.8*	11	**10**	*83.3*	10	**1**	*8.3*	1
Rubs raw honey inside hive	**10**	*41.7*	10	**1**	*8.3*	1	**9**	*75.0*	9
Seals baited hives by plastering with cow dung / mud	**11**	*45.8*	11	**4**	*33.3*	4	**7**	*58.3*	7
Uses wax as hive bait	**4**	*16.7*	4	**1**	*8.3*	1	**3**	*25.0*	3
Uses a red hot rice paddle to clean hives	**2**	*8.3*	3	**2**	*16.7*	3	**0**	*0.0*	0
Does NOT burn inside hives	**20**	*83.3*	20	**8**	*66.7*	8	**12**	*100.0*	12

HIVE INSPECTION / MANAGEMENT PRACTICES	Hepka and Melchham Sum	*Hepka & Melchham % of +ve responses*	n	Hepka Sum	*Hepka % of +ve responses*	n	Melchham Sum	*Melchham % of +ve responses*	n
Inspects bees in winter for food	**1**	*4.2*	1	**1**	*8.3*	1	**0**	*0.0*	0
Inspects between Mar and May	**2**	*8.3*	2	**2**	*16.7*	2	**0**	*0.0*	0
Inspects at swarming time	**6**	*25.0*	6	**3**	*25.0*	3	**3**	*25.0*	3
Inspects bees at harvest time	**16**	*66.7*	16	**6**	*50.0*	6	**10**	*83.3*	10
Inspects bees during times of disease (July – August)	**5**	*20.8*	5	**4**	*33.3*	4	**1**	*8.3*	1
Inspects from outside usually	**2**	*8.3*	2	**2**	*16.7*	2	**0**	*0.0*	0
Destroys queen cells after too many swarms	**3**	*12.5*	3	**1**	*8.3*	1	**2**	*16.7*	2

PESTS OF BEES	Hepka and Melchham Sum	*Hepka & Melchham % of +ve responses*	n	Hepka Sum	*Hepka % of +ve responses*	n	Melchham Sum	*Melchham % of +ve responses*	n
Pine marten - major pest	**14**	*58.3*	14	**6**	*50.0*	6	**8**	*66.7*	8
Oringal mention as pest	**16**	*66.7*	16	**6**	*50.0*	6	**10**	*83.3*	10
Hornet (Bacchhu in Nepali) kills bees	**6**	*25.0*	6	**1**	*8.3*	1	**5**	*41.7*	5
Lizard mentioned as pest	**9**	*37.5*	9	**1**	*8.3*	1	**8**	*66.7*	8
Bears mentioned as pest	**15**	*62.5*	15	**6**	*50.0*	6	**9**	*75.0*	9
Ants mentioned as pest	**7**	*29.2*	7	**3**	*25.0*	3	**4**	*33.3*	4
Mice mentioned as pest	**6**	*25.0*	6	**4**	*33.3*	4	**2**	*16.7*	2
Jackal mentioned as pest!	**1**	*4.2*	1	**1**	*8.3*	1	**0**	*0.0*	0
Water (i.e soaking with rain) mentioned as pest	**3**	*12.5*	3	**2**	*16.7*	2	**1**	*8.3*	1
Bird (red colour) mentioned as pest	**2**	*8.3*	2	**0**	*0.0*	0	**2**	*16.7*	2

Black insect mentioned as pest	**3**	*12.5*	3	**3**	*25.0*	3	**0**	*0.0*	0

COMMENTS / REQUESTS FROM FARMERS	Hepka and Melchham Sum	*Hepka & Melchham % of +ve responses*	n	Hepka Sum	*Hepka % of +ve responses*	n	Melchham Sum	*Melchham % of +ve responses*	n
Requested bee medicine / bee disease control	**13**	*54.2*	13	**5**	*41.7*	5	**8**	*66.7*	8
Requested beekeeping training (ways to improve traditional methods)	**19**	*79.2*	19	**8**	*66.7*	8	**11**	*91.7*	11
Requested beekeeping equipment (especially protection)	**9**	*37.5*	9	**3**	*25.0*	3	**6**	*50.0*	6

18.4.2 Appendix 4b. Compiled data on numbers of hives and honey production from the Humla Bee disease Survey forms as shown in Figure 1 (SE Means and pooled data also shown)

n indicates the number of farmers who responded to the question

Sum indicates the sum of quantitative responses given by farmers

Averages of all those who replied are calculated for questions with quantitative replies
SE Mean = Standard deviation / square root (n-1) – this indicates the error margin of the mean

Response	**Sum in both VDCs**	*Average of all answers in both VDCs*	SE Mean of all answers in both VDCs	n for both VDCs	**Hepka Sum**	*Average of all Hepka answers*	SE Mean of all answers in Hepka VDC	n for Hepka VDC	**Melchham Sum**	*Average of all Melchham answers*	SE Mean of all answers in Melchham VDC	n for Melchham VDC
NUMBERS OF OCCUPIED HIVES												
No. of hives now	**180**	*5.6*	*0.8*	32	**95**	*5.6*	*1.3*	17	**85**	*5.7*	*1.1*	15
No. of hives 2056	**194**	*7.5*	*1.6*	26	**115**	*7.7*	*2.1*	15	**79**	*7.2*	*2.5*	11
No. of hives 2055	**181**	*8.2*	*2.2*	22	**112**	*8.6*	*3.0*	13	**69**	*7.7*	*3.5*	9
No. of hive 5 years ago	**147**	*11.3*	*4.1*	13	**70**	*10.0*	*5.1*	7	**77**	*12.8*	*7.6*	6
No. of hive 10 years ago	**160**	*17.8*	*7.3*	9	**73**	*18.3*	*10.7*	4	**87**	*17.4*	*12.1*	5
No. of hives before disease	**68**	*13.6*	*5.6*	5	**68**	*17.0*	*5.6*	4	**0**	*0.0*	*0.0*	1
HONEY YIELDS												
Honey harvested this year in approx. kg	**8.2**	*0.5*	0.4	18	**0.0**	*0.0*	0	7	**8.2**	*0.7*	0.7	11
Honey harvested 2056 in approx. kg	**480.7**	*24.0*	10.4	20	**363.0**	*40.3*	22.9	9	**117.7**	*10.7*	3.0	11
Honey harvested 2055 in approx. kg	**552.1**	*30.7*	12.2	18	**417.7**	*59.7*	29.3	7	**134.4**	*12.2*	4.9	11
Honey harvested 5 years ago in approx. kg	**353.8**	*44.2*	24.9	8	**200.0**	*200.0*		1	**153.8**	*22.0*	8.5	7
Honey harvested 10 years ago in approx. kg	**1105.0**	*122.8*	90.6	9	**860.0**	*430.0*	523.3	2	**245.0**	*35.0*	15.3	7
Honey harvested before disease first came. approx. kg	**105.0**	*35.0*	28.9	3	**80.0**	*80.0*		1	**25.0**	*12.5*	17.7	2
NUMBERS OF HIVES, BEEKEEPERS ETC.												
No. of baited hives in 'forest'	**74**	7.9	*1.7*	*23*	**30**	*3.3*	1.5	9	**44**	*7.3*	3.1	*6*
No. of beekeepers in whole village		27.0	*4.5*	*23*				9				9

Total estimated no. of beehives in village		93.9	*17.8*	*20*				5				7

18.5 Appendix 5. PRA preference ranking exercises from Melchham VDC, Humla

3 worksheets from Excel file: ‘App 5&6 pra pref dpp’

Charigaun worksheet - 1 page

Melchham worksheet - 2 pages

Mashidhara worksheet - 2 pages

18.6 Appendix 6. PRA preference ranking exercises from Tangin in Hepka VDC, Humla as conducted during ApTibeT study in March 2000

1 worksheet from Excel file: ‘App 5&6 pra pref dpp’
Tangin worksheet - 2 pages

18.7 Appendix 7. Sample hive inspection questionnaire forms in Nepali and English

Excel file: ‘App 7 hive insp fm’
Nepali worksheet - 1 page

English worksheet - 1 page

18.8 Appendix 8. Data compiled from 16 bee colony inspections (Hepka and Melchham VDCs)

Excel file ‘App 8 – ‘hive insp results’
Sheet 1 – 2 pages

18.9 Appendix 9. List of invertebrate samples taken, probable identification where known and suggested means of identifying unknown samples

Sample no.	Date taken	Village	VDC	Farmer's name	Probable identification	Confirming Identification Needs	notPest or disease organism or
1	16-9-00	Lama Gaun	Hepka	Denchen Dorje Lama	Pseudoscorpion	1	0
2	16-9-00	Lama Gaun	Hepka	Denchen Dorje Lama	Small black bug	1	?
3	17-9-00	Hepka	Hepka	Hetuk Lama	Phorid fly cocoons	1	1
4	17-9-00	Tangin	Hepka	?	Hive beetle	1	1?
5	20-9-00	Durpaa	Kharpunath	Rame Rokaya	Wax moth adult	1	1
6	24-9-00	Korka	Melchham	Bir Bahadur Budha	Phorid fly	1	1
7	24-9-00	Korka	Melchham	Bir Bahadur Budha	Varroa Mite	0	1
8	24-9-00	Korka	Melchham	Bir Bahadur Budha	Fine worm found inside hive	1	?
9	24-9-00	Korka	Melchham	Bir Bahadur Budha	Juvenile earwig?	1	0?
10	24-9-00	Korka	Melchham	Tulaya Sarki	Phorid fly	1	1
11	26-9-00	Korka	Melchham	(None)	Adult bee (to check if *A.c. cerana*) subspecies	1	0
12	25-9-00	Melchham	Melchham	Khaampa Budha	Adult fly from brood eating maggot	1	0
13	26-9-00	Mashidhara	Melchham	(None) Sample taken from old comb used for wax processing	Wax moth larvae	1	1

18.10 Appendix 10. List of larval and pupal smear samples taken on slides and paper

Sample no.	Date taken	Village	VDC	Farmer's name	Larval / pupal smear on paper	Larval / pupal smear on slide
1	16-9-2000	Gadapaari	Hepka	Panma Lama	1	1
2	16-9-2000	Lama Gaun	Hepka	Dechendra Dorje Lama	1	1
3	20-9-2000	Durpaa	Kharpunath	Rame Rokaya	1	1
4	24-9-2000	Charigaun	Melchham	Prem Singh Siraha	1	0
5	24-9-2000	Korka	Melchham	Bir Bdr Budha	1	1
6	25-9-2000	Melchham	Melchham	Khaampa Budha	1	0
7	25-9-2000	Melchham	Melchham	Bal Jit Budha	1	1
8	25-9-2000	Melchham	Melchham	Jase and Karna Bahadur Budha	1	1
9	26-9-2000	Mashidhara	Melchham	Hangsa Bdr. Budha	1	1

Preliminary microscopic analysis of samples has not indicated the presence if any brood diseases.

18.11 Appendix 11. Honey production estimates given by farmers during the ApTibeT survey in different villages of Humla district in April 2000.

18.12 Appendix 12. Honey analysis results

Honey samples were analysed from three separate study visits to Humla:

i) 7 samples from the currently reported DPP study conducted in September 2000;

ii) 3 samples from the November 2000 beekeeping workshop conducted for DPP to compare cooked and squeezed honey samples from Humla farmers with honey harvested and processed under the supervision of the authors using improved methods of separating sealed and unsealed honey and skimming combined with filtering of honey.

iii) 3 samples from the April 2000 ApTibeT study.

The various properties of honey analysed and their significance in terms of assessing honey quality are described below:

- *Water content*

The water content is the main determinant of keeping quality of honey. When water content is higher than 20% osmophilic yeasts develop very fast and cause fermentation.

- *Reducing sugars*

Reducing sugars are monosaccharides, which are the major component of the honey. More than 65% of reducing sugars are present in honey.

- *Sucrose*

Sucrose is a disaccharide and is present in small quantity (less than 5%) in all honey. Its presence in large amount should arouse the suspicion of adulteration.

- *HMF (Hydroxymethylfurfural)*

HMF content is used as an indicator of the amount of heat to which a honey has been exposed and/or the length of time the honey has been stored.

- *Peroxide activity*

Test of peroxide activity gives the impression on the enzyme activity. Hydrogen peroxide is produced by the action of a heat sensitive enzyme in honey called glucose oxidase. Strongly heated and adulterated honey does not contain this enzyme.

- *Microscopic analysis*

Normally honey contains small amount of pollen, a well-known indicator of the authenticity of honey. Microscopic analysis of honey is used for determination of the geographical and the botanical origin of honey. Microscopic analysis can also reveal adulteration of honey with cane sugar and also presence other undesirable particles such as carbon (from smoke), bee parts and so on. Starch cells may be naturally found in honey and can be detected under the microscope. Excessively high levels of startch cells may indicate aldulterated honey.

18.12.1 Table of results of honey analyses from Humla (conducted by Maha Laxmi Shrestha of BEEDECO NGO in Kathmandu).

Sample no.	Name of beekeeper & village from which sample taken	Altitude honey was taken from	Processed \ stored honey (1/0)	Honey cut directly from combs (1/0)	water content %	HMF	Peroxide activity	pH	Reducing sugar	Sucrose	Microscopy
1	Hetuk Lama, Hepka Gaun, Hepka VDC	2740m	0	1	16.5	less than 40mg/kg	25 µg/g/hr	4.8	72.15	5.52	Mixed pollen (Balsaminaceae, Labiatae), starch cells and carbon particles absent.
2	Sunam Budha, Charigaun, Melchham VDC	2900m	0	1	16.5	less than 40mg/kg	25 µg/g/hr	4.7	76.29	5.07	Pollen unidentified (type-1), dust, and carbon particles present, lots of starch cells present. Dirty.
3	Denchen Dorje Lama, Lama Gaun Hepka VDC	2895m	0	1	21	less than 40mg/kg	10 µg/g/hr	4.6	66.2	3.11	Mixed pollen (type-1, Labiatae) no carbon particle and starch cells. Clean.
4	Khaampa Budha, Melchham VDC wd no. 5	2640m	0	1	20.5	less than 40mg/kg	25 µg/g/hr	5.3	65.95	1.71	Mixed pollen (Euphorbiaceae & Labiatae), few starch cells and few carbon particles present.
5	Jase & Karna Bdr Budha, Melchham VDC Wd no 5	2640m	0	1	18.5	less than 40mg/kg	25 µg/g/hr	5.4	71.84	4.45	Mixed pollen (Euphorbiaceae, type-1), carbon particles present, no starch cells. Dirty.
6	Aja Bir Shahi, Mashidhara, Melchham VDC	2740m	0	1	18	less than 40mg/kg	10 µg/g/hr	4.8	67.36	3.56	Unifloral (type-1), few maize pollen, no dust or carbon particles present.
7	Tulaya Sarki Korka, Melchham VDC	2840m	0	1	19.5	less than 40mg/kg	10 µg/g/hr	5.2	67.36	5.62	Unifloral (Labiatae), with few types of pollen, clean no carbon particles or starch cells.
8	Skimmed & filtered honey harvested & processed in Simikot in training	2950m	0	1	17.8	less than 40mg/kg	25 µg/g/hr	4.8	68.14	2.48	Mixed floral (Balsaminaceae, Labiatae, Polygonaceae, and type-1, clean and no carbon and dust particles present.

9	Squeezed Honey from Baraunse, Simikot VDC	3050m	1	0	20	less than 40mg/kg	25 µg/g/ hr	4.8	65.11	1.93	Mixed floral, with dust particles and carbon particles present.
10	Cooked honey from Baraunse, Simikot VDC	3050m	1	0	25	about 40mg/ kg	zero	4.9	63.44	2.15	Mixed floral (Labiatae, tetrad pollen and other), dust particles and starch particles present
11	Hepka village, Hepka VDC Apr 2000 ApTibeT study	2740m	1	0	17.0	absent	10	4.7	69.79	2.07	Mixed floral including Labiatae, Balsaminanceae, Rosaceae (Tricolpate grains which look like *Malus* sp.). A few carbon particles present.
12	Khadka Chatel, Kargai, Kalika VDC Apr 2000 ApTibeT study	c.2600 m	1	0	20.5	absent	2.5	5.1	68.30	1.32	Mixed floral including Labiatae, Balsaminanceae, Rosaceae (Tricolpate grains). A few carbon particles and a few starch grains present.
13	Paldin Tschering Lama, Tangin, Hepka VDC Apr 2000 ApTibeT study	3250m	0	1	17.5	Very slight presence only	10	4.5	71.31	2.17	Tricolpate pollen (Rosaceae famile, perhaps *Malus* species), Labiatae, Starch grains in small clusters. Some dust particles and carbon particles present. Honey dew particles present.

Table of Averages from honey analyses of uncooked (raw) honey only

	Name of beekeeper & village from which sample taken	**Altitude honey was taken from**	**Processed \ stored honey (1/0)**	**Honey cut directly from combs (1/0)**	**water content %**	**HMF**	**Peroxide activity**	**pH**	**Reducing sugar**	**Sucrose**	**Microscopy**
	Average of all uncooked honey samples	*2832 m*			*18.6*	*10 samples with less than 40 mg/ kg, 2 with HMF absent*	*16.9*	*4.9*	*69.14*	*3.25*	

	SE mean	*854m*			*5.6*		*5.1*	*1.5*	*20.85*	*0.98*	
	N	*12*	*3*	*9*	*12*	*12*	*12*	*12*	*12*	*12*	

Appendix 13. List of species to be used in agroforestry systems in Humla (above c.2500m)

FRUIT TREES
- Khaambu / Gale aru (*Prunus communis*)*;
- Chuli (*Prunus armeniaca / Prunus persica*)*
- Mehel (*Pyrus pashia*)*;
- Irie mehel (*Prunus* sp?)*;
- Syau / Apple (*Malus domestica*)*
- Aru bokara (*Prunus* sp?)*;
- Okher (*Juglans regia*);

WILD SHRUBS AND TREES
- Eyrie (*Rosa moscata*)
- Kwiesie (*Rosa* spp.)
- Dhatelo (*Prinsepia utilis*)*;
- Chameli (*Jasminum* sp.);
- Chutro (*Berberis aristata / Berberis chitria*);
- Bhui Chutro (*Berberis* sp);
- Bais (*Salix* spp.);
- Ghangaru (*Cotoneaster* sp.)*;
- Any other shrubs that grow wild in the district and are useful as bee forage;

WILD AND CULTIVATED HERBS
- Kalo Bhaineri (?*Labiatae*)*;
- Sinki (*Labiatae*);
- Gala Pani (*Salvia nubicola*);
- Bigreti (?)*;
- Comfrey (*Symphytum officinale*)*;
- Peppermint (*Mentha piperum*?)*;
- Bhui kaphal (*Fragaria* sp.);
- Gobe (*Taraxacum officinale*);
- Any other herbs that are used by bees etc.

In the main area of the apiary plot a mixture of agroforestry and insect (bee-) pollinated crops should be planted. Tree and shrub species to be planted in the centre of the plot as well as in the 'living fence' are marked with an *. These species provide fruit, oil and medicinal herbs as well as providing forage for bees. Remember to plant under and around fruit trees to increase production from the land.

Bee-pollinated crops to grow in rotation on the land to cover as wide an area as possible should be:
- mustard (tori),
- buckwheat (mite and tite phapar),
- beans (simi),
- peas (kerau) and other flowering legumes;
- any other flowering crops;

For pollen supply maize could be planted in small quantities though this may attract bears, which is obviously disadvantageous.

18.13 Appendix 14. Herbal Decoction for treatment of bee brood diseases

On the basis of advice from Kaminee Vaidya (a specialist on ayurvedic medicine from Tribhuvan University) and experiences in Jumla district, a simple decoction of medicinal herbs combined with sugar to make syrup can be fed to bees to alleviate the symptoms of bee brood disease and perhaps also other infections.

The mixture of herbs can vary slightly from place to place depending on the availability of medicinal plants. However a basic recipe for the decoction is as follows:

- 1 handful of 'bagaino' (*Melia azdaractica);*
- 1 handful of 'titepati' (*Artemisia indica*);
- ½ handful of 'khukure ghaas' or 'salle ghaas' (*Equisteum* sp.);
- 1 piece of raw 'besaar' / turmeric root c. 3cm long ground finely (*Cucurma longa*);
- 7 flowers of Jasmine locally known as 'kaal tiki' in Humla and 'Chameli phul' elsewhere (*Jasminum* sp.).

Other herbs that may be added include pine needles ('pirul' if dried and 'sallako paat' if fresh) and Chiraiti Tito (*Swertia chiraiti*) a bitter herb from high altitudes, which may be used instead of Bagaino.

The herbs (if fresh) should be boiled for 5-10 minutes in about ½ -1 litre of water until a strong bitter decoction is formed. If dried herbs are used, smaller quantities of the herbs can be used. The decoction should be mixed with an equal volume of sugar whilst hot to make sweet syrup. This can be fed to a bee colony once cool by placing it in a bowl with plenty of straw, small sticks or pine needles to prevent the bees from drowning in the liquid, and placing it inside the beehive. The feed should be given in the evening at dusk and removed again the following morning to avoid robbing. Volumes fed to bees vary in relation to the size of the colony. A large colony can consume a large bowl overnight whereas a small colony can only consume a small quantity.

The decoction should be fed to diseased colonies every other day for at least a week, preferably at least 5 times in total.

REPORT SUPPLEMENT

Complete data set for Hepka and Melchham VDCs from questionnaire survey

‘General’ worksheet from Excel file App 4b - Humla Bee disease
(21 pages)