

COMPARITIVE BENEFITS OF BEEKEEPING ENTERPRISE IN CHITWAN, NEPAL

Suroj Pokhrel (PhD)¹

ABSTRACT

Based on the survey conducted in 2004, beekeepers in Chitwan had small and fragmented land holdings with lower rate of return from subsistence crop farming. They are keeping *Apis mellifera* L. in Langstroth hive in Terai and *A. cerana* Fab. in improved, traditional-log and wall hives in hills, for honey production purpose. The honey productivity in Terai was 3.54 folds higher (28.7 vs 8.1 kg/yr/hive) than in hills with highest average annual income in Bharatpur area followed by East and West Chitwan. Moreover, the income of the beekeepers in Chitwan from honey production was 3.62 folds higher than crop farming (NRs 83,996.88 vs NRs 23,214.22 /house hold/year). It clearly showed that beekeeping with *A. mellifera* in the Terai is potential enterprise for higher income compared to crop production.

Key words: annual income, apiculture, crop production, honey productivity, land holding.

INTRODUCTION

Bee Keeping Section (2004) reported 1,27,501 honeybee colonies including 1,01,684 traditional (log and wall hives) and 25,200 improved (*A. cerana* 17,744 and *A. mellifera* 7,456) hives kept in Nepal. The annual honey production is estimated 529.3 mt and it is one of the exporting, high value cash earning commodities in Nepal. Honey export in the year 2003 was equivalent to Rs 4,41,985 and was 4439.2 folds higher than that of 2002 (Bee Keeping Section, 2003). However, the role of bees as crop pollinators has been largely ignored and a vast potential, in using bees to augment national income through increased crop production has been forgotten. Honey production and crop pollination have to be exploited for the agriculture development and poverty reduction in Nepal. The Asiatic honeybee, *A. cerana* is adopting by the hill caste community and *A. mellifera* in Terai of Chitwan (DADO, 2004; DADO, 2005). The total estimated honeybee colony in Chitwan is 7500 (*A. mellifera* 5500 and *A. cerana* 2000) (Neupane, 2002). Chitwan seems to be the potential district enriched with apicultural raw materials, labor, and market. However, increasing use of agrochemicals specially the pesticide use on crop protection is a emerging threat. Nectar and pollen as raw materials are available from both forest and cultivated areas. Development of road infrastructure provides easy bee migration in all the seasons (DADO, 2004; DADO, 2005). More over, the services, institutional development, honey productivity and market development are not satisfactory. Beekeepers in Chitwan are in hurdele from different managerial, technical, ecological, behavioral and socio-economical problems and policy issues hindering the beekeeping industry. Beekeepers in Chitwan are mostly the medium class economic category, growing different crops and majority engaged in other occupation too. Thus, it was necessary to compare the income from beekeeping to crop production and study the market situation of honey in Chitwan. The objective of the study was to compare the income from beekeeping and crop production, to investigate the situation of honey market and make subsequent recommendation for the beekeepers in Chitwan.

¹ Program Director, Crop Directorate, Department of Agriculture, Nepal, surojpkhrel@yahoo.com

MATERIALS AND METHODS

SURVEY SITE, TIME AND DURATION

The survey was conducted in Chitwan district (Inner Terai and the peripheral Mahabharata hills) at central Nepal. The survey sites of *A. cerana* beekeepers were Chandibhanjyang, Shaktikhor, Korak and Siddhi VDCs. Similarly, survey of *A. mellifera* colonies was carried out in the Terai areas: East Chitwan (Pithuwa, Jutevani, Shaktikhor, Chainpur and Padampur VDCs and Ratnanagar Municipality), west Chitwan (Dibyanagar, Sukranagar and Parbatipur VDCs) and Bharatpur municipality during September-October 2004. These were the emerging beekeeping pockets of Chitwan valley where number of beeflora are available and thousands of bee colonies in migrated during the honey flow season.

BEEKEEPERS' INTERVIEW

A questionnaire was developed, pre-tested, revised and the final version of which was duplicated and used for collecting necessary information from the beekeepers (65 households randomly selected out of the list prepared by Nepal Beekeepers Association) to see the income of beekeepers (from crop cultivation and honey production) and honey market situation in Chitwan. The information collected from the survey was verified with available literature.

DATA PROCESSING

Collected data were tabulated using MS-EXCEL software and necessary tables, graphs figures were prepared and means were calculated to draw the results regarding the size of land holdings, cropped areas, food sufficiency, crop productivity, apiary sizes, labour use and house hold incomes from crop cultivation and honey production.

RESULTS

A survey of 65 beekeepers (36 in hills and 29 in Terai) was accomplished in 2004 to compare the gross income from crop cultivation and beekeeping and investigate the marketing situation of honey in hills and Terai of Chitwan.

STATUS OF CROP PRODUCTION

Land holding

The hill and Terai respondents had an average land holding of 0.70 ha (irrigated 0.12 ha) and 0.57 ha (irrigated 0.34 ha), respectively (Table 1). The beekeepers in West Chitwan had the highest land holding of 0.67 ha (irrigated 0.42 ha), followed by Bharatpur 0.57 ha (irrigated 0.24 ha) and the least 0.53 ha (irrigated 0.38 ha) in East Chitwan.

Crop cultivated

Crops cultivated in Terai were diversified than in hills. Most of the respondents (82.8%) in Terai and nearly half of the respondents (44.4%) in hills had lowlands. They grew rice, *Oryza sativa* L in their lowland in rainy season. In the upland maize, *Zea mays* L. (91.7%, N=33 in hills and 72.4%, N=21 in Terai) and finger millet, *Eleusine coracana* Gaertn (77.7%, N=28 in hills) were the major crops grown during the rainy season. While, mustard, *Brassica campestris* L. var *dichotoma* (Roxb.) Kitam. in Terai (58.6%, N=17) and buckwheat, *Fagopyrum esculentum* Moench (36.1%, N=13) and mustard, *B. campestris* (33.3%, N=12) in

hills were the major crops grown during winter. The respondents also grew sesame, *Sesamum orientale* L. (17.2%, N=5); buckwheat, *F. esculentum* (17.2%, N=5) and nizer, *Guizotia abyssinica* (L.) Cass. to some extent in Terai. Other minor crops included vegetable; wheat, *Triticum aestivum* L.; lentil, *Lens esculenta* Moench; blackgram, *Phaseolus mungo* L.; potato, *Solanum tuberosum* L.; cowpea, *Vigna unguiculata* (L.) Walp; sunflowers, *Helianthus annuus* L.; litchi, *Litchi chinensis* Sonner; mandarin orange, *Citrus reticulata* Balanco and greengram, *Phaseolus aureus* Roech (Table 2).

Table 1. Land holding of the beekeepers in Chitwan, 2004

Geographical area	Land holding (ha/household)		
	Upland	Lowland	Total
Hills	0.58	0.12	0.70
West Chitwan	0.25	0.42	0.67
East Chitwan	0.15	0.38	0.53
Bharatpur	0.33	0.24	0.57
Terai average	0.23	0.34	0.57
District average	0.41	0.33	0.74

Table 2. Crops grown by the beekeepers in Chitwan, 2004

Crops	Respondent (%)					Grand Total
	Hills	Terai			Total	
		West	East	Bht*		
Rice, <i>Oryza sativa</i> L.	44.4 (16)	100 (8)	92.3 (12)	50.0 (4)	82.8 (24)	61.5 (40)
Mustard, <i>Brassica campestris</i> L. var <i>dichotoma</i> (Roxb.) Kitam.	33.3 (12)	100 (8)	46.2 (6)	37.5 (3)	58.6 (17)	44.6 (29)
Maize, <i>Zea mays</i> L.	91.7 (33)	75.0 (6)	92.3 (12)	37.5 (3)	72.4 (21)	83.0 (54)
Sesame, <i>Sesamum orientale</i> L.	-	37.5 (3)	-	25.0 (2)	17.2 (5)	7.7 (5)
Buckwheat, <i>Fagopyrum esculentum</i> Moench	36.1 (13)	62.5 (5)	-	-	17.2 (5)	27.7 (18)
Vegetables	11.1 (4)	-	7.7 (1)	37.5 (3)	13.8 (4)	12.3 (8)
Wheat, <i>Triticum aestivum</i> L.	5.5 (2)	-	-	12.5 (1)	3.4 (1)	4.6 (3)
Lentil, <i>Lens esculenta</i> Moench.	-	-	7.7 (1)	-	3.4 (1)	1.5 (1)
Blackgram, <i>Phaseolus mungo</i> L.	2.8 (1)	-	-	-	-	1.5 (1)
Potato, <i>Solanum tuberosum</i> L.	-	-	-	25.0 (2)	6.8 (2)	3.1 (2)
Finger millet, <i>Eleusine coracana</i> Gaertn	77.7 (28)	-	-	-	-	43.0 (28)
Cowpea, <i>Vigna unguiculata</i> (L.) Walp.	5.5 (2)	-	-	-	-	3.1 (2)
Greengram, <i>Phaseolus aureus</i> Roech	5.5 (3)	-	-	-	-	4.6 (3)
Nizer, <i>Guizotia abyssinica</i> (L.) Cass.	5.5 (2)	25.0 (2)	-	37.5 (3)	17.2 (5)	10.8 (7)
Sunflowers, <i>Helianthus annuus</i> L.	-	-	25.0 (3)	-	10.3 (3)	4.6 (3)
Litchi, <i>Litchi chinensis</i> Sonner	2.8 (1)	37.5 (3)	16.7 (2)	37.5 (3)	27.6 (8)	13.8 (9)
Mandarin orange, <i>Citrus reticulata</i> Balanco	19.4 (7)	-	-	-	-	10.8 (7)

Figures in parentheses show the respondent numbers.

* Bharatpur

Income and food sufficiency

Per capita income from crop cultivation in hills (Rs 16122.20/household) was lower by 49.6% than in Terai (Rs 32,018.00/household). It was comparatively higher in East Chitwan (NRs 34691.63) than in West Chitwan (NRs 31321.14) and Bharatpur (NRs 28370.50 /hh/year) in Terai (Table 3). Food from their farm production was only

Table 3. Beekeeper's land holdings, annual gross income from the crops and food sufficiency in Chitwan, 2004

Geographical area	Land hold. (ha/hh)	Income from crop (NRs)	Food suffi. (months/yr)	Way to meet the deficiency	
				Source	Respondents (%)
Hills	0.70	16122.20	6.6	Wage labor,	41.7 (15)
				Shop keeping	5.6 (2)
West Chitwan	0.67	31321.14	9.9	Apiculture	25.0 (2)
East Chitwan	0.53	34691.63	9.3	Grocery	37.5 (3)
				Apiculture	37.5 (3)
				Metal-workshop	37.5 (3)
Bharatpur	0.57	28370.50	5.1	Civil service	37.5 (3)
				House renting	12.5 (1)
Terai average	0.57	32018.10	8.3	-	-
District mean	0.41	23214.20	7.36	-	-

Figures in parentheses show the respondent numbers

sufficient for 6.6 months in the hills and for 8.3 months in the Terai. It was highest in West Chitwan (9.9 months) followed by East Chitwan (9.3 months) and Bharatpur (5.1 months). The hill beekeepers fulfilled their additional requirements from wage labor while in the Terai, they derived their income sources from apiculture (37.5%, N=3), grocery (37.5%, N=3), metal workshop (37.5%, N=3), civil services, etc.

STATUS OF BEEKEEPING

Purpose of beekeeping

The purpose of beekeeping in Chitwan was mainly for income generation from honey production and selling. However, 27.8% hill and 86.0% Terai beekeepers also realized the role of honeybee on crop pollination and thereby crop diversification (Table 4). All beekeepers in Terai also produced wax from *A. mellifera* combs while it was insignificant in the hills.

Table 4. Main purpose of beekeeping in Chitwan, 2004

Particular	Respondent (%)		
	Hills	Terai	Total
Honey production	100.0(36)	100.0(29)	100.0(65)
Wax production	8.3(3)	100.0(29)	49.2(32)
Pollination awareness	27.8(10)	86.2(25)	53.8(35)

Figures in parenthesis show the respondent number

Among the respondent beekeepers, 27.8% (N=10) in hill and 86.0 % (N=25) in Terai were aware about the role of honeybees on pollination. The beekeepers in hills reported that the yield of mustard, *B. campestris*; citrus, *C. reticulata*; and buckwheat, *F. esculentum* rose by 10.0-25.0% from honeybee pollination. However, the Terai beekeepers realized the crop yield of cross-pollinated crops i.e. mustard, *B. campestris*; buckwheat, *F. esculentum* and litchi, *L. chinensis* rose up to 40.0% (Table 5).

Table 5. Crop productivity realized from honeybee pollination in Chitwan, 2004

Production rose	Respondent (%)					Grand Total
	Hills	Terai				
		West	East	Bharatpur	Total	
< 14 %	25.0 (9)	-	-	12.5 (1)	3.4 (1)	15.4 (10)
14-25%	2.8 (1)	75.0 (6)	53.8 (7)	50.0 (4)	58.6 (17)	27.7 (18)
25-35%	-	-	23.1 (3)	25.0 (2)	17.2 (5)	7.7 (5)
>35%	-	-	15.1 (2)	-	6.8 (2)	15.4 (2)
Mean	14.1 %	20.6 %	30.4 %	22.1 %	25.4 %	19.1 %

Figures in parentheses show the respondent numbers

Species of honeybees

Two domesticated honeybees: *A. mellifera* in Langstroth hive in Terai and *A. cerana* in 3 different hives (41.1% in improved, 31.2% in traditional log and 27.6% in wall hives) mainly in hills, with an mean colony size of 4.4 per household (N=36) in hills and 50.0 per household (N=29) in Terai were adopted by the beekeepers in Chitwan (Table 6, Fig. 1). The mean colony number of *A. mellifera* was highest in Bharatpur (87.5 colonies/household) followed by East Chitwan (43.6 colonies/household) and West Chitwan (22.6 colonies/household), respectively.

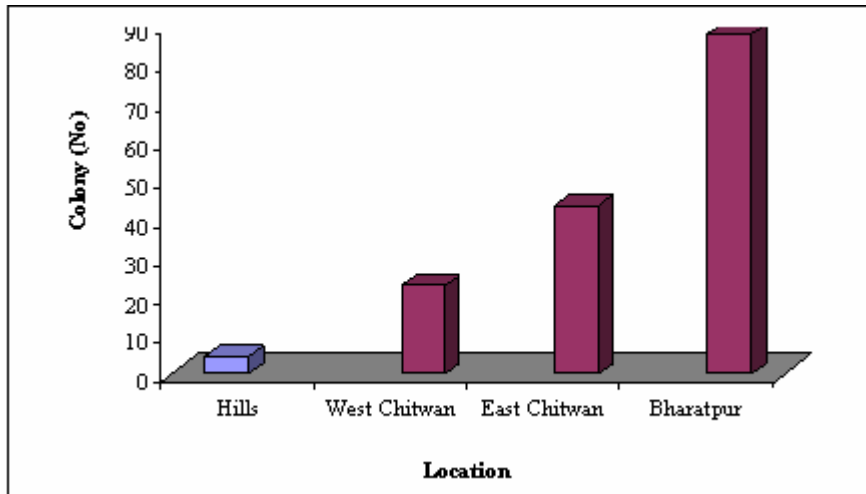
Table 6. Honeybee species kept by the beekeepers in Chitwan, 2004

Particulars	Location	<i>A. cerana</i>		<i>A. mellifera</i>		Total	
		Colony	%	Colony	%	Colony	%
Colony number	Hills	170	99.4	1	0.6	171	10.6
	Terai	-	-	1448	100	1448	89.4
	Total	170	10.5	1449	89.5	1619	100
Hive types	Hills: Improved	70	41.2	1	100	71	4.4
	Log	53	31.2	-	-	53	3.3
	Wall	47	27.6	-	-	47	2.9
	Terai: Improved	-	-	1448	100	1448	89.4
	Total	170	100	1449	100	1619	100
	Average colony/hh	Hills	4.4 (36)	-	1(1)	-	4.4 (36)
	Terai	-	-	50.0 (29)	-	50.0 (29)	-
	East Chitwan	-	-	43.6 (13)	-	43.6 (13)	-
	Bharatpur	-	-	87.5 (8)	-	87.5 (8)	-
	West Chitwan	-	-	22.6 (8)	-	22.6 (8)	-

Figures in parentheses show the respondent numbers

Colony handling

The range of the bee colonies per household ranges 4-250. The colony holding of *A. cerana* was found 4.4 /household, ranging from 4-12. The human resource involved to manage these colonies was 1.6/household and the range was 1-3. However, human resource engaged in keeping with *A. mellifera* in Terai ranged from 1-9 persons (Average 2.9/household). It was lower in West Chitwan (1.9 person/household) than in Bharatpur area (3 person/household) and in East Chitwan (3.5 person/household). Moreover, the per capita holding of *A. mellifera* colonies in Terai was significantly higher (50.0 colonies per



household), among the respondents. Where, it was extremely higher (88.4 colonies/household) in Bharatpur followed by East Chitwan (43.3 colony/household) and least in West Chitwan (23.3 colonies/household) (Table 7).

Figure 1. Mean number of colonies kept by beekeepers in Chitwan, 2004.

Table 7. Man power involved in beekeeping in Chitwan, 2004

Location	Honeybee colonies (No.)			Labour involved (No./household)		
	Range /household	Mean /household	Total	Range /household	Mean /household	Total
Hills	4-12	4.4	170 (36)	1-3	1.6	57
Terai	10-250	50.0	1456 (29)	1-9	2.9	85
West Chitwan	10-65	22.6	185 (8)	1-4	1.9	15
East Chitwan	10-95	43.6	563 (13)	1-7	3.5	46
Bharatpur	10-250	87.5	708 (8)	1-9	3.0	24
District total	4-250	25.0	1626 (65)	1-9	2.2	142

Figures in parentheses show the respondent numbers.

Honey production

The productivity of *A. mellifera* was 254.3% higher (28.7 kg vs 8.1 kg/colony/yr) than *A. cerana* (improved hive 8.6 kg, log hive 7.7 kg and wall hive 7.4 kg/yr) (Table 8). The beekeepers harvested honey 2-7 (mean 3.2) times from *A. cerana* in autumn and spring in the hills and 3-7 times (mean 4.8) from *A. mellifera* in the Terai in winter and spring. East Chitwan farmers had the highest honey harvesting frequencies (5.3 times/year) with the highest productivity of 34.8 kg per colony per year followed by (Bharatpur 4.6 times with 25.1 kg /colony /year) and West Chitwan (4.2 times with 22.2 kg /colony /year) (Table 8).

Table 8. Honey yield and harvesting frequency in Chitwan, 2004

Geographical location	Yield (kg/hive/yr.)	Harvesting frequency (No./year)	
		Range	Mean
Hills	8.1	2 - 7	3.2
Terai	28.7	3 - 7	4.8
West Chitwan	22.6	3 - 7	4.6
East Chitwan	34.8	3 - 7	5.3
Bharatpur	25.1	3 - 6	4.2
District mean	26.5	2 - 7	3.9

Honey price

Honey price was found decreasing annually by 4.7% in Terai and by 3.9% in hills and was ranging from Rs 100-150/kg in 2004. The average price of honey in the hills was 9.2% lower (Rs 104.7 vs 115.4/kg) than in Terai, and was highest in Bharatpur (Rs 132.5 vs 108.9 and 109.9) than in East and West Chitwan (Table 9, Fig. 2).

Table 9. Market price of honey during 2000-2005 in Chitwan, 2004

Year	Hills	Terai			Total
		West	East	Bharatpur	
2000	130.0	140.0	150.0	160.0	150.0
2001	130.0	135.0	135.0	150.0	140.0
2002	120.0	135.0	140.0	145.0	140.0
2003	120.0	128.0	126.0	136.0	130.0
2004	110.0	109.9	108.9	132.5	115.4
2005	104.7	109.9	108.9	132.5	115.4

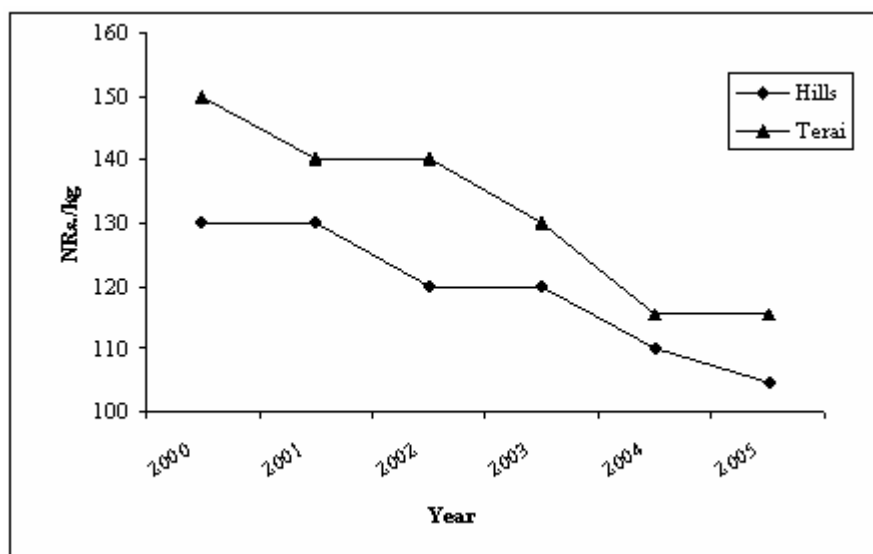


Figure 2. Honey price in Chitwan during 2000/2005

Honey marketing

The hill beekeepers in Chitwan sold *A. cerana* honeycombs or hand squeezed honey in Terai. The small and medium beekeepers (72.4%) in Terai supplied honey to the local market after wire/muslin cloth filtering. Some beekeepers also sold raw honey to the bigger farmers and or to Nepal Bee Keepers Association. Big farmers (27.6%) were involved in home processing, packing and marketing of honey or sold it to bee association, and thus, had access to market with all sorts of consumers i.e. with in district, inter-district and even at the international level. Honey marketing channel in Chitwan is shown in Fig. 3.

A total of 17.2% of *A. mellifera* honey sold was seal packed and rest (82.8%) was sold after wire/cloth filtered (Table 10).

Table 10. Types of honey marketed by beekeepers in Chitwan, 2004

Location	Farmer	Respondents (%)			Total
		Raw/comb	Filtered	Processed	
Hills	Small	100 (36)	-	-	100 (36)
Terai	Small	20.0 (2)	80.0 (8)	-	100 (10)
	Medium	72.7 (8)	27.3 (3)	-	100 (11)
	Big	9.1 (1)	18.2 (2)	62.5 (5)	100 (8)
	Sub total	37.9 (11)	44.8 (13)	17.2 (5)	100 (29)
Total		72.3 (47)	20.0 (13)	7.7 (5)	100 (65)

Figures in parentheses show the respondent numbers

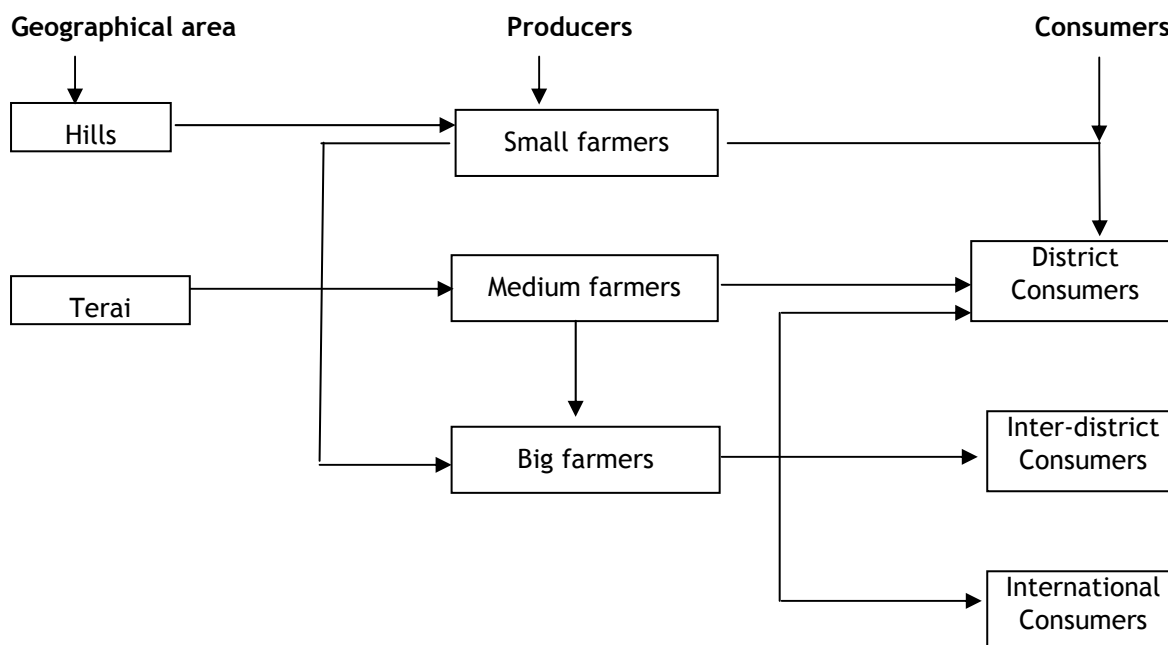


Figure 3. Marketing channel of honey in Chitwan, 2004.

Income from honey marketing

The average annual gross income from beekeeping was Rs 3794.4 /household (Rs. 862.36 /colony/year) in hills and Rs 1,84,474.3 (Rs 3,689.49/colony/year) in Terai. The range of the annual income from *A. cerana* beekeeping in hills was Rs 1,200-7,200 per household per year, which was several folds less than that of *A. mellifera* beekeepers in Terai (Rs 12,000-11,50,000) (Table 11). The average annual income of *A. mellifera* beekeeping in Bharatpur area was Rs 3,29,893 and was 475% higher than that of West Chitwan and 90.2% higher than East Chitwan because of high number of the colonies kept by the beekeepers in Bharatpur.

Table 11. Honey production and household gross income in Chitwan, 2004

Site/hive type	Colony number /hh		Productivity (kg/hive/yr)		Honey price (Rs)		Income (Rs/year)	
	Range/h	Total	Range	Mean	Range	Mean	Range	Mean
Hills	4-12	4.40(36)	2-15	8.1	100-150	104.7	1200-7200	3794.4
Improved	2-12	4.12 (17)	2-14	8.6	100-150			
Log hive	1-6	3.41(17)	5-15	7.7	100-150			
Wall hive	1-5	2.80(15)	3-15	7.4	100-150			
Terai	10-250	53.66(29)	10-60	28.7	100-150	115.4	12000-115000	184474.3
West	10-65	23.13 (8)	10-35	22.2	100-130	109.0	12000-149500	57047.5
East	10-95	43.31(13)	10-60	34.8	100-120	108.9	13800-627000	173401.9
Bharatpur	10-250	88.50(8)	10-40	25.1	115-150	132.5	15000-1150000	329893.8
District total	4-250	25.01(65)	2-60	26.5	100-150	114.3	1200-1150000	83996.8

Figures in parentheses show the respondent numbers.

Comparitive income from beekeeping with crop production

The mean per capita gross agricultural income of the beekeepers in Chitwan was NRs 107211.10 per household per annum. It was several folds higher in Terai than in hills (NRs 216492.40 vs NRs 19916.60). The per capita income was highest in Bharatpur (NRs 358264.30) followed by East Chitwan (NRs 208073.50) and West Chitwan (NRs 88357.60 /hh/year). The per capita income was higher by 261.83 % from apiculture than crop cultivation (NRs 83996.88 vs NRs 23214.22 /hh/year). Out of the total income, 78.35% was from beekeeping and rest from crop production. Income from apiculture was highest in Bharatpur (92.08%), followed by East Chitwan (83.33) and West Chitwan (64.56%). However, in hills the per capita income from apiculture was lower (19.05%) than crop production (80.95%). It was because of the adoption of lower number of colonies by the beekeepers in hills and the productivity and production of honey were in smaller quantities. The beekeepers in hills are dependent to crop cultivation and other alternatives income generating activities although it was also found marginal (Nrs 16122.20/hh). It was highest in East Chitwan (Nrs 34691.63/hh) followed by West Chitwan

(N31321.14/hh) and in Bharatpur (Nrs 28370.50/hh) (Table 12). Thus, the total income from agriculture in hills was several folds smaller than in Terai.

Table 12. Contribution of beekeeping in the household income in Chitwan, 2004

Location	Income (NRs)			Apicultural contribution (%)
	Crop production	Honey production	Total	
Hills (36)	16122.20	3794.40	19916.60	19.05
West Chitwan (13)	31321.14	57047.5	88357.60	64.56
East Chitwan (8)	34691.63	173401.90	208093.50	83.33
Bharatpur (8)	28370.50	329893.80	358264.30	92.08
Terai mean (29)	32018.10	184474.30	216492.4	85.21
District mean (65)	23214.20	83996.88	107211.10	78.35

Figures in parentheses show the respondent numbers

Suggestions given from beekeepers

A diagnostic laboratory for problem identification and provision of bee treatment, technical help and follow up support, breed selection, queen rearing and bee research program has been felt necessary in beekeeping for its commercialization in Chitwan. Beekeepers from the hills and Terai have suggested in many ways for the promotion of beekeeping in Chitwan. Modification of traditional log and wall hives, training on hive making, swarm capture and hiving, absconding control, better methods of honey harvesting and wax processing trainings are suggested by the *A. cerana* keepers. They also suggested for the development of low cost honey extractor. *A. cerana* race selection for better productivity and domestication has been felt necessary. However, the commercial *A. mellifera* keepers in Terai suggested for the advance level crop pollination and problem solving training and demanded a secured honey market and declaration of beekeeping policy and guideline from GoN. They demanded a diagnostic laboratory and provision of bee treatment follow up support and technical help from the government side. They are aware on the conflict arbitration on bee migration between beekeepers and bee crop growers and demanded interaction between the crop growers and beekeepers. Traffic problem on bee migration should be solved and GoN should attempt to control bee poisoning through legislative way.

DISCUSSION

Beekeepers adopted *A. mellifera* in Terai in improved hives and *A. cerana* in improved (41.1%), traditional log (31.2%) and wall hives (27.6%) in hills. Devkota (2003) stated that the Chepang and the hill caste communities were adapting *A. cerana* in traditional hives in hills. DADO (2004; 2005) stated that *A. mellifera* multiplied during nineties and distributed through both farmers to farmers (59%) and from DADO to farmers (41.0%) in nineties in Terai. The average colonies in the hills were 4.4 and in Terai 50.0 per household. Labor engaged to manage these colonies were 1.6 in hills and 2.9 in Terai, which is in agreement with Neupane (2002). He estimated 5,500 *A. mellifera* and 2,000 *A. cerana* bee colonies in Chitwan in the year 2002. Beekeeping in Chitwan was mainly for income generation from honey selling as pointed by Bee Keeping Section (2003). However, considerable number of respondents (27.8% in hills and 86.0% in Terai) realized the role of honeybees in crop pollination. Reddy (1995) estimated that crop production increased by 30 to 3000 percent through bee pollination. Devkota (2000) also agreed on the result that

pollination could significantly improve both yield and seed quality of bee pollinated crops. Similarly, many crops benefited from bee pollination (Free, 1993, Pokhrel, 2001).

The hill and Terai respondents had an average landholding of 0.70 ha (irrigated 0.12 ha) and 0.57 ha (irrigated 0.34 ha), respectively which is smaller than national average of 0.727 ha/hh (Agri-Business Promotion and Statistics Division, 2005). Mean annual income from crop cultivation in hills (Rs 16,122.20/hh) was lower by 49.6% than in Terai (Rs 32,018.00/hh) and food sufficiency was only for 6.6 months in hills and 8.3 months in Terai. The per capita GDP is lower in hills and higher in Terai than the national average of Rs 20821 (Agri-Business Promotion and Statistics Division, 2005).

The productivity of *A. mellifera* was 254.3% higher (28.7 kg vs 8.1 kg/colony/yr) than *A. cerana* (improved hive 8.6 kg, log hive 7.7 kg and wall hive 7.4 kg/yr). The results was similar to the previous study (Devkota, 2000). The beekeepers harvested honey 2-7 (mean 3.2) times from *A. cerana* during autumn and spring in the hills and 3-7 times (mean 4.8) from *A. mellifera* in Terai during winter and spring. Where, East Chitwan farmers had highest honey harvesting frequency (5.3 times/year) with the highest productivity (34.8 kg/colony/year) followed by Bharatpur (4.6 frequency with 25.1 kg/colony/year) and West Chitwan (4.2 frequency with 22.2 kg/colony/year), respectively. The production, productivity and harvesting frequencies were highly correlated with flora availability, management practices adopted and the colony number kept by the beekeepers.

Honey price (wholesale) was found decreasing annually by 4.7% in Terai and by 3.9% in hills, which ranged from Rs 100-150/kg in the year 2004. The mean honey price decreased from Rs.125 to 111 per kg in the past five years before 2003 in Chitwan (DADO, 2004). It was 9.2% lower (Rs 104.7 vs 115.4/kg) in hills than in Terai and was highest in Bharatpur (Rs 132.5 vs 108.9 and 109.9) than in East and West Chitwan. The reason was increased volume of honey production and limited domestic market availability with limitation on honey export due to unavailability of residue monitoring facility in the country (Pokhrel, 2001). The mean per capita income of the beekeepers from beekeeping in Chitwan was NRs 107211.10 which was several folds higher in Terai than in hills (NRs 216492.40 vs NRs 19916.60).

The per capita income of the beekeepers was higher by 261.83 % from apiculture than crop cultivation (NRs 83996.88 vs NRs 23214.22 /hh/year) although, it was lower (19.05% vs 80.95%) in hills because of the lower number of colonies kept by the beekeepers and lower honey production and productivity. In such cases, beekeeping can play a major role in poverty reduction and food security enhancement in Terai of Nepal. However, it needs special apicultural package of practices for the promotion of beekeeping in hills.

CONCLUSION AND RECOMMENDATION

The study realized that the hills needed a special package of practices for crop production that supported promotion of *A. cerana* beekeeping, which include educational activities, technical supports and extension of low cost technology to increase the productivity of *A. cerana* colonies.. In the Terai, *A. mellifera* was found promoting in terms of honey production, harvesting frequency, per capita colony holding and annual income, where commercialization of beekeeping with *A. mellifera* can earn higher than crop production. Hence, the demand of honey in both the domestic and external market is growing and to meet the demand an advanced apicultural research and extension mechanism including crop pollination and beekeeping trainings, a secured market for honey and formulation and implementation of clear beekeeping policy and guidelines by the government are recommended.

REFERENCES

- Agri-Business Promotion and Statistics Division. /2005. Statistical Information on Nepalese Agriculture, 2004/2005.125pp.
- Beekeeping Section. 2003. Annual Progress Report, 2002/2003. Bee Keeping Section, Godavari, Lalitpur, Nepal. 57 pp.
- Beekeeping Section. 2004. Annual Progress Report, 2003/2004. Bee Keeping Section, Godavari, Lalitpur, Nepal. 52 pp.
- Devkota, F.P. 2000. Comparative pollination behavior of *Apis cerana* F. and *A. mellifera* L. on brocauli and their impact on seed production. Master Thesis Tribhuvan University, Institute of Agriculture and Animal Science, Rampur, Chitwan, Nepal.
- Devkota, K.H. 2003. Economic impact of apiculture in Nepal (a case study of Jutpani VDC), Chitwan. Master Thesis. Tribhuvan University, Faculty of Humanities and Social Science, Birendra Multiple Campus, Bharatpur, Chitwan, Nepal. 76 pp.
- District Agriculture Development Office (DADO). 2004. An overview of beekeeping and honey production in Chitwan district, Nepal. DADO, Chitwan, Nepal. 27 p.
- District Agriculture Development Office (DADO). 2005. Barsik Krishi Bikas Karyakram Tatha Tathyanka. 2004. DADO, Chitwan, Nepal. 124 pp.
- Free, J.B. 1993. Insect pollination of crops (second edition). London: Academic Press Inc. Ltd.
- Neupane, K.R. 2002. Byabasaik Mauri Palanma Chitwan Jilla Agrasthanma. Chitwan Mahotsov Smarika Chitwan. pp.31. (in Nepali).
- Pokhrel, S. 2001. Impact of supplement diets on brood and honey production of *Apis mellifera* L. Master's Thesis. Tribhuvan University, Institute of Agriculture and Animal Science, Rampur, Chitwan, Nepal. 103 pp.
- Reddy, C.C. 1995. Management practices and migratory beekeeping. In: P.G. Kevan (ed.), The Asiatic hive bee: Apiculture, biology and role in sustainable development in tropical and sub-tropical Asia. Enviroquest Ltd., Canada. pp 209-215.