Chapter- 7

ECONOMICS OF NICHE-BASED AGRICULTURAL ENTERPRISE

7.1 Potentials and Constraints of Niche-based Agriculture

Despite having relatively low crop cultivation activities and crop-yields in hill agriculture, the agroclimatic and physiographic diversity in the mountain region offer different production 'niches. Many of such niches may not be suitable for food crops (Pratap, 1995), while they enable to develop multiple agro-enterprises such as horticulture, floriculture, sericulture, apiculture, agro-forestry, pisciculture as well as other miscellaneous crops. Such niche-based agricultural enterprises have great potential to usher prosperity in the region (Chand, 1997). The transformation of the area from food-crops to fruit-crops, besides improving the hill people's livelihoods, generates positive effects on environment through windbreaks, microenvironment migration, efficiency in solar radiation, and soil and water conservation (Bao, 1998, 1999). Such shift of land also acts as a bulwark against landslide as in agroforestry, apiculture and mulberry plantation for sericulture. However, this induces extra production and marketing risks and challenges, for overcoming which, new ideas, improved technologies and management would be crucial (Bao, *et. al*., 2001). With differences in areas of consumption and production, the floriculture has no local market (Nasol, 1993), and thereby the production-base needs to be diversified. The production niches are, however, elevation-specific and thus are not accessible to all mountain farmers.

The intentional manipulation of farmland through cultivation of annual and perennial crops is currently known as agroforestry that compromises between intensive and extensive land-use to ensure biomass (Denholm, 1991). Such land-use system involves intercropping of multipurpose trees on farmland along with field and fruit crops and livestock, and it thus leads to diversified farming system. It also generates some minor niche which can be realised through cultivating high-value species by intercropping (*ibid.*). Hence, agroforestry is a resource management programme usually adopted by mountain farmers to cope with various problems resulted from natural resource-based production, for ensuring sustainable rural development (Djogo, 1995). Agroforestry is an integral component of the traditional hill farming system, and plays a vital role for better utilisation of marginal cropland (Neupane & Thapa, 2001).
Apiculture converts environmental niche into productive activities for hill farmers, especially those belonging to the marginalised communities, and diversifies their incomes through using limited resources (ICIMOD, Annual Report, 2004). The indigenous honey bees, *Apis cerana,* in the region improve the people's livelihood by generating high-value products such as honey, wax, pollen, royal jelly and propels. They also raise and enhance productivity of seeds and crops in the farming system and the surrounding natural flora through pollination (Pratap & Pratap, 1997), and thus, provide an immeasurable service to agriculture and environment. Cross-pollination of entomophilous crops by honey bees is one of the most effective and cheap methods of increasing their yields (Free, 1993; Verma, 1993).

Sericulture through mulberry plantation also improves the livelihoods of the poor people, especially the marginalised farmers, and has high return and low gestation. The mulberry plants hold the soil firmly through their profuse and robust roots and thereby prevent soil erosion (Shrestha, 2006). With light work-burden in sericulture, it can be practised with family labour irrespective of age and gender (Malakar, 1986), and thereby it is women friendly. Sericulture can be considered as a component of agroforestry system because of multipurpose uses of mulberry plants (JMC, Final Report, 2003), and it has a great potential in the north-eastern regions of India with sloping landscape (Dhyani, *et al*.**,** 1996).

7.2 Status and Economics of Non-traditional Residual Agricultural Enterprises

Besides tea, the region is also known for mandarin orange. With respect to horticulture, the Darjeeling hills can be subdivided into two agroclimatic zones- a) the sub-tropical zone ranging from 600-1200 metres and b) the temperate zone ranging from 1200 metres to higher altitudes (BCKV, 1996). Although the congenial agroclimatic conditions of the region offer excellent potential for growing sub-tropical and temperate fruits such as mandarin orange(*Citrus raticulata*), banana (*Musa spp.*), avocado (*Persea americana*), plum (*Prunus domestica)*, peach (*Prunus persicq*) and pear (*Pyrus spp.*) (*ibid.*), the main fruit grown is mandarin orange that thrives best within the sub-tropical zone (DRDA, 1990, *op.cit.*). In the region, about 15000ha land was committed to mandarin orange, although its average productivity was very low at the range of 5-6 quintals per hectare (BCKV, 1996, *op.cit.*).

Apis cerana, the native hive bee of Asia, is the most valuable natural resource in the region and a vital component of the natural ecosystem (Thapa, 2012; Abrol, 2013). A healthy bee fauna is an indication of a healthy forest and its natural balance (MSHMPB, 2008). Thus, apiculture is an integral component of agroforestry system. The diversified bee forage plants in the region offer great potential for the development of apiculture (BCKV, 1996, *op.cit.*). The unique biological wealth of forests and agriculture mix of the hills and the adjacent transitional belts can be transformed into economically prosperous region through apiculture (*ibid.*). Thus, apiculture is a subsidiary means of income generation for the poor farmers, especially in remote villages (DRDA, 1990).

7.2.1 Status and Economics of Fruits

Table 7.1 shows the area, number and frequency distribution of fruit trees/ plants in the study villages. Several varieties of major fruits such as mandarin orange, banana, papaya (*Carica papaya*), *arucha* (peach), *arubokhra* (plum), pear, avocado, *garendal* (passion fruit, *Passiflora edulis*) as well as minor fruits such as mulberry (*Morus alba*), apple (*Malus domestica)*, *morello* (brandy cherry), *lopsi* (*Spondias axillaris)*, *kimbu* (*Morus indica*) and *kamala* (loose jacket or santra orange) were grown in the villages, while the main commercial fruit was mandarin orange. However, because of necessity of suitable agroclimate for orange cultivation, the household participation rate in orange cultivation, orange trees owned per household and the proportion of orange tress to the total fruit trees were low in the

Table 7.1: Area and Number of Fruit Trees and Frequency Distribution of Fruit Growers across Villages

	Absolute Number of Fruit Trees/Plants											Tree/Plant Distribution [%]									
	Major									Min-or		Major									Min-or
Hamlet	Oran-ge$	Bana-na	Papa-ya	Gua-va	Pea-ch	Plu-m*	Pear	Avo-cado	Pass-ion fruit	All**	All	Oran-ge$	Bana-na	Papa-ya	Gua-va	Pea-ch	Plu-m*	Pear	Avo-cado	Pass-ion fruit	All**
High Diversification Trend																					
Chisopani	25	231	8	67	12	5	2	8	1	36	395	*6.3*	*58.5*	*2.0*	*17.0*	*3.0*	*1.3*	*0.5*	*2.0*	*0.3*	*9.1*
Poshyore	1745	336	17	73	13	3	20	18	79	57	2361	*73.9*	*14.2*	*0.7*	*3.1*	*0.6*	*0.1*	*0.8*	*0.8*	*3.3*	*2.4*
Ramitay	131	465	32	76	26	17	22	18	42	39	868	*15.1*	*53.6*	*3.7*	*8.8*	*3.0*	*2.0*	*2.5*	*2.1*	*4.8*	*4.5*
Moderate Diversification Trend																					
Mahakaldara	164	270	5	56	26	6	12	8	147	236	930	*17.6*	*29.0*	*0.5*	*6.0*	*2.8*	*0.6*	*1.3*	*0.9*	*15.8*	*25.4*
Lamini Gaon	293	373	10	93	20	8	13	7	4	94	915	*32.0*	*40.8*	*1.1*	*10.2*	*2.2*	*0.9*	*1.4*	*0.8*	*0.4*	*10.3*
Lepcha Gaon	65	365	43	99	25	61	78	9	12	66	823	*7.9*	*44.3*	*5.2*	*12.0*	*3.0*	*7.4*	*9.5*	*1.1*	*1.5*	*8.0*
Yogda	365	318	48	83	21	11	16	6	146	71	1085	*33.6*	*29.3*	*4.4*	*7.6*	*1.9*	*1.0*	*1.5*	*0.6*	*13.5*	*6.5*
Low Diversification Trend																					
Lwr Gairi Gaon	14	277	1	31	16	2	12	2	1	23	379	*3.7*	*73.1*	*0.3*	*8.2*	*4.2*	*0.5*	*3.2*	*0.5*	*0.3*	*6.1*
Khawas Gaon	101	513	26	21	10	0	5	1	13	134	824	*12.3*	*62.3*	*3.2*	*2.5*	*1.2*	*0.0*	*0.6*	*0.1*	*1.6*	*16.3*
Upr Gairi Gaon	3	91	1	30	27	2	11	3	4	26	198	*1.5*	*46.0*	*0.5*	*15.2*	*13.6*	*1.0*	*5.6*	*1.5*	*2.0*	*13.1*
Bimbong	590	306	25	65	10	8	3	0	41	173	1221	*48.3*	*25.1*	*2.0*	*5.3*	*0.8*	*0.7*	*0.2*	*0.0*	*3.4*	*14.2*
Sundung	12	326	37	69	18	3	15	18	3	62	563	*2.1*	*57.9*	*6.6*	*12.3*	*3.2*	*0.5*	*2.7*	*3.2*	*0.5*	*11.0*
Total Selected Villages	**3508**	**3871**	**253**	**763**	**224**	**126**	**209**	**98**	**493**	**1017**	**10562**	***33.2***	***36.7***	***2.4***	***7.2***	***2.1***	***1.2***	***2.0***	***0.9***	***4.7***	***9.6***

Hamlet	Proportion of Households [Hhs] Engaged in Nurturing Fruits [%]											Per Hh Fruit Tree/ Plant [No.]		Proportion of Trees/ Plants Yielding Fruits [%]		Cultivated Area Occupied by Fruits		Fruit Trees/ Plants Per ha Cultivated Area	
	Major									Min-or									
	Oran-ge	Bana-na	Papa-ya	Gua-va	Pea-ch	Plum	Pear	Avo-cado	Pass-ion fruit	All	All	All	Orange	All	Orange	Hec-tare	Per-cent	All	Orange
High Diversification Trend																			
Chisopani	*56*	*80*	*24*	*96*	*36*	*16*	*8*	*20*	*4*	*40*	*100*	16	1.0	*57.0*	*40.0*	0.198	*1.5*	30	2.0
Poshyore	*64*	*76*	*32*	*80*	*32*	*4*	*52*	*28*	*32*	*56*	*100*	94	70.0	*54.0*	*53.8*	3.545	*21.4*	142	105.0
Ramitay	*48*	*88*	*60*	*84*	*60*	*40*	*36*	*20*	*8*	*28*	*100*	35	5.0	*46.2*	*8.4*	0.253	*2.0*	68	10.0
Moderate Diversification Trend																			
Mahakaldara	*60*	*76*	*12*	*88*	*60*	*16*	*36*	*20*	*36*	*68*	*96*	37	7.0	*71.5*	*65.2*	0.672	*5.7*	78	14.0
Lamini Gaon	*52*	*88*	*20*	*84*	*48*	*24*	*36*	*12*	*8*	*56*	*100*	37	12.0	*41.5*	*3.4*	0.212	*1.4*	62	20.0
Lepcha Gaon	*32*	*84*	*60*	*68*	*60*	*92*	*72*	*8*	*20*	*72*	*100*	33	3.0	*61.7*	*18.5*	0.348	*2.8*	65	5.0
Yogda	*84*	*84*	*64*	*88*	*56*	*28*	*44*	*16*	*48*	*48*	*96*	43	15.0	*53.2*	*33.7*	0.643	*4.5*	76	26.0
Low Diversification Trend																			
Lwr Gairi Gaon	*28*	*92*	*4*	*64*	*52*	*8*	*44*	*4*	*4*	*20*	*96*	15	1.0	*44.6*	*85.7*	0.134	*1.2*	35	1.0
Khawas Gaon	*8*	*100*	*60*	*48*	*40*	*0*	*20*	*4*	*12*	*52*	*100*	33	4.0	*43.7*	*0.0*	0.180	*1.1*	50	6.0
Upr Gairi Gaon	*12*	*52*	*4*	*68*	*64*	*8*	*32*	*8*	*16*	*44*	*96*	8	0.1	*61.1*	*100.0*	0.148	*1.6*	21	0.3
Bimbong	*92*	*84*	*36*	*72*	*24*	*16*	*12*	*0*	*28*	*76*	*100*	49	24.0	*54.4*	*59.0*	1.692	*8.8*	63	31.0
Sundung	*24*	*84*	*72*	*80*	*44*	*8*	*24*	*24*	*8*	*48*	*100*	23	0.5	*51.7*	*33.3*	0.139	*1.2*	48	1.0
Total Selected Villages	***47***	***82***	***37***	***77***	***48***	***22***	***35***	***14***	***19***	***51***	***98.7***	**35**	**12.0**	***53.4***	***45.0***	**8.164**	***5.0***	**65**	**21.0**

Source: *Sample Survey*

$ Mandarin Orange; * *Arucha and Arubokhra*; and ** incl. Mango, Mulberry, Apple, Lemon, Jackfruit, Litchi, *Morello*, Shaddock, *Lopsi*, Walnut, Pineapple, *Kimbu*, *Jambir*, Custard apple (*Sherifa)*, *Amala*, Pomegranate, Washington, *Kusum*, *Kamala*, *Simbali* and *Mail*

villages, but this varied widely between the villages. These were higher in villages like Bimbong with lower diurnal duration of sunshine, limited winter cropping and inferior slope aspect when compared to the villages like Khawas Gaon with moderate to superior slope aspects. Conversely, the household participation rate in banana cultivation, banana plants owned per household and proportion of banana plants to the total fruit trees/plants were high in most villages, mainly because of multiple uses of the banana fruits and plants, agroclimatic non-sensitiveness of banana plants and possibility of banana cultivation on inferior farmland. Generally, these were higher in the villages at low elevation like Khawas Gaon, and lower in the villages at higher elevation like Chisopani. The households cultivated multiple varieties of banana such as *chinichampa and malbhog* on a smaller scale primarily in homestead land like as papaya for consumption smoothing and generating stable yields during the year.

The avocado and passion fruit were recently initiated by limited households on a smaller scale with their emerging market and the initiative of a private company for spreading passion fruit through imposing buy-back term, while the households would also collect wild avocado from forests. Consequently, the household participation rate in cultivation of both avocado and passion fruit as well as of avocado trees and passion fruit plants per household was low in the villages. For avocado, this was higher in most of the nearer villages. With more ethnic connection in cultivation of passion fruits, the household partication was higher in the tribal villages than in the non-tribal villages. The growing of mulberry and *kimbu* trees was the consequence of rearing of silkworm and of growing of orange respectively in the villages. Most of the minor fruits were mainly grown by the households on a trial basis. Nevertheless, fruit cultivation was popular among the households in the villages. The higher household participation rate in these villages in the cultivation of the total fruits and the larger number of fruit trees/plants per household reflected this popularity. These were relatively higher in villages with inferior slope aspect because of their greater opportunity for cultivating orange, and lower in villages with moderate to superior slope aspects. Hence, commercial orange growing was recently performed mainly in the villages with inferior slope aspect and in the moderate distant hamlet of Poshyore, although this pattern is likely to shift from orange to avocado and passion fruit growing in some hamlets in future.

Instead of land commitment to specific fruit, the total orchard land of the households was collected, since most fruit trees were not grown alone in pure stand, rather they were grown either along with field crops or on field bunds and field boundaries. Generally, fruits with low commercial value such as banana were grown on field bunds. The papaya plants were generally grown on homestead land like as banana plants. Although most *garendal* growers cultivated *garendal* plants on field boundaries using trees as supporter, some of them even cultivated it on crop field, mainly in the villages with inferior slope aspect. Because of scarcity of superior land and low profitability in orange cultivation, the large orange growers generally practised orange-intercropping. In the study region, the proportion of orange growers following intercropping with field crops to the total orange growers was 43.6 per cent. Along with orange intercropping, orange fruit and farmland commitment to orange per household and the proportion of orange land to the total land commitment to fruits were relatively higher in the villages with inferior slope aspect.

Table 7.2 depicts the area and number and frequency distribution of fruit trees/ plants across the holding-sizes.

Table 7.2: Area and Number of Fruit Trees and Frequency Distribution of Fruit Growers across the Holding-size Categories of the Households

Land-Holding-size Categories	Absolute Number of Fruit Trees/Plants: Major: Orange$	Banana	Papaya	Guava	Peach	Plum*	Pear	Avocado	Passion fruit	Minor All**	All	Tree/Plant Distribution [%]: Major: Orange$	Banana	Papaya	Guava	Peach	Plum*	Pear	Avocado	Passion fruit	Minor All**
≤1 acre	321	996	83	193	77	39	57	35	138	205	2144	*15.0*	*46.5*	*3.9*	*9.0*	*3.6*	*1.8*	*2.7*	*1.6*	*6.4*	*9.6*
1-3 acres	995	2084	142	409	121	69	138	41	198	565	4762	*20.9*	*43.8*	*3.0*	*8.6*	*2.5*	*1.4*	*2.9*	*0.9*	*4.2*	*11.9*
>3 acres	2192	791	28	161	26	18	14	22	157	247	3656	*60.0*	*21.6*	*0.8*	*4.4*	*0.7*	*0.5*	*0.4*	*0.6*	*4.3*	*6.8*
All Sample Hhs	**3508**	**3871**	**253**	**763**	**224**	**126**	**209**	**98**	**493**	**1017**	**10562**	***33.2***	***36.7***	***2.4***	***7.2***	***2.1***	***1.2***	***2.0***	***0.9***	***4.7***	***9.6***

Land-Holding-size Categories	Proportion of Households [Hhs] Engaged in Nurturing Fruits [%]: Major: Orange	Banana	Papaya	Guava	Peach	Plum	Pear	Avocado	Passion fruit	Minor All	All	Per Hh Fruit Tree/ Plant [No.]: All	Orange	Proportion of Trees/ Plants Yielding Fruits [%]: All	Orange	Cultivated Area Occupied by Fruits: Hectare/ Hhs	Percent	Fruit Trees/ Plants Per ha Cultivated Area: All	Orange
≤1 acre	*38*	*76*	*35*	*69*	*47*	*25*	*29*	*11*	*17*	*43*	*96.2*	20	3	*49.9*	*29.6*	0.007	*3.5*	96	14
1-3 acres	*46*	*86*	*40*	*79*	*52*	*20*	*41*	*14*	*18*	*51*	*100.0*	31	7	*55.0*	*37.9*	0.016	*2.7*	52	11
>3 acres	*71*	*88*	*36*	*88*	*36*	*19*	*26*	*19*	*24*	*67*	*100.0*	87	52	*53.4*	*50.5*	0.118	*10.0*	74	44
All Sample Hhs	***47***	***82***	***37***	***77***	***48***	***22***	***35***	***14***	***19***	***51***	***98.7***	**35**	**12**	***53.4***	***45.0***	**0.027**	***5.0***	**65**	**21**

Source: *Sample Survey*

$ Mandarin Orange; * *Arucha and Arubokhra*; and ** incl. Mango, Mulberry, Apple, Lemon, Jackfruit, Litchi, *Mollero*, Shaddock, *Lopsi*, Walnut, Pineapple, *Kimbu*, *Jambir*, Custard apple (*Sharifa)*, *Amala*, Pomegranate, Washington, *Kusum*, *Kamala*, *Simbali* and *Mail*

The household participation rate in total fruits and orange cultivation was higher in larger-sized holdings than in small-sized holdings. The total fruit trees/plants and orange trees per household were the highest for large-sized holdings and the lowest for the small-holding sizes. Consequently, fruit land per household, the proportion of fruit trees/plants yielding fruits to the total fruit trees and the proportion of orange trees yielding fruits to the total orange trees, and the proportion of orange trees to the total fruit trees/plants rose gradually with growing holding-sizes. The intensity of fruit trees/ plants was highest for holdings of large-size and lowest for medium-sized holdings, while the intensity of orange trees was the highest in large-sized holdings and the lowest in the holdings of medium-size. With relatively more land scarcity in smallholding sizes, orange intercropping prevailed more in small-sized holdings. Since the households in the holdings of smaller-size had introduced orange trees more recently compared to

the households in larger-size holdings, orange production would increase substantially in smaller-sized holdings in future.

Table 7.3 analyses the economics of fruit cultivation in the study villages.

Table 7.3: Economic Aspects of Fruit Cultivation across Villages

Hamlet	Proportion of Fruit Grow-ers Yielding Fruits [%]		Value of Out-put [Rs/yr.]		Proportion of Output Sold [%]		Proportion of Hhs Engaged in Selling Output [%]		Value of Output Sold [Rs/yr.]		Cost of Production [Rs/yr.]		Per Household [Hh]					
													Value of Output [Rs/yr.]		Value of Output Sold [Rs/yr.]		Net Return [Rs/yr.]	
	All	Oran-ge	All	Orange	All	Oran-ge	All	Oran-ge	All	Orange	All	Orange	All	Oran-ge	All	Oran-ge	All	Oran-ge
High Diversification Trend																		
Chisopani	*100*	*57.1*	30773	4010	*34.8*	*0.0*	*48*	*0*	10716	0	6400	1350	1231	160	429	0	975	106
Poshyore	*100*	*81.3*	355748	315580	*90.8*	*96.0*	*84*	*32*	322860	303000	73298	64521	14230	12623	12914	12120	11298	10042
Ramitay	*100*	*50.0*	88674	6674	*71.3*	*59.9*	*72*	*12*	63180	4000	11193	4042	3547	267	2527	160	3099	105
Moderate Diversification Trend																		
Mahakaldara	*100*	*80.0*	68825	39999	*71.8*	*87.0*	*68*	*24*	49440	34800	16912	7517	2753	1600	1978	1392	2077	1299
Lamini Gaon	*100*	*30.8*	39871	3400	*39.8*	*17.6*	*72*	*4*	15880	600	15810	8058	1595	136	635	24	962	-186
Lepcha Gaon	*100*	*37.5*	55535	4700	*43.9*	*25.5*	*84*	*4*	24389	1200	14806	2032	2221	188	976	48	1629	107
Yogda	*100*	*76.2*	80976	41869	*69.7*	*83.4*	*88*	*44*	56405	34900	19351	9746	3239	1675	2256	1396	2465	1285
Low Diversification Trend																		
Lwr Gairi Gaon	*100*	*100.0*	18660	2320	*8.0*	*0.0*	*24*	*0*	1484	0	3887	355	746	93	59	0	591	79
Khawas Gaon	*100*	*0.0*	34464	0	*33.0*	*0.0*	*68*	–	11380	0	7662	2266	1379	0	455	0	1072	-91
Upr Gairi Gaon	*100*	*71.4*	22313	3600	*4.9*	*0.0*	*20*	*0*	1090	0	5384	1055	893	144	44	0	677	102
Bimbong	*100*	*95.7*	95680	72756	*79.1*	*89.4*	*96*	*80*	75692	65060	22840	17047	3827	2910	3028	2602	2914	2228
Sundung	*100*	*50.0*	29719	1520	*35.7*	*0.0*	*72*	*0*	10602	0	7462	525	1189	61	424	0	890	40
Total Selected Villages	***100***	***67.9***	**921236**	**496428**	***69.8***	***89.4***	***66.3***	***16.7***	**643118**	**443560**	**205003**	**118514**	**3071**	**1655**	**2144**	**1479**	**2387**	**1260**

Source: *Sample Survey*

The contribution of orange to the total value and income from total fruits was greater than the contribution of other fruits in most villages. Since relatively smaller proportion of households commercially cultivated mandarin orange in the selected villages and the yields of most other fruits like banana were low, the annual total value and income generation and profits from total fruits and orange per household were high over the whole sample, but low in most villages. These were relatively higher in most villages with inferior slope aspect because of their higher total value and income generation from orange, but lower in most villages with moderate to superior slope aspects. These were the highest in the moderate distance hamlet of Poshyore that has south-west slope aspect and the lowest in the village of Khawas Gaon where not a single orange tree was yielding orange. Despite having relatively more orange trees in the villages with inferior slope aspect like Lamini Gaon, the low proportion of orange yielding trees to the total orange trees resulted in low total annual value of orange and total fruits per household in the villages.

The variation in total value and income of orange per household in the villages depended upon their year of introduction of orange plant, market access, mode of selling oranges and management cost of orange. For instance, in Poshyore, around two-thirds of the households planted orange, and 81 per cent of the orange planters yielded orange and only 61 per cent of the orange producers sold orange. Hence, in this village, 48 and 68 per cent of the households did not generate value and income respectively from orange. Despite having 2.7 times more orange yielding plants in Poshyore than in the more remote villages, the former generated 4.3 times more value from orange than the latter mainly, because the former village had better access to market and greater management costs than the latter village. Because of less access to market and financial stress in Bimbong, around two-thirds of the orange sellers in this

village sold the oranges of the tree in wholesale, and the remaining households sold oranges at home at low price. Hence, the orange-intercropping, wholesale and low management cost in the cultivation of mandarin orange primarily resulted in the low yield and value of orange in the villages, especially in the more remote villages and those with inferior slope aspect.

The hill region had less economic potential in cultivation of many fruits than the plain areas. For instance, despite having relatively more yielding plants of banana than orange over the whole sample, the value of orange per household was around five times more than the value of banana. However, in the study region, avocado cultivation had substantial economic potential, and also had more favourable influence on environment compared to orange, as the long roots of avocado arrested soil erosion. Nevertheless, the proportion of the households selling fruits was high in the villages, and this was relatively higher in the villages with inferior slope aspect. The profits of the fruits were computed by subtracting the costs of seedlings, wages, manure, fertilisers, pesticides and selling, staking and transportation of the produced fruits from their total value. The fruits, especially the mandarin orange, had the economic potential of diversification only in the south-west aspect hamlet of Poshyore and in most villages with inferior slope aspect.

Table 7.4 shows the economics of fruit cultivation across the holding-sizes.

Table 7.4: Economic Aspects of Fruit Cultivation across Holding-size Categories

Land-Holding-size Categories	Proportion of Fruit Grow-ers Yielding Fruits [%]		Value of Out-put [Rs/yr.]		Proportion of Output Sold [%]		Proportion of Hhs Engaged in Selling Output [%]		Value of Output Sold [Rs/yr.]		Cost of Production [Rs/yr.]		Per Household [Hh]					
													Value of Output [Rs/yr.]		Value of Output Sold [Rs/yr.]		Net Return [Rs/yr.]	
	All	Oran-ge	All	Orange	All	Oran-ge	All	Oran-ge	All	Orange	All	Orange	All	Oran-ge	All	Oran-ge	All	Oran-ge
≤1 acre	*100*	*57.5*	188789	25427	*53.1*	*61.4*	*55.7*	*8.5*	100252	15600	35656	11263	1781	240	946	147	1445	134
1-3 acres	*100*	*71.4*	315417	119099	*56.3*	*77.4*	*69.7*	*17.8*	177551	92200	75894	29781	2075	784	1168	607	1576	588
>3 acres	*100*	*73.3*	417030	351903	*87.6*	*95.4*	*81.0*	*33.3*	365315	335760	93454	77471	9929	8379	8698	7994	7704	6534
All Sample Hhs	***100***	***67.9***	**921236**	**496428**	***69.8***	***89.4***	***66.3***	***16.7***	**643118**	**443560**	**205003**	**118514**	**3071**	**1655**	**2144**	**1479**	**2387**	**1260**

Source: *Sample Survey*

The proportion of orange growers yielding orange to the total orange growers, the proportion of households engaged in selling orange to the total orange growers, the proportion of the fruits sold to the total fruits as well as orange, rose gradually with increased holding-size. Consequently, the total annual value and income generation and profits from orange and the total fruits per household increased steadily with growing holding-size. Hence, the fruit cultivation inflamed the farm-size dependent inequalities in the distribution of income as revealed in crop cultivation activities. This also reflected on a smaller scale the subsistence fruit production for the households in smaller holding-sizes along with cost escalation of fruit production in the study region.

The plantation of fruit trees during the last 5 years in the study villages have been shown in Table 7.5. The existing fruit growers had planted fruit seedlings during the previous 5 years for introducing specific fruit plants, particularly avocado and passion fruit, for increasing the existing stock of fruit trees and for replacing the existing fruit trees/ plants, especially orange when they fell down or became dieback because of age or were attacked by diseases. Over the whole sample, half of the fruit growers (excluding the growers of banana, papaya and pineapple) had planted an average of 10.5 fruit seedlings, mostly comprising of orange, passion fruit, guava, peach, plum, and avocado seedlings. Hence, increment in fruit output would occur in future in the study region. The total fruit seedlings and orange seedlings per household were relatively higher in villages with inferior slope aspect and lower in

Table 7.5: Plantation of Fruit Seeding during Last Five Years across Villages

Hamlet	Plantation of Fruit Seedling [Number] During Last 5 Years: Major: Oran-ge	Gua-va	Pea-ch	Plu-m	Pear	Avo-cado	Pass-ion fruit	Min-or All*	All**	Proportion of Fruit Seedling Planted out of Fruit Trees/ Plants during Last 5 Years [%]: Major: Ora-nge	Gua-va	Pea-ch	Plu-m	Pear	Avo-cado	Pass-ion fruit	Min-or All*	All**	Proportion of Fruit Growers Planted Fruit Seedling [%]: All**	Ora-nge	Avo-cado	Pass-ion fruit
High Diversification Trend																						
Chisopani	15	12	6	2	0	4	1	18	58	*60*	*18*	*50*	*40*	*0*	*50*	*100*	*50*	*37*	*76*	*57*	*60*	*100*
Poshyore	806	10	0	0	2	10	71	8	907	*46*	*14*	*0*	*0*	*10*	*56*	*90*	*14*	*45*	*84*	*75*	*43*	*100*
Ramitay	120	31	9	8	2	8	42	12	232	*92*	*41*	*35*	*47*	*9*	*44*	*100*	*41*	*64*	*88*	*92*	*80*	*100*
Moderate Diversification Trend																						
Mahakaldara	57	7	15	2	0	8	147	65	301	*35*	*13*	*58*	*33*	*0*	*100*	*100*	*28*	*46*	*75*	*53*	*100*	*100*
Lamini Gaon	283	32	4	5	0	7	4	23	358	*97*	*34*	*20*	*63*	*0*	*100*	*100*	*25*	*67*	*68*	*69*	*100*	*100*
Lepcha Gaon	53	2	10	17	5	9	11	12	119	*82*	*2*	*40*	*28*	*6*	*100*	*92*	*18*	*29*	*76*	*100*	*100*	*80*
Yogda	242	20	10	3	4	5	146	23	453	*66*	*24*	*48*	*27*	*25*	*83*	*100*	*38*	*64*	*100*	*91*	*75*	*100*
Low Diversification Trend																						
Lwr Gairi Gaon	2	10	6	0	1	2	1	11	33	*14*	*32*	*38*	*0*	*8*	*100*	*100*	*48*	*33*	*44*	*29*	*100*	*100*
Khawas Gaon	101	6	8	0	1	1	13	6	136	*100*	*29*	*80*	*0*	*20*	*100*	*100*	*18*	*74*	*73*	*100*	*100*	*100*
Upr Gairi Gaon	0	17	11	1	2	1	4	12	48	*0*	*57*	*41*	*50*	*18*	*33*	*100*	*46*	*45*	*50*	*0*	*50*	*100*
Bimbong	242	18	7	5	1	0	41	124	438	*41*	*28*	*70*	*63*	*33*	*–*	*100*	*72*	*49*	*80*	*78*	*–*	*100*
Sundung	8	5	12	2	2	16	3	33	81	*67*	*7*	*67*	*67*	*13*	*89*	*100*	*53*	*41*	*74*	*67*	*83*	*100*
Total Selected Villages	**1929**	**170**	**98**	**45**	**20**	**71**	**484**	**347**	**3164**	***55***	***22***	***44***	***36***	***10***	***72***	***98***	***39***	***50***	***74***	***72***	***76***	***98***

Source: *Sample Survey*
* excl. Pine apple, and ** excl. Banana, Papaya and Pineapple

villages with moderate to superior slope aspect. The proportion of orange seedlings to the existing orange trees was relatively higher in the nearer villages. The proportion of newly fruit seedlings planted to the existing fruit trees and the proportion of fruit growers who planted such seedlings reflected more popularisation in fruit cultivation, especially orange, avocado and passion fruits in the villages, particularly in the nearer villages.

Table 7.6 below shows plantation of fruit seedlings during the last five years across the holding-sizes.

Table: 7.6- Plantation of Fruit Seeding during Last Five Years across Holding-size Categories

Land-Holding-size Categories	Plantation of Fruit Seedling [Number] During Last 5 Years: Major: Oran-ge	Gua-va	Pea-ch	Plu-m	Pear	Avo-cado	Pass-ion fruit	Min-or All*	All**	Proportion of Fruit Seedling Planted out of Fruit Trees/ Plants during Last 5 Years [%]: Major: Ora-nge	Gua-va	Pea-ch	Plu-m	Pear	Avo-cado	Pass-ion fruit	Min-or All*	All**	Proportion of Fruit Growers Planted Fruit Seedling [%]: All**	Ora-nge	Avo-cado	Pass-ion fruit
≤1 acre	226	50	43	14	5	23	130	79	570	*70.4*	*25.9*	*55.8*	*35.9*	*8.8*	*65.7*	*94.2*	*38.7*	*53.6*	*69.7*	*70.0*	*83.3*	*100.0*
1-3 acres	618	77	46	26	15	31	197	208	1218	*62.1*	*18.8*	*38.0*	*37.7*	*10.9*	*75.6*	*99.5*	*41.2*	*49.2*	*75.7*	*72.9*	*76.2*	*96.4*
>3 acres	1085	43	9	5	0	17	157	60	1376	*49.5*	*26.7*	*34.6*	*27.8*	*0.0*	*77.3*	*100.0*	*32.1*	*49.5*	*78.6*	*73.3*	*62.5*	*100.0*
All Sizes	**1929**	**170**	**98**	**45**	**20**	**71**	**484**	**347**	**3164**	***55.0***	***22.3***	***43.8***	***35.7***	***9.6***	***72.4***	***98.2***	***38.7***	***50.1***	***74.0***	***72.1***	***75.6***	***98.2***

Source: *Sample Survey*
* excl. Pine apple, and ** excl. Banana, Papaya and Pineapple

The plantation of total fruit seedlings as well as orange, avocado and passion fruit seedlings per household during the past five years were the highest for large-sized holdings and the lowest for smallholding sizes. The proportions of fruit growers who planted fruit seedlings to the existing fruit growers for total fruits as well as for orange, avocado and passion fruit were relatively higher in

holdings of large-size compared to the others. Hence, the larger farms had greater potential in increasing fruit output in future compared to the smaller farms. Because of the earlier initiation of orange cultivation by households in larger-sized holdings than in smaller holding-size category, the proportion of existing orange seedlings planted to the existing orange trees decreased gradually, while for avocado and passion fruit, it rose steadily with growing holding-size. However, the proportion of the total fruit seedlings planted to the existing total fruit trees/ plants was the highest for small-sized holdings and the lowest for medium-sized holdings.

7.2.2 Status and Economics of Bamboo Plants and Woody Trees Agro-forestry

The bamboos play crucial roles in smoothing the hill people's livelihoods. In the study region, in addition to traditional use, bamboo (*bhalu bans*) is used for bringing water from *jhora* and preparing the container (*tonba*) for drinking *jar* (a kind of local wine). Young *choya bans* is also used as food (*tama*), and all bamboos provide fodder to the stall feeding livestock and act as a bulwark against landslide. Table 7.7 below explores the stock, area, composition and economics of bamboos in the study villages.

Table 7.7: Area, Stock, Composition and Economics of Bamboos across Villages

Hamlet	Bam-boo Area [ha]	Hhs Hav-ing Bam-boo Plant [%]	Bamboo Groves [Number]					Plants in Groves/Hh		Mature yield [Culms/yr]			Culms Sold [%]		Hhs Invo-lved in Sell-ing [%]	Earning from Bamboo Sale [Rs/yr]		Value of Bamboo yield** [Rs/yr]		Per Hh Fodd-er yield [kg/yr]
			Major				Min-or					All								
			Bha-lu		*Cho-ya*	*Sing-are*	All*	All	Maj-or	All	Maj-or	Per Hh	All	Maj-or		Total	Per Hh	Total	Per Hh	
High Diversification Trend																				
Chisopani	0.991	*76*	5	78	13	26	2	124	405	381	2226	2106	89	*60.8*	*64.3*	*32.0*	36500	1460	56323	2253	160
Poshyore	0.291	*72*	12	28	1	32	3	76	178	172	710	680	28	*4.2*	*4.4*	*4.0*	300	12	14029	561	31
Ramitay	0.583	*84*	4	45	20	10	0	79	189	189	961	961	38	*58.4*	*58.4*	*24.0*	11165	447	18863	755	74
Moderate Diversification Trend																				
Mahakaldara	0.668	*84*	0	68	17	21	29	135	445	204	1685	1073	67	*25.2*	*39.6*	*16.0*	6825	273	19948	798	52
Lamini Gaon	0.704	*72*	5	101	14	33	7	160	810	756	3303	3021	132	*62.6*	*64.5*	*36.0*	36980	1479	59765	2391	199
Lepcha Gaon	0.401	*88*	4	59	9	38	5	115	382	342	1483	1388	59	*11.8*	*12.6*	*8.0*	2110	84	25083	1003	54
Yogda	0.332	*88*	2	60	16	10	1	89	192	184	832	802	33	*2.4*	*2.5*	*4.0*	200	8	14117	565	43
Low Diversification Trend																				
Lwr Gairi Gaon	0.251	*92*	4	48	15	12	4	83	203	177	903	833	36	*14.8*	*16.1*	*20.0*	1810	72	14689	588	34
Khawas Gaon	0.219	*80*	1	45	18	10	0	74	130	130	708	708	28	*10.5*	*10.5*	*8.0*	1490	60	13109	524	26
Upr Gairi Gaon	0.463	*96*	1	75	32	11	28	147	410	193	1359	1021	54	*29.4*	*39.2*	*24.0*	6850	274	21260	850	46
Bimbong	0.502	*100*	0	52	20	18	16	106	298	162	1052	730	42	*5.5*	*5.8*	*8.0*	552	22	13372	535	44
Sundung	0.206	*84*	0	29	13	13	5	60	146	98	766	671	31	*18.9*	*17.1*	*12.0*	1710	68	11479	459	24
Total Selected Villages	**5.611**	***85***	**38**	**688**	**188**	**234**	**100**	**1248**	**316**	**249**	**15988**	**13994**	**53**	***34.1***	***37.7***	***16.0***	**106492**	**355**	**282036**	**940**	**66**

Source: *Sample Survey*

* incl. *Niba*, *Pareng*, *Dore* and *Jangli*; and ** ignoring value of bamboo fodder

Multiple varieties of bamboos such as *bhalu bans (Bambusa arundinacea* (Retz.) Willd), *muli bans* (*Melocanna baccifera), choya bans* (*Dendrocalamus hamiltonii), singare bans* (*Bambusa vulgaris*) and minor bamboos were grown at sample farms. Of these bamboo varieties, comparatively fatter *bhalu bans* and harder *mali bans* were relatively better than the others for the hill farmers, although each such variety had a specific use. For instance, relatively less hard *choya and singare bans* were used for preparing *doko* (a kind of box). Each variety of major bamboos was many folds taller, fatter and more economically valuable than minor bamboos. Consequently, over the whole sample, the average number of plants per bamboo grove was 48 for *bhalu bans* compared to the 66 for other major bamboos and 200 for minor bamboos. The bamboos were grown on uncultivated sloping land, generally at the end of the crop-field, so that the bamboo shadow cannot damage the crops. Over the whole sample, the numbers of bamboo groves and major bamboo plants per household were around 4 and 50 respectively. Because of multiple necessities of bamboos in rural life, household participation in bamboo plantation, farmland

commitment to bamboo plants, bamboo groves and plants of both major and minor bamboos per household were high in the villages. These were higher in the villages with higher uncultivable sloping land because of their high land gradients, and less in the villages with lower land gradients.

The yield of matured bamboo culms per household in the villages depended upon the possession of the villages of such culms and their access to market for bamboo sale. The annual yield of bamboo columns per household was high in the villages, while the value of matured bamboo culms per households was low in most villages mainly because of low price of bamboo culms in the villages, particularly in the more remote villages. These were relatively higher in most villages with high land gradients. However, because of transportation problem in the villages, smaller proportion of the households sold bamboo directly in the villages, mainly in the nearer villages with better road connectivity. Hence, bamboos were sold indirectly through making household necessity items such as *doko* in the villages located away from market centres. Consequently, the proportion of the households selling bamboos and the annual income through bamboo sale per household were low in most villages. These were relatively higher in the villages located closer to market centres. The bamboo plants also partially fulfilled the fodder need of the bovine livestock in the villages, particularly between January and May when green fodder would be scarce. The annual fodder yield of bamboo plants per household was high in most villages, and this was higher in most villages with high land gradients.

Table 7.8 below shows area, stock, composition and economics of bamboo plants across the holding-sizes.

Table 7.8: Area, Stock, Composition and Economics of Bamboo Plants across Holding-size Categories

Land-Holding-size Categories	Bam-boo Area [ha]	Hhs Hav-ing Bam-boo Plant [%]	Bamboo Groves [Number]					Plants in Groves/Hh			Mature yield [Culms/yr]			Culms Sold [%]		Hhs Invo-lved in Sell-ing [%]	Earning from Bamboo Sale [Rs/yr]		Value of Bamboo yield** [Rs/yr]		Per Hh Fodd-er yield [kg/yr]
			Major				Min-or														
			Bha-lu		*Cho-*	*Sing-*							All								
			Bans	*Mali*	*-ya*	*-are*	All*	All	All	Maj-or	All	Maj-or	Per Hh	All	Maj-or		Total	Per Hh	Total	Per Hh	
≤1 acre	0.765	*74*	4	138	39	35	23	239	137	103	2877	2494	27	*30.2*	*34.9*	11.3	14475	137	46226	436	31
1-3 acres	3.025	*89*	16	366	106	143	48	679	317	252	8600	7799	57	*31.2*	*34.0*	16.4	52345	344	152132	1001	65
>3 acres	1.821	*98*	18	184	43	56	29	330	761	606	4511	3701	107	*41.9*	*47.4*	28.6	39672	945	83679	1992	154
All Sizes	**5.611**	***85***	**38**	**688**	**188**	**234**	**100**	**1248**	**316**	**249**	**15988**	**13994**	**53**	***34.1***	***37.7***	**16.3**	**106492**	**355**	**282036**	**940**	**66**

Source: *Sample Survey*

* incl. *Niba*, *Pareng*, *Dore* and *Jangli*; and ** ignoring value of bamboo fodder

The bamboo land, the numbers of bamboo groves and plants and the household participation rate in bamboo plantation rose markedly with increased holding-sizes. Along with increased necessity of bamboo plants in crop cultivation activities in the holdings of larger-size, the total annual matured culms yield, value generation, income and fodder yield of the bamboos per household as well as the proportion of the households selling bamboos increased sharply with growing holding-size. Hence, the bamboo plants also enlarged the farm-size dependent inequalities in the distribution of rural income.

The regional trees/plants are the result of natural multiplication process and of the special initiatives of the people of the region for growing valuable utility trees/plants. However, because of land scarcity, the trees/plants were shifted to the field boundaries and to marginal land, especially uncultivated sloping land, although a few trees were grown on homestead land. Table 7.9 analyses the status of agro-forestry in the study villages. The sample farms grew 113 varieties of trees, which comprised of 30.1 per cent timber-yielding trees such as teak (*Tectona grandis)* and *dhupi* (Pine, *Cryptomeria japonica*); 20.4 per cent fodder-generating trees/plants like *kabra* (*Ficus lacor* Buch-Han) and *khanew* (*Ficus sunia)*; 38.9 per cent fuelwood-yielding trees such as *tarpin* (*Eucalyptus globosa)* and *khanakpa* (*Evodia fraxinifolia* Hook. F. syn.)*;* and 10.6 per cent other utility trees such as *chiuri* (*Aesandra butyraceae)* and

Table 7.9: Status of Agro-forestry Trees/Plants across Villages

Hamlet	Forest Area [ha]	Absolute Number of Trees/Plants: Timber yielding with Grading A	B	C	D	All*	Fodder-yielding	Fuelwood yielding	Other Utility Plant	Total	Total Per Hh	Total Per ha Forest Land	Composition of Trees/Plants [%]: Timber A	B	C	D	All Trees/Plants: Timber	Fodder Yielding	Fuelwood yielding	Other Utility Plant
High Diversification Trend																				
Chisopani	1.39	875	591	6	19	1491	422	39	8	1960	78	1414	*58.7*	*39.6*	*0.4*	*1.3*	*76.1*	*21.5*	*2.0*	*0.4*
Poshyore	1.01	201	1110	58	12	1381	274	37	9	1701	68	1681	*14.6*	*80.4*	*4.2*	*0.9*	*81.2*	*16.1*	*2.2*	*0.5*
Ramitay	1.51	634	440	0	5	1079	178	38	8	1303	52	863	*58.8*	*40.8*	*0.0*	*0.5*	*82.8*	*13.7*	*2.9*	*0.6*
Moderate Diversification Trend																				
Mahakaldara	1.66	384	1561	105	159	2209	531	403	46	3189	128	1920	*17.4*	*70.7*	*4.8*	*7.2*	*69.3*	*16.7*	*12.6*	*1.4*
Lamini Gaon	1.43	1239	2258	52	89	3638	635	384	61	4718	189	3289	*34.1*	*62.1*	*1.4*	*2.4*	*77.1*	*13.5*	*8.1*	*1.3*
Lepcha Gaon	0.93	1320	1179	58	84	2641	417	371	55	3484	139	3743	*50.0*	*44.6*	*2.2*	*3.2*	*75.8*	*12.0*	*10.6*	*1.6*
Yogda	1.30	1005	983	128	245	2361	1322	103	82	3868	155	2978	*42.6*	*41.6*	*5.4*	*10.4*	*61.0*	*34.2*	*2.7*	*2.1*
Low Diversification Trend																				
Lwr Gairi Goan	1.28	1528	562	60	27	2177	557	134	1	2869	115	2243	*70.2*	*25.8*	*2.8*	*1.2*	*75.9*	*19.4*	*4.7*	*0.0*
Khawas Gaon	0.82	299	704	35	15	1053	189	263	10	1515	61	1858	*28.4*	*66.9*	*3.3*	*1.4*	*69.5*	*12.5*	*17.4*	*0.7*
Upr Gairi Gaon	1.16	623	472	38	43	1176	491	148	15	1830	73	1584	*53.0*	*40.1*	*3.2*	*3.7*	*64.3*	*26.8*	*8.1*	*0.8*
Bimbong	2.39	1912	1468	110	111	3601	545	67	33	4246	170	1775	*53.1*	*40.8*	*3.1*	*3.1*	*84.8*	*12.8*	*1.6*	*0.8*
Sundung	0.71	619	756	37	12	1424	344	467	36	2271	91	3188	*43.5*	*53.1*	*2.6*	*0.8*	*62.7*	*15.1*	*20.6*	*1.6*
Total Selected Villages	**15.59**	**10639**	**12084**	**687**	**821**	**24231**	**5905**	**2454**	**364**	**32954**	**110**	**2114**	***43.9***	***49.9***	***2.8***	***3.4***	***73.5***	***17.9***	***7.4***	***1.1***

Source: *Sample Survey*

* one household of Sundung has mentioned of growing *Debra lahara* (Butea parviflora, Roxb.), a climber plant in 2 decimal land, but is not taken into account for computing total fodder trees/plants as well as total trees/plants

lopsi (Hog plum). Based on timber quality and price, the timber-yielding trees were classified into four grades- grade A which includes trees like teak and *champ* (Magnolia, *Michelia champaka*), grade B which includes trees like *chilaune* (Needle wood, *Schima wallichi*) and *lampate (Duabanga sonneratioides*), grade C which includes trees like *dabdabe* (*Garuga pinnata* Roxb.) and *seto siris* (*Albizzia procera),* and grade D which includes trees like chatiwan (Devil's tree, *Alstonia scholaris*) and *phaledo* (Himalayan coral bean, *Erythrina indica*). Over the whole sample, of the total varieties of timber-yielding trees, 50, 23, 15 and 12 per cent were of grades A, B, C and D respectively. Depending on the availability and requirement, the timber trees of grades B, C and D were used for fuelwood.

The forest land, total trees/plants as well as the number of timber and fodder yielding trees per household were high in most villages. These were relatively higher in villages with relatively more uncultivable sloping land because of their high land gradients than in most villages with lower land gradients. With relatively more stock of bovine livestock per household and less availability of paddy straw in villages with lower irrigation access, the fodder-yielding trees/plants per household were relatively higher in such villages than in most villages with better irrigation access. The forest density was also high in most villages. With more forest-integration of tribal people, this density was relatively higher in most tribal villages and lower in the non-tribal villages. Nevertheless, of such trees/plants, the timber-yielding trees, especially of grades A&B, occupied dominant position in the villages, since special care were taken for planting them. This dominancy of such trees was relatively more in most villages located closer to the market centres.

The status of the agro-forestry across the holding-sizes is shown in Table 7.10. The forest land, total trees/plants as well as the number of timber and fodder-yielding trees/plants per household increased sharply with growing holding-size. However, the forest density was the highest in small-sized holdings and the lowest in the holdings of medium-size. The proportion of timber-yielding trees to the total trees

Table 7.10: Status of Agro-forestry Trees/Plants across Holding-size Categories

Land-Holding-size Categories	Forest Area [ha]	Absolute Number of Trees/Plants: Timber yielding with Grading A	B	C	D	All*	Fodder yielding	Fuelwood yielding	Other Utility Plant	Total	Total Per Hh	Total Per ha Forest Land	Composition of Trees/Plants [%]: Timber A	B	C	D	All Trees/Plants: Timber	Fodder Yielding	Fuelwood yielding	Other Utility Plant
≤1 acre	2.28	1715	1806	109	106	3736	1111	279	50	5176	49	2268	*45.9*	*48.3*	*2.9*	*2.8*	*72.2*	*21.5*	*5.4*	*1.0*
1-3 acres	8.63	5876	6015	344	420	12655	3097	1418	193	17363	114	2011	*46.4*	*47.5*	*2.7*	*3.3*	*72.9*	*17.8*	*8.2*	*1.1*
>3 acres	4.67	3048	4263	234	295	7840	1697	757	120	10414	248	2230	*38.9*	*54.4*	*3.0*	*3.8*	*75.3*	*16.3*	*7.3*	*1.2*
All Sizes	**15.59**	**10639**	**12084**	**687**	**821**	**24231**	**5905**	**2454**	**363**	**32953**	**110**	**2114**	***43.9***	***49.9***	***2.8***	***3.4***	***73.5***	***17.9***	***7.4***	***1.1***

Source: *Sample Survey*

* one household of Sundung has mentioned of growing *Debra lahara* (Butea parviflora, Roxb.), a climber plant in 2 decimal land, but is not taken into account for computing total fodder trees/plants as well as total trees/plants

rose gradually with increased holding-size, while the proportion of grade A timber-yielding trees to the total timber-yielding trees was found to be the highest in medium-sized holdings and to be the lowest in large-sized holdings. Hence, the large farmer households had possessed greater and better tree species compared to other farmer households.

Table 7.11 explores the economics of agro-forestry in the study villages.

Table 7.11: Economics of Agro-forestry Trees/Plants across Villages

Hamlet	Leaf-fodder Yield [kg/ yr]: Total	Per Hh	Per ha Forest Land	Fuelwood: Yield: Total [kg/ yr]	Per Hh [kg/ yr]	Per ha Forest Land [kg/ yr]	Value [Rs/ yr]	Sale: Proportion to Total Yield [%]	Sale Value [Rs/ yr]	Timber: Yield: Total [Qb. ft./ yr]	Per Hh [Qb. ft./ yr]	Value [Rs/ yr]	Sale: Proportion to Total Yield [%]	Sale Value [Rs/ yr]	Non-timber Forest Product* [Rs/ yr]: Output Value	Sale Value	Product Value$ [Rs/ yr]: Total	Per Hh	Earning [Rs/yr]: Total	Per Hh
High Diversification Trend																				
Chisopani	6642	266	4792	54081	2163	39018	58764	*33.7*	21950	191	7.6	52540	*38.7*	20800	0	0	111304	4452	42750	1710
Poshyore	11352	454	11221	49710	1988	49134	46878	*0.0*	0	15	0.6	4170	*0.0*	0	174	100	51222	2049	100	4
Ramitay	5028	201	3331	39825	1593	26383	39914	*7.2*	2850	176	7.0	65468	*60.8*	43250	100	0	105481	4219	46100	1844
Moderate Diversification Trend																				
Mahakaldara	9954	398	5992	61723	2469	37155	68071	*9.7*	8800	108	4.3	28842	*26.9*	8000	323	30	97236	3889	16830	673
Lamini Gaon	21120	845	14722	117236	4689	81719	100625	*31.1*	28300	168	6.7	52180	*26.8*	14500	2056	1430	154861	6194	44230	1769
Lepcha Gaon	16794	672	18043	71645	2866	76972	67133	*10.5*	7700	20	0.8	5560	*0.0*	0	504	200	73197	2928	7900	316
Yogda	18354	734	14129	66929	2677	51522	60575	*6.7*	3000	10	0.4	2780	*0.0*	0	1248	136	64603	2584	3136	125
Low Diversification Trend																				
Lwr Gairi Gaon	16362	654	12795	67755	2710	52983	64367	*8.0*	5400	35	1.4	10280	*0.0*	0	392	0	75039	3002	5400	216
Khawas Gaon	8304	332	10183	36210	1448	44405	35254	*0.0*	0	39	1.6	11436	*0.0*	0	930	300	47620	1905	300	12
Upr Gairi Gaon	13842	554	11980	45705	1828	39558	42698	*5.0*	2280	75	3.0	22060	*26.7*	6000	506	0	65264	2611	8280	331
Bimbong	12780	511	5343	70499	2820	29477	65822	*5.1*	2400	20	0.8	5560	*0.0*	0	803	500	72185	2887	2900	116
Sundung	7440	298	10446	33155	1326	46549	31830	*5.4*	1800	22	0.9	6336	*0.0*	0	983	300	39149	1566	2100	84
Total Selected Villages	**147972**	**493**	**9494**	**714472**	**2382**	**45839**	**681926**	***12.4***	**84480**	**879**	**2.9**	**267212**	***31.3***	**92550**	**8019**	**2996**	**957157**	**3191**	**180026**	**600**

Source: *Sample Survey*

* incl. the output value of fruits of *Lapsi, Okhar* and *Harra*, the seed of *Totala*, the flower of *Kabra* and *Kairalo*, the fiber of *Shimul,* as well as the spice of *Tejpat* and Black Pepper and the value of plants of Okhar sold by one household; $ excl. the value of leaf-fodder

The agro-forestry was the primary source of leaf-fodder for the bovine livestock, especially during the dry season, as well as source of fuel energy and timber for households in the study hamlets. The annual

leaf-fodder yield per household was high in the villages. With relatively more bovine livestock animals and less paddy straw in the less irrigated villages, the annual leaf-fodder yield was higher in these villages than in the villages with better irrigation access. Besides availability of fuelwood-yielding trees in the villages, the fuelwood yield of agroforestry in the villages depended upon their market access for selling fuel-wood, as well as the alternative source of getting fuelwood like Government forests and use of liquefied petroleum gas [LPG] as an alternative of fuelwood. Over the whole sample, the proportion of households using LPG along with fuelwood to the total households was 40.3 per cent and most of them resided in the villages located closer to market centres. Because of lower utilisation of LPG by the households, the annual fuelwood yield per household was very high in the villages. Generally, this was comparatively higher in most of the remote villages. The timber yield of the agro-forestry in the villages primarily depended upon the sale possibility of timber and the access of the villages to sowing mill. The annual timber yield per household was low in most of these villages, while it was relatively higher in the villages located closer to market centres.

The pressure of leaf-fodder and fuelwood generation on private forest land was very high in the villages. Hence, such substantial pressure on forest land created adverse effects on natural resource-base and environment. However, this pressure was relatively lower in the nearer villages. Over the whole sample, the households used most of the fuelwood they yielded, while this fuelwood met only two-thirds of their annual fuelwood needs. Thus,the households collected one-thirds of their required fuelwood from other *khas* forest, especially from Govt. Forest, or they purchased it. In the study region, 43.7 per cent of the households collected fuelwood from other *Khas* forest, mostly from Govt. Forest, and thereby this created pressure on Govt. Forest too. Because of less access to road and transport of most households, only 10.3 and 6.3 per cent of the households sold fuelwood and timber respectively over the whole sample. So, the annual income from fuelwood sale, timber per household and the proportion of sold fuelwood and timber to the total fuelwood and timber yielded were low in the villages. However, these were relatively higher in the nearer villages.

The agroforesty also provided non-timber forest products such as *katus* (Castanopsis tribuloides), *okhar (Juglans regia)* and *barar* (*Artocarpus lakoocha*) fruits, and incense-preparing leaves of Kashmiri *dhupi*; edible *nebero* (*Ficus hookeri*) *and khane khanyu* (*Ficus semicordata)* fruits, and pickle-preparing *kabra* (*Ficus semicordata)* flower; *sil timbur* (*Linderaa neesiana)* and *kadam* (*Anthocephalus kadamba/ indicus*) fruits to be used as medicines; and sour fruits such as *chiuri* (*Aesandra butyraceae), lopsi* (Hog plum), *aiselu* (Raspberry, *rubus ellipticus*), *boke umiulu, boke timur* (*Zanthoxylum acanthopodium* DC.), *kairalo* (*Bauhinia variegate)* flower; and *tejpat* (*Cinnamomum tamala*, Nees.), black pepper and *karupat* to be used as spice. However, majority of such products were consumed by local people, and few of these products like *kabra* flower and *lopsi* were marketed in limited villages. For instances, *okhar* was sold in Lamini Gaon and Lopsi was marketed in Yogda. So, the annual value and income generation of the non-timber forest products per household was low in the villages. Because of multiple contributions of the agro-forestry to the hill farmers, the annual value generation of the agro-forestry per household was high in the villages, while the income from it was low in most of the villages. Generally, these were comparatively higher in nearer villages. Hence, the agro-forestry partially compensated for the low value and income from crop cultivation in the nearer villages.

Table 7.12 shows the economics of the agro-forestry trees/plants across the holding-sizes. The annual leaf-fodder, fuelwood and timber yield, value and income generation from non-timber forest products and total agro-forestry, and sale value of fuelwood per household rose with holding-size. However, with relatively lower forest land per household in smaller-sized holdings, leaf-fodder and fuelwood generation pressure on per hectare forest land decreased steadily with increased holding-size. The annual timber yield per household was the highest for large-sized farms and the lowest for medium-sized farms, although the proportion of timber sale to the total timber yield was highest in small-sized holdings and lowest in medium-sized holdings which reflected the relatively greater economic distress

Table 7.12: Economics of Agro-forestry Trees/Plants across Holding-size Categories

Land-Holding-size Categories	Leaf-fodder Yield [kg/ yr] Total	Per Hh	Per ha Forest Land	Fuelwood Yield Total [kg/ yr]	Per Hh [kg/ yr]	Per ha Forest Land [kg/ yr]	Value [Rs/ yr]	Sale Pro-por-tion to Total Yield [%]	Sale Value [Rs/ yr]	Timber Yield Total [Qb. ft./ yr]	Per Hh [Qb. ft./ yr]	Value [Rs/ yr]	Sale Pro-por-tion to Total Yield [%]	Sale Value [Rs/ yr]	Non-tim-ber Forest Product* [Rs/ yr] Out-put Val-ue	Sale Val-ue	Product Value$ [Rs/ yr] Tot-al	Per Hh	Earning [Rs/yr] Total	Per Hh
≤1 acre	33246	314	14566	143054	1350	62676	137765	*2.8*	4700	305	2.9	97920	*36.0*	41050	1047	100	236732	2233	45850	433
1-3 acres	80100	527	9277	377555	2484	43729	360344	*10.1*	37880	375	2.5	109752	*28.0*	32600	4073	966	474169	3120	71446	470
>3 acres	34626	824	7414	193863	4616	41512	183817	*24.1*	41900	199	4.7	59540	*31.0*	18900	2899	1930	246256	5863	62730	1494
All Sizes	**147972**	**493**	**9494**	**714472**	**2382**	**45839**	**681926**	***12.4***	**84480**	**879**	**2.9**	**267212**	***31.0***	**92550**	**8019**	**2996**	**957157**	**3191**	**180020**	**600**

Source: *Sample Survey*

for households in smallholding sizes. Hence, the agro-forestry also reinforced the farm-size dependent inequalities in the distribution of rural income.

7.2.3 Economics of Miscellaneous Crops and Collected Items

Table 7.13 below shows the economics of miscellaneous crops and other collected items in the hamlets.

Table 7.13: Economics of Miscellaneous Crops and Collected Items across Villages

Hamlet	Sugarcane & Plantation Crops Yield [Rs/yr] Plan-tat-ion Sugar-cane	Crop-s**	Total	Sale Val-ue$ [Rs/ yr]	Earn-ing from Pla-nt* Sale [Rs/ yr]	Collected Items *Amliso* Yield [kg/ yr]	Sale [Rs/ yr]	[kg/ yr]	[Rs/ yr]	Maize-based Minor Products@ Yield [kg/ yr]	Sale [Rs/ yr]	Sale Val-ue [Rs/ yr]	Sale Val-ue of *Siru*/ Grass [Rs/ yr]	Sale Val-ue of Othe-rs# [Rs/ yr]	Paddy Straw [Rs/ yr] Sale Val-ue	Total Value of Output [Rs/ yr] Total	Per Hh	Earning [Rs/ yr] Total	Per Hh
High Diversification Trend																			
Chisopani	790	0	790	40	0	679	7699	662	7500	222	2275	300	0	0	39120	49884	1995	15740	630
Poshyore	1060	150	1210	100	0	2213	15982	2190	15720	271	2872	378	0	0	21105	41169	1647	16798	672
Ramitay	820	200	1020	0	0	171	1731	154	1540	177	1837	0	0	0	40750	45338	1814	1540	62
Moderate Diversification Trend																			
Mahakaldara	2520	0	2520	0	0	4545	62718	4520	62380	227	2373	0	600	5000	0	73211	2928	67980	2719
Lamini Gaon	895	2400	3295	0	2700	4238	51133	4215	50860	703	7179	700	0	1500	0	65807	2632	55760	2230
Lepcha Gaon	640	0	640	0	0	445	5340	425	5100	333	3518	154	0	0	23870	33368	1335	6214	249
Yogda	660	0	660	0	1920	4425	63170	4400	62690	184	2049	0	0	0	4700	72499	2900	65210	2608
Low Diversification Trend																			
Lwr Gairi Gaon	1475	0	1475	0	0	1229	15714	1204	15408	115	1361	0	1200	0	24860	44610	1784	17238	690
Khawas Gaon	160	800	960	0	0	64	670	50	500	130	1536	0	0	0	27350	30516	1221	2900	116
Upr Gairi Gaon	1220	0	1220	0	0	2935	25919	2910	25620	86	1032	0	0	0	3150	31321	1253	25620	1025
Bimbong	1110	1400	2510	50	0	3939	48871	3914	48548	221	2452	0	0	0	1000	54833	2193	48598	1944
Sundung	800	0	800	300	0	359	4276	340	4050	195	2061	0	0	0	16000	23137	925	7910	316
Total Selected Villages	**12150**	**4950**	**17100**	**490**	**4600**	**25238**	**303219**	**24984**	**299916**	**2864**	**30545**	**1532**	**1800**	**6500**	**201905**	**565669**	**1886**	**331488**	**1105**

Source: *Sample Survey*

** incl. Coffee, Tea, Arecanut and Coconut; $ only from Sugarcane; * plants of field crops like Broccoli, Cauliflower, etc.; @ incl. *Ginari*, *Late*, *Bethu*, *Zarengo*, *Poisaaj* (Indian spinach) and Fenugreek; and # collected fuelwood and old stock of Ginger

Although the households cultivated various miscellaneous crops such as sugarcane, tea, coffee, coconut, arecanut and *amliso* (Broom grass *Thysanolaena maxima*, *Poaceae* family) as well as collected multiple items like paddy straw and *siru*/grass, the most crucial of them were *amliso* and paddy straw. *Amliso* was mainly grown within agro-forestry and terrace bunds, and was used as an important cashcrop and provider of green fodder in the villages, especially in the less irrigated villages, where *amliso* was treated as a substitute of paddy straw. *Amliso sticks were* used as supporters of small creeper

plants such as peas, and *amliso* grasses helped in tightening soils through its brushy roots. The annual value and income generation from *amliso* per household were low in most of the villages. These were relatively higher in less irrigated villages with relatively more uncultivable land than in well irrigated villages. The annual value of paddy straw per household was low in most of the villages. Because of fulfilling fodder need of own livestock, the proportion of paddy straw sold to the total paddy straw was low in the villages. The annual value and income from paddy straw per household were higher in well irrigated villages. However, the annual value and income generation of the miscellaneous crops and other collected items per household were high in most of the villages. Generally, these were higher in the villages with lower irrigation access and less in well irrigated villages. Hence, the miscellaneous crops and other collected items, especially the *amliso*, partially compensated for the relatively low annual value and income of crop cultivation activities in most of the villages, particularly in the less irrigated villages.

Table 7.14 shows the economics of the miscellaneous crops and other collected items across the holding-sizes.

Table 7.14: Economics of Miscellaneous Crops and Collected Items across Holding-size Categories

Land-Holding-size Categories	Sugarcane & Plantation Crops: Yield [Rs/yr] Sugar-cane	Plan-tation Crop-s**	Total	Sale Val-ue$ [Rs/ yr]	Earn-ing from Pla-nt* Sale [Rs/ yr]	Collected Items: *Amliso* Yield [kg/ yr]	[Rs/ yr]	Sale [kg/ yr]	[Rs/ yr]	Maize-based Minor Products@ Yield [kg/ yr]	[Rs/ yr]	Sale Val-ue [Rs/ yr]	Sale Val-ue of *Siru*/ Grass [Rs/ yr]	Sale Val-ue of Othe-rs# [Rs/ yr]	Paddy Straw [Rs/ yr] Sale Val-ue	Total: Value of Output [Rs/ yr] Total	Per Hh	Earning [Rs/ yr] Total	Per Hh
≤1 acre	3555	200	3755	300	0	45107	426	44060	416	8540	81	778	0	1500	28780	2390	87682	827	49028	463
1-3 acres	6640	1550	8190	150	1920	162325	1068	160548	1056	15218	100	154	1200	0	135315	7610	324168	2133	171582	1129
>3 acres	1955	3200	5155	40	2700	95787	2281	95308	2269	6787	162	600	600	5000	37810	6650	153839	3663	110898	2640
All Sizes	**12150**	**4950**	**17100**	**490**	**4600**	**303219**	**1011**	**299916**	**1000**	**30545**	**102**	**1532**	**1800**	**6500**	**201905**	**16650**	**565669**	**1886**	**331488**	**1105**

Source: *Sample Survey*

** incl. Coffee, Tea, Arecanut and Coconut; $ only from Sugarcane; * plants of field crops like Broccoli, Cauliflower, etc.; @ incl. *Ginari*, *Late*, *Bethu*, *Zarengo*, *Poisaaj* (Indian spinach) and Fenugreek; and # collected fuelwood and old stock of Ginger

The annual value and income generation of most components of miscellaneous crops as well as the total miscellaneous crops and collected items per household rose sharply with growing holding-size. Hence, the miscellaneous crops and collected items also increased the farm-size dependent inequalities in the distribution of income and wealth. Despite having relatively lower annual value generation from sugarcane and maize-based minor crops per household in smaller farmer households compared to larger farmer households, mainly because of greater economic distress in households in the small-size holdings, the income from such crops per household was relatively higher in small-sized holdings than in large-sized holdings. Relatively higher proportion of paddy straw was used for one's own bovine livestock in the land-holdings of medium-size than in the other holding-sizes.

7.2.4 Status and Economics of Apiculture

Table 7.15 examines the status and economics of apiculture in the study villages. While apiculture was a traditional farming activity in the study region, mainly because of limited scientific knowledge and management of apiculture, very low proportion of households practised subsistence apiculture with a smaller number of apiaries in the villages. With relatively more forest land and lower income and value generation from crop cultivation in the less irrigated villages, the proportion of the households

Table 7.15:- Status and Economics of Apiculture across Villages

Hamlet	Hhs Having Beekeeping Box: Number	Hhs Having Beekeeping Box: Proportion To Total Hhs [%]	Box Per Beekeeper [Number]	Proportion of Beekeepers Yielding Honey [%]	Proportion of Boxes Having Bees [%]	Honey-yield [lit/yr]: Total	Honey-yield [lit/yr]: Per Grower	Honey-yield [lit/yr]: Per Hh	Value of Honey-yield [Rs/yr]: Total	Value of Honey-yield [Rs/yr]: Per Grower	Value of Honey-yield [Rs/yr]: Per Hh	Value of Honey-yield [Rs/yr]: Per Box	Proportion of Honey Sold [%]	Sale Value of Honey [Rs/yr]: Total	Sale Value of Honey [Rs/yr]: Per Grower	Sale Value of Honey [Rs/yr]: Per Hh	Man-days Involved [Number]	Wage Costs [Rs/yr]	Net Return [Rs/yr]: Total	Net Return [Rs/yr]: Per Grower	Net Return [Rs/yr]: Per Hh
High Diversification Trend																					
Chisopani	5	*20.0*	2.6	*100.0*	*53.8*	54.0	10.8	2.2	7383	1477	295	1055	*72.2*	5490	1098	220	8.5	355	7028	1406	281
Poshyore	4	*16.0*	1.3	*100.0*	*80.0*	8.0	2.0	0.3	886	222	35	222	*0.0*	0	0	0	3.0	110	776	194	31
Ramitay	2	*8.0*	1.0	*50.0*	*50.0*	4.0	4.0	0.2	440	440	18	440	*50.0*	220	220	9	1.0	40	400	400	16
Moderate Diversification Trend																					
Mahakaldara	9	*36.0*	1.7	*100.0*	*86.7*	62.0	6.9	2.5	6803	756	272	523	*61.3*	4170	463	167	14.0	630	6173	686	247
Lamini Gaon	7	*28.0*	1.3	*100.0*	*88.9*	39.0	5.6	1.6	4123	589	165	515	*64.1*	2610	373	104	8.5	375	3748	535	150
Lepcha Gaon	3	*12.0*	1.0	*33.3*	*33.3*	3.0	3.0	0.1	332	332	13	332	*0.0*	0	0	0	1.0	40	292	292	12
Yogda	7	*28.0*	2.3	*85.7*	*68.8*	36.0	6.0	1.4	4082	680	163	371	*72.2*	2980	497	119	11.0	400	3682	614	147
Low Diversification Trend																					
Lwr Gairi Gaon	7	*28.0*	1.0	*85.7*	*85.7*	17.0	2.8	0.7	1883	314	75	314	*0.0*	0	0	0	6.0	300	1583	264	63
Khawas Gaon	2	*8.0*	1.0	*100.0*	*100.0*	5.0	2.5	0.2	554	277	22	277	*0.0*	0	0	0	2.0	80	474	237	19
Upr Gairi Gaon	8	*32.0*	1.4	*100.0*	*90.9*	30.5	3.8	1.2	3363	420	135	336	*32.8*	1100	138	44	9.0	450	2913	364	117
Bimbong	3	*12.0*	1.0	*66.7*	*66.7*	8.0	4.0	0.3	850	425	34	425	*75.0*	640	320	26	2.0	60	790	395	32
Sundung	1	*4.0*	1.0	*100.0*	*100.0*	2.0	2.0	0.1	222	222	9	222	*0.0*	0	0	0	1.0	50	172	172	7
Total Selected Villages	**58**	***19.3***	**1.5**	***89.7***	***75.9***	**268.5**	**5.2**	**0.9**	**30921**	**595**	**103**	**468**	***54.4***	**17210**	**331**	**57**	**67.0**	**2890**	**28031**	**539**	**93**

Source: *Sample Survey*

practising apiculture was relatively higher in such villages than in most of the villages with better irrigation access The proportion of apiaries with bees to the total apiaries was high in most of the villages, and it was relatively higher in the villages with lower irrigation access. The frequency of annual honey yielding per hive was also low for most beekeepers. Such low honey-yielding frequency and year-round empty apiaries of around one-fourths of the beekeepers reflected their limited skill and knowledge on apiculture. Because of small scale of apiculture practice and unscientific method of extracting honey from bee hives, the beekeepers emphasized solely on honey, neglecting its byproducts such as wax, royal jelly, pollen and propolis. Consequently, the annual honey yield and income through honey sale per household and per grower were low in the villages. Generally, these were relatively higher in the less irrigated villages. Hence, despite having great potential in apiculture in the study region, limited households harnessed this opportunity because of their lack of consciousness and proper training on apiculture.

People, irrespective of age and gender, were able to practise apiculture through providing work efforts in cleaning the hives and in extracting honey. However, because of low household participation rate in apiculture and small scale of production, the apiculture annually generated low mandays in the villages. Besides wage cost, apiculture involved moderate amount of fixed cost for preparing apiaries which needed to be replaced every 5-10 years, and hence, the poor households faced difficulties to initiate it. The net return of apiculture was computed by subtracting the wage cost from the value of annual honey-yield. The annual net return of apiculture per grower was low in the villages, and this was relatively higher in the villages with lower irrigation access. Besides providing private economic gains, apiculture had significant external economies and favourable influence on the environment by increasing crop-yields through cross pollination.

Table 7.16 depicts the status and economics of apiculture across the holding-sizes.

Table 7.16 : Status and Economics of Apiculture across Holding-size Categories

Land-Holding-size Categories	Hhs Having Beekeeping Box		Box Per Bee-keep-er [Num-ber]	Propor-tion of Bee-keep-ers Yield-ing Honey [%]	Propo-rtion of Boxes Hav-ing Bees [%]	Honey-yield [lit/yr]			Value of Honey-yield [Rs/yr]				Pro-por-tion of Hon-ey Sold [%]	Sale Value of Honey [Rs/yr]			Man-days Invo-lved [Num-ber]	Wage Costs [Rs/yr]	Net Return [Rs/yr]		
	Num-ber	Propo-rtion To Total Hhs [%]				Tot-al	Per Gro-wer	Per Hh	Tot-al	Per Gro-wer	Per Hh	Per Box		Total	Per Gro-wer	Per Hh			Tot-al	Per Gro-wer	Per Hh
≤1 acre	10	*9.4*	1.1	*90.0*	*81.8*	32.0	3.6	0.3	3445	383	33	383	*53.1*	1810	201	17	9	410	3035	337	29
1-3 acres	35	*23.0*	1.7	*88.6*	*74.1*	177.5	5.7	1.2	21235	685	140	494	*55.8*	12300	397	81	44	1910	19325	623	127
>3 acres	13	*31.0*	1.4	*92.3*	*77.8*	59.0	4.9	1.4	6240	520	149	446	*50.8*	3100	258	74	14	570	5670	473	135
All Sizes	**58**	***19.3***	**1.5**	***89.7***	***75.9***	**268.5**	**5.2**	**0.9**	**30921**	**595**	**103**	**468**	***54.4***	**17210**	**331**	**57**	**67**	**2890**	**28031**	**539**	**93**

Source: *Sample Survey*

The household participation rate in apiculture rose gradually with increasing holding-size, and thereby the annual honey yield and profits of apiculture per household gradually increased with growing holding-size. However, the number of apiaries per beekeeper was the highest for medium-sized farmers and the lowest for small-sized farmers. Consequently, despite having lowest proportion of boxes with bees in medium-sized holdings and highest proportion of boxes with bees in small-sized holdings, the annual honey yield, income and profits of apiculture per grower as well as honey per apiary were found to be the highest in medium-sized holdings and to be the lowest in small-sized holdings. Hence, the apiarists in holdings of medium-size were relatively more efficient in producing honey than those of the other holding-sizes, and the farm-size dependent inequalities revealed in crop income were reduced slightly through apiculture practice.

7.3 Status and Economics of Non-Traditional Agricultural Enterprises

The niche-based floriculture in the Darjeeling hills has great potential in improving their people's livelihoods, and it pioneered the floriculture development in India. On the basis of floriculture, the region can be sub-divided into three zones- a) the *Terai* foothill slopes or the sub-tropical belt, b) the green hills or the sub-temperate "Golden" belt, and c) the upper hills or the temperate belt (KHS, 1997). The sub-tropical belt comprising of the plains and the foothills including the river valleys ranging from 150-300 metres above sea level with temperature of above 30^0C and having the potential of producing cacti and succulents, anthuriums, orchids like dendrobiums, and most of the bulbous, tuberous and rhizomatus plants, and palms (*ibid.*). The sub-temperate "Golden" belt comprises of all the areas falling above the *Terai* foothills and above the river valleys, ranging from 300-1200 metres with temperature lying between 15^0C-25^0C and having the potential of producing a remarkable range of floricultural items such as anthurium, cacti, succulents, all the bulbous, tuberous and rhizomatus plants (*ibid).* The temperate belt consists of the areas falling between, or above the sub-temperate "Golden" belt up to or below the snowline, ranging from 1200 metres to higher altitudes with temperature of below 15^0C, and having the potential of producing qualitative floriculture items such as gloxinias, begonias, hydranzeas, cyclamen and crchids (*ibid.*). Kalimpong is the main floriculture hub in the study region with over 50 nurseries, and the single most common floriculture item is gladioli with annual production of 2008725 corms in 1996 (*ibid.*). The annual production of eucharis, haemanthus, zepheranthus exceeds 3 lakhs; that of gloxinia Sp., achimenes, begonias, lilium longifolium, gerberas, gloriosa and other bulbous plants varies between 50000-100000; and that of anthurium, cyclamen, cymbidium, ornithogalum and freezias ranges between 25000-50000 in 1996 in the whole region (*ibid.*).

Jhora-fishery is another instance of utilisation of mountain production niches. The *Jhora*-fishery in the Darjeeling hills is the first of its kind in the country, and scientific pisciculture fed by perennial *jhora* water was first started in small excavated ponds in Kalimpong in the year 1981-1982 (DRDA, 1990,

op.cit.). *Jhora*-fish ponds were constructed by the Fisheries Department of the Government of West Bengal through various fish farmers' development agencies [FFDA] for individual families in the Darjeeling hills to make them economically self-dependent and to improve their livelihoods (*ibid.*). For making the programme successful, the government initiated in producing fingerlings at Riang in collaboration with the DGHC (WBFD, 2010-2011). In 2004-2005, around 4000 *jhora* ponds persisted in the Darjeeling hills by involving 306 persons in pisciculture with net available area of 2.2028 ha to produce around 73.5 qts fishes per annum (District Statistical Hand Book, 2005). The *jhora*-fishery through *katli* has potential in the Kalimpong hill region (Jha, *et al*., 2004). The sub-tropical to tropical climatic conditions in the Darjeeling hills have also led to the acceptance of bivoltine sericulture as a viable alternative cashcrop (Das & Chakrabarti, 2003).

7.3.1 Area, Status, Participation and Economics of Floriculture

With increasing domestic and international demand for floriculture products like cut-flowers, spikes/cutting, bulbs and pot plants, floriculture is becoming a prosperous enterprise in many parts of the country along with the study region. The agro-climatic suitability of floriculture in the region has created production niches for floriculture. Table 7.17 analyses the area, status and ownership of floriculture in the study villages.

Table 7.17: Area, Status and Ownership of Floriculture across Villages

	Area [*sq m*]							Proportion of the Households [Hh] Involved [%]							Area Per Hh [*sq m*]							Flori-cul-tural Area to NCA [%]
Hamlet	Gla-dio-lus	Ly-co-ris	Ant-huri-um	Ama-ryl-lis lily	Eu-char-is	Oth-er*	All	Gla-dio-lus	Ly-co-ris	Ant-hu-rium	Ama-ryl-lis lily	Eu-cha-ris	Oth-er*	All	Gla-dio-lus	Ly-co-ris	Ant-hur-ium	Ama-ryl-lis lily	Eu-cha-ris	Oth-er*	All	
High Diversification Trend																						
Chisopani	8943	730	1586	0	2	2194	13456	*40*	*12*	*16*	*0*	*4*	*16*	*40*	358	29.2	63.4	0.0	0.1	87.8	538	10.7
Poshyore	243	0	81	81	0	324	728	*8*	*0*	*4*	*4*	*0*	*8*	*16*	10	0.0	3.2	3.2	0.0	12.9	29	0.7
Ramitay	12837	81	108	20	10	197	13253	*52*	*12*	*16*	*4*	*4*	*12*	*52*	513	3.2	4.3	0.8	0.4	7.9	530	10.6
Moderate Diversification Trend																						
Mahakaldara	0	650	25	121	344	631	1772	*0*	*28*	*8*	*4*	*20*	*32*	*44*	0	26.0	1.0	4.9	13.8	25.2	71	1.6
Lamini Gaon	8094	0	162	162	0	1258	9675	*8*	*0*	*4*	*4*	*0*	*12*	*12*	324	0.0	6.5	6.5	0.0	50.3	387	7.9
Lepcha Gaon	324	0	0	0	405	0	728	*8*	*0*	*0*	*0*	*4*	*0*	*12*	13	0.0	0.0	0.0	16.2	0.0	29	0.6
Yogda	10	81	0	0	81	174	346	*4*	*4*	*0*	*0*	*12*	*8*	*12*	0	3.2	0.0	0.0	3.2	6.9	14	0.4
Low Diversification Trend																						
Lwr Gairi Gaon	0	121	81	0	61	121	384	*0*	*4*	*4*	*0*	*8*	*4*	*8*	0	4.9	3.2	0.0	2.4	4.9	15	1.0
Khawas Gaon	16025	0	0	3	121	931	17081	*72*	*0*	*0*	*4*	*8*	*8*	*72*	641	0.0	0.0	0.1	4.9	37.2	683	18.2
Upr Gairi Gaon	0	20	81	40	40	3592	3774	*0*	*4*	*4*	*4*	*4*	*8*	*8*	0	0.8	3.2	1.6	1.6	143.7	151	13.4
Bimbong	0	59	16	0	119	486	680	*0*	*12*	*4*	*0*	*16*	*12*	*20*	0	2.4	0.6	0.0	4.8	19.4	27	0.5
Sundung	3521	0	93	20	0	97	3732	*24*	*0*	*16*	*4*	*0*	*8*	*36*	141	0.0	3.7	0.8	0.0	3.9	149	24.8
Total Selected Villages	**49996**	**1742**	**2234**	**448**	**1184**	**10004**	**65610**	***18.0***	***6.3***	***6.3***	***2.3***	***6.7***	***10.7***	***27.7***	**167**	**5.8**	**7.4**	**1.5**	**3.9**	**33.3**	**219**	**6.0**

Source: *Sample Survey*
1ha = 10000 *sq m*; *incl. rest 45 floricultural products

More than 50 varieties of floriculture items such as anthurium, cymbidium, zygo cactus, cyclamen, gloxinia were grown at sample farms in the study region under poly-houses mainly produced by nursery workers or owners. Others such as gladiolus, gloriosa, lycoris, amaryllis lily, *foot ball lily* (hemanthus) and eucharis were grown on open field. Of these, gladiolus, anthurium, lycoris, amaryllis lily and eucharis were the main floriculture items in terms of household participation rate and land commitment to these items. However, compared to other floriculture produces, gladiolus spread more to ordinary farm households from floriculture nurseries. Household participation rate in gladiolus cultivation and cropland commitment to gladiolus were many folds more than in the cultivation of other floriculture items in most of the villages. However, household participation rate and cropland commitment to total and main floriculture items were low in the study villages.

Along with technical knowledge and financial capability, access to market, marketing channels and irrigation are necessary for introducing and sustaining most floriculture items, especially gladiolus. Thus, household participation rate in gladiolus cultivation and land commitment to gladiolus per household were higher in the well irrigated villages and lower in the less irrigated villages. Most of the floriculture nurseries of the Kalimpong Subdivision are situated within the periphery of Kalimpong Town, and thereby the spillover knowledge on floriculture and access to market are relatively greater in the villages located closer to the market centres than in the villages located farther away from the town. Consequently, household participation rate in floriculture cultivation and land commitment to floriculture per household were higher in the nearer villages than those in the more remote villages. The other floriculture produces mainly included nursery-based floriculture items like cyclamen and gloxinia as well as less irrigation sensitive floriculture items like hemanthus and gloriosa. The land commitment to other floriculture items per household and the household participation rate in the cultivation of these floriculture produces were higher in most less irrigated villages.

Buy-back system between the ordinary growers and the technology, seed and capital providers also persisted in floriculture, especially in gladiolus production. In many cases, such providers were nursery men/ traders/ Govt. Agents. The floriculture technology was initially transferred from the nurseries to ordinary growers, and later from existing growers to more local people. Some growers had also acquired such knowledge through training from local agricultural institution. Most gladiolus growers had got seed from Mr. D.N. Pradhan (a nursery man as well as a floriculture trader) and other local people, while only 3.7 per cent of them had faced buy-back terms in selling flowers to the seed provider. However, 34 per cent of the gladiolus growers sold flowers to the seed providers. They grew gladiolus based on own capital, while 3.7 per cent of them took advance from CADC and Mr. Pradhan. Sometimes the existing growers, especially nursery men, sold the floriculture seeds to ordinary growers during depression with oral assurance of purchasing the products. However, at low price, they did purchase the final products. Hence, asymmetric information and principal-agents relationship existed in floriculture.

Table 7.18 shows the area, status and ownership of the floriculture across the holding-sizes.

Table 7.18: Area, Status and Ownership of Floriculture across Holding-size Categories

Land-Holding-size Categories	Area [*sq m*]							Proportion of the Households [Hh] Involved [%]							Area Per Hh [*sq m*]							Flori-cul-ture Area to NCA [%]
	Gla-dio-lus	Ly-co-ris	Ant-huri-um	Ama-ryl-lis lily	Eu-cha-ris	Oth-er*	All	Gla-dio-lus	Ly-co-ris	Ant-hu-rium	Ama-ryl-lis lily	Eu-cha-ris	Oth-er*	All	Gla-dio-lus	Ly-co-ris	Ant-hur-ium	Ama-ryl-lis lily	Eu-cha-ris	Oth-er*	All	
≤1 acre	8822	123	255	61	79	3633	12973	*12.3*	*6.6*	*7.5*	*1.9*	*2.8*	*6.6*	*21.7*	83	1.2	2.4	0.6	0.7	34.3	122	8.8
1-3 acres	28427	1123	450	24	981	3555	34560	*19.7*	*5.3*	*3.9*	*1.3*	*9.2*	*11.2*	*28.9*	187	7.4	3.0	0.2	6.5	23.4	227	5.6
>3 acres	12747	496	1529	364	124	2816	18077	*26.2*	*9.5*	*11.9*	*7.1*	*7.1*	*19.0*	*38.1*	304	11.8	36.4	8.7	2.9	67.1	430	5.4
All Sizes	**49996**	**1742**	**2234**	**448**	**1184**	**10004**	**65610**	***18.0***	***6.3***	***6.3***	***2.3***	***6.7***	***10.7***	***27.7***	**167**	**5.8**	**7.4**	**1.5**	**3.9**	**33.3**	**219**	**6.0**

Source: *Sample Survey*
1ha = 10000 *sq m*; *incl. rest 45 floricultural products

Household participation rate in gladiolus, other floriculture produces and total floriculture production as well as land commitment to gladiolus, lycoris, anthurium and total floriculture per household rose gradually with increasing holding-size, while the floriculture intensity of cropland gradually decreased with growing holding-size. Household participation rate in lycoris, anthurium and amaryllis lily production as well as land commitment to amaryllis lily per household were also highest in large-sized holdings and lowest in medium-sized holdings. However, household participation rate in eucharis production and land commitment to it per household were relatively greater in medium-sized holdings

compared to other holding categories. Hence, the floriculture opportunity was harnessed more by larger farmer households than the smaller farmer households.

Floriculture prevailed more among farmers with better irrigation access than among farmers with less irrigation access. The participation rates in gladiolus and total floriculture production were 33.2 and 36.5 per cent respectively for farmers with more irrigated land against the 2.1 and 18.5 per cent respectively for farmers with less irrigated land. Consequently, land commitment to gladiolus and total floriculture items per household was 5 and 3 times higher respectively for farmers with better irrigation access compared to the farmers with lower irrigation access who on an average committed land to gladiolus and total floriculture items by the extent of 58 and 118 *sq m* respectively. Nevertheless, the participation rates in gladiolus and total floriculture production were 10.6 and 1 per cent higher respectively for farmers who did not own land, compared to the 17.5 and 27.6 per cent respectively for landowning farmers, mainly because the farmers who did not own land possessed irrigated land. Consequently, land commitment to gladiolus and total floriculture items per household was 2.1 and 1.6 times higher respectively for farmers who did not own land compared to the 159 and 213 *sq m* respectively for landowning farmers.

Table 7.19 examines the economics of floriculture in the study hamlets. Despite having low household participation and low land commitment to floriculture in the study villages, the annual value, income and profits of the total floriculture produces per household were high in most of the villages, while for gladiolus these were also high but in selected villages, particularly in the well irrigated villages located closer to the market centres. Over the whole sample, the proportion of land commitment to gladiolus to the total land commitment to floriculture was 75 per cent, and the gladiolus contributed about 42 per cent of the total value and income from floriculture. The second important floriculture item was anthurium which contributed 7 per cent of the total value from floriculture. The annual value, income and profits of the total floriculture production and gladiolus per household, as well as the contribution of gladiolus to total floriculture were higher in most well irrigated villages and lower in most less-irrigated villages. These were also higher in the nearer villages than in most of the villages located farther away from the market centres. Despite having lower yield rates in gladiolus cultivation than in the production of other floriculture produces, especially in nursery-based floriculture, the gladiolus yield rates were 7.8 times higher than the yield rates of field crops in crop agriculture over the whole sample. In terms of

Table 7.19: Economics of the Floriculture across Villages

	Value of Floriculture Products [Rs/yr]							Sale Value of Floricultural Products [Rs/yr]							Production Costs [Rs/yr]		
Hamlet	Gladi--olus	Lyco--ris	Anthu--rium	Ama--ryl--lis lily	Euch--aris	Other	All	Gladi--olus	Lyco--ris	Anthu--rium	Ama--ryl--lis lily	Euch--aris	Other	All	Gla--dio--lus	Lyco--ris	Anthu--rium
High Diversification Trend																	
Chisopani	252325	52900	77980	0	2000	819453	1204658	198875	12400	77500	0	0	663980	952755	77410	4362	40635
Poshyore	6610	0	15120	7800	0	24500	54030	5000	0	15000	6800	0	22500	49300	2066	0	11530
Ramitay	340574	2225	9515	2400	675	18983	374372	292900	2000	9275	1900	375	11820	318270	126935	600	2285
Moderate Diversification Trend																	
Mahakaldara	0	31764	3160	5500	40500	26601	107525	0	17629	3000	4500	21000	11885	58014	0	4172	1790
Lamini Gaon	106450	0	11120	12400	0	18430	148400	85300	0	11000	10400	0	11514	118214	49350	0	9200
Lepcha Gaon	16640	0	0	0	27500	0	44140	15000	0	0	0	12500	0	27500	10083	0	0
Yogda	110	2500	0	0	1850	4990	9450	0	0	0	0	0	350	350	135	765	0
Low Diversification Trend																	
Lwr Gairi Gaon	0	5000	16150	0	4250	11100	36500	0	4500	16000	0	3500	10500	34500	0	1275	8150
KhawasGaon	246660	0	0	250	2950	15350	265210	160140	0	0	200	2500	10400	173240	94105	0	0
Upr Gairi Gaon	0	3000	15000	5000	4500	57013	84513	0	3000	12500	4000	4000	49400	72900	0	1240	4375
Bimbong	0	4750	9000	0	9000	12755	35505	0	2000	9000	0	7000	11800	29800	0	2130	3690
Sundung	75530	0	10292	600	0	5825	92247	53300	0	10000	0	0	3000	66300	22412	0	5585
Total Selected Villages	**1044899**	**102139**	**167337**	**33950**	**93225**	**1014998**	**2456548**	**810515**	**41529**	**163275**	**27800**	**50875**	**807149**	**1901143**	**382496**	**14544**	**87240**

Hamlet	Production Costs [Rest/yr]				Net Return [Rest/yr]		Value of Output [Rs/yr]				Sale Value [Rs/yr]				Net Return [Rs/yr]			
							Total		Gladiolus		Total		Gladiolus		Total		Gladiolus	
	Amaryllis	Eucharis	Other	All	Total	Gladiolus	Per Hh	Per ha Land	Per Hh	Per ha Land	Per Hh	Per ha Land	Per Hh	Per ha Land	Per Hh	Per ha Land	Per Hh	Per ha Land
High Diversification Trend																		
Chisopani	0	94	248492	370993	833665	174915	48186	895262	10093	282129	38110	708056	7955	222366	33347	619552	6997	195576
Poshyore	930	0	11960	26486	27544	4544	2161	741725	264	272227	1972	676791	200	205920	1102	378125	182	187140
Ramitay	280	110	4125	134335	240037	213639	14975	282470	13623	265313	12731	240141	11716	228174	9601	181112	8546	166429
Moderate Diversification Trend																		
Mahakaldara	850	4735	7308	18855	88670	0	4301	606929	0	0	2321	327464	0	0	3547	500501	0	0
Lamini Gaon	930	0	4986	64466	83934	57100	5936	153379	4258	131521	4729	122180	3412	105390	3357	86750	2284	70548
Lepcha Gaon	0	2420	0	12503	31637	6557	1766	605955	666	513977	1100	377521	600	463321	1265	434313	262	202533
Yogda	0	500	1183	2583	6867	-25	378	273477	4	108726	14	10129	0	0	275	198723	-1	-24710
Low Diversification Trend																		
Lwr Gairi Gaon	0	700	5730	15855	20645	0	1460	949401	0	0	1380	897379	0	0	826	536997	0	0
KhawasGaon	120	1200	3420	98845	166365	152555	10608	155265	9866	153916	6930	101422	6406	99928	6655	97397	6102	95194
Upr Gairi Gaon	590	590	17940	24735	59778	0	3381	223927	0	0	2916	193158	0	0	2391	158388	0	0
Bimbong	0	2105	3845	11770	23735	0	1420	521861	0	0	1192	438007	0	0	949	348863	0	0
Sundung	460	0	1620	30077	62170	53118	3690	247204	3021	214526	2652	177671	2132	151387	2487	166603	2125	150870
Total Selected Villages	**4160**	**12454**	**310609**	**811503**	**1645045**	**662403**	**8188**	**374414**	**3483**	**208992**	**6337**	**289762**	**2702**	**162112**	**5483**	**250729**	**2208**	**132488**

Source: *Sample Survey*

value, income and profits, begonia, cylamen and gloxinia occupied important positions. Over the whole sample, only one household (nursery man Mr. Kumar Chettri) in Chisopani generated equal value of Rs 154000 per annum by committing 11.1 *sq m* land each under begonia, cyclamen and gloxinia.

The floriculturists sold perishable cut-flowers and spikes immediately after production. However, they retained a portion of bulbs, cutting/plants, potted plants, seedlings and seeds for re-cultivation or for later sale, especially for new introducers of bulbous floriculture produces such as gladiolus and freezia. Mainly because of this retainment, the value and income of gladiolus was low in the nearer village of Lamini Gaon and in the more remote village of Lower Gairi Gaon. The total cost of floriculture was computed by adding seed/seedling cost, manure cost, fertiliser cost, pesticide cost, packaging cost, transport cost, vitamin cost, rental cost and preparation costs comprising of cost of plastic and pot, green plastic sheet and wage. In per hectare terms, the costs of cultivation of the total floriculture items were very high but lower for gladiolus in the study villages. Thus, besides marketing risk, floriculture production also involved high degree of production risk, and relatively lower costs of gladiolus cultivation enabled the ordinary growers to involve in gladiolus cultivation. The profit of floriculture was computed by subtracting its cost from its value of output. The profitability of total floriculture produces and gladiolus was very high in most of the villages, and the latter exceeded Rs 95 thousand in the well irrigated villages located closer to market centres. Hence, the floriculture produces, especially gladiolus, had substantial economic potential of diversification in the villages, particularly in the nearer villages with better irrigation access.

Table 7.20 below exhibits the economics of floriculture across the holding-size categories. The annual value, income and profits of the total floriculture items and gladiolus per household were high for households in all holding-sizes, while these increased gradually with growing holding-size. Hence, the floriculture had substantial economic potential of diversification for households in all holding sizes, although such opportunity was harnessed more by households in large-sized holdings than in the others.

Table 7.20: Economics of Floriculture across Holding-size Categories

Land-Holding-size Categories	Value of Floriculture Products [Rs/yr]							Sale Value of Floricultural Products [Rs/yr]							Production Costs [Rs/yr]		
	Gladi--olus	Lyco--ris	Anthu--rium	Ama--ryl--lis lily	Euch--aris	Other	All	Gladi--olus	Lyco--ris	Anthu--rium	Ama--ryl--lis lily	Euch--aris	Other	All	Gla--dio--lus	Lyco--ris	Anthu--rium
≤1 acre	261110	6980	32182	5600	6500	63742	376114	225390	4730	29150	4000	4000	52854	320124	104510	3664	10895
1-3 acres	565384	63974	46135	2650	66225	814016	1558384	420750	21674	45625	2100	36875	667165	1194189	200209	6860	35330
>3 acres	218405	31185	89020	25700	20500	137240	522050	164375	15125	88500	21700	10000	87130	386830	77777	4020	41015
All Sizes	**1044899**	**102139**	**167337**	**33950**	**93225**	**1014998**	**2456548**	**810515**	**41529**	**163275**	**27800**	**50875**	**807149**	**1901143**	**382496**	**14544**	**87240**

Land-Holding-size Categories	Production Costs [Rest/yr]				Net Return [Rest/yr]		Value of Output [Rs/yr]				Sale Value [Rs/yr]				Net Return [Rs/yr]			
							Total		Gladiolus		Total		Gladiolus		Total		Gladiolus	
	Ama--ryl--lis lily	Eu--cha--ris	Other	All	Total	Gladio--lus	Per Hh	Per ha Land	Per Hh	Per ha Land	Per Hh	Per ha Land	Per Hh	Per ha Land	Per Hh	Per ha Land	Per Hh	Per ha Land
≤1 acre	1050	1370	19013	140502	235612	156600	3548	289921	2463	295970	3020	246763	2126	255481	2223	181618	1477	177507
1-3 acres	400	9515	256871	509185	1049199	365175	10253	450916	3720	198888	7857	345537	2768	148009	6903	303584	2402	128459
>3 acres	2710	1569	34725	161816	360234	140628	12430	288790	5200	171330	9210	213988	3914	128945	8577	199276	3348	110317
All Sizes	**4160**	**12454**	**310609**	**811503**	**1645045**	**662403**	**8188**	**374414**	**3483**	**208992**	**6337**	**289762**	**2702**	**162112**	**5483**	**250729**	**2208**	**132488**

Source: *Sample Survey*

The floriculture also increased farm-size dependent inequalities as revealed in crop income. Nevertheless, in per hectare terms, costs of gladiolus cultivation as well as profits of the total floriculture produces and gladiolus reduced gradually with increased holding-size, while the costs of total floriculture cultivation was observed to be highest in medium-sized holdings and to be lowest in large-sized holding-size. Hence, the small farms were more efficient in floriculture cultivation than the large farms.

7.3.2 Status and Economics of Sericulture

Despite private initiative taken for introducing sericulture in Kalimpong since 1879, the farmers practised bivoltine sericulture during the 1970s through government initiatives in the study region (CSD, 2006). Table 7.21 explores the status and economics of sericulture in the study villages. The Chinese variety sericulture was practised only in the more remote villages with inferior slope aspect, where non-farm work opportunities and crop-yields were less. Despite the introduction of sericulture practice by 40 and 48 per cent of the households in Bimbong and Mahakaldara respectively, only half of them, and 4 per cent households in Yogda were currently practising sericulture. Hence, land commitment to mulberry plants per household was low in the silkworm rearing villages. In the region, sericulture was confined to mulberry plantation and silkworm rearing, without any reeling activity. The households practised sericulture in three crop seasons- a) Spring (April-May) for normal crop and b) Summer (June-July) for commercial crop, and c) Autumn (August-September) for seed crop. One-fifths of the sericulturists followed three crop seasons only in Mahakaldara, while the rest followed just two crop seasons ignoring the summer one, since high humidity and continuous rain hindered the successful silkworm rearing during this season.

The scale of silkworm rearing based on egg-stock of the sericulturists depended upon the availability of mulberry leaf with them which resulted from their commitment of cropland to mulberry plants such as *indica*, *kossion*, *gosar swami* and local varieties of plants. The mulberry plants also produced low quantity of fruits per household in the villages. Generally, for rearing 100 dfls eggs, 1500-1600kg mulberry leaves were required. The low land commitment to mulberry plants per household and thereby

Table 7.21: Status and Economics of Sericulture across Villages

Hamlets	Engage-ment of Hhs in Silkworm Rearing		Mulberry Plantation							Silkworm Rearing			Sericulture								
				Leaf-yield		Fruit-yield		Cash Earning [Rs/yr]			Cocoon yield (Sold)		Vari-able Costs [Rs/yr]	Value of Output [Rs/yr]			Cash Earning [Rs/yr]		Net Return [Rs/yr]		
	Tot-al	Per-cen-tage	Area (ha)	[kg/ yr]	[Rs/ yr]	[kg/ yr]	[Rs/ yr]	Leaf Sale	Fruit Sale	Sto-ck of Eggs [dfls]	[kg/ yr]	[Rs/ yr]		Total	Per Hh	Per ha Land	Tot-al	Per Hh	Total	Per Hh	Per ha Land
High Diversification Trend																					
Chisopani	0	*0*	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poshyore	0	*0*	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ramitay	0	*0*	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Moderate Diversification Trend																					
Mahakaldara	4	*16*	0.704	9900	19800	46	1840	3700	1280	615	224	22371	11330	44011	1760	62502	27351	27351	32681	1307	46412
Lamini Gaon	0	*0*	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepcha Gaon	0	*0*	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yogda	1	*4*	0.081	480	960	4	160	0	0	30	17	2210	1643	3330	133	41143	2210	2210	1688	68	20849
Low Diversification Trend																					
Lwr Gairi Gaon	0	*0*	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Khawas Gaon	0	*0*	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upr Gairi Gaon	0	*0*	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bimbong	5	*20*	0.097	4080	8160	22	880	1200	200	145	49	6730	6154	15770	631	162368	8130	8130	9616	385	99003
Sundung	0	*0*	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Selected Villages	**10**	***3.3***	**0.882**	**14460**	**28920**	**72**	**2880**	**4900**	**1480**	**790**	**290**	**31311**	**19127**	**63111**	**210**	**71537**	**37691**	**37691**	**43984**	**147**	**49856**

Source: *Sample Survey*

the low availability of leaf permitted the sericulturists to rear silkworms on a smaller scale in the villages. Consequently, the annual value and income generation of sericulture per household were low in the silkworm rearing villages, while these were high for the sericulturists.

The variable cost of silkworm rearing was computed by adding the costs of leaf, wage, transportation, and annual maintenance of mulberry plantation ignoring the egg cost. The Sate Sericulture Board provided the entire equipment and materials such as *chandika* (mountage), *dala* (prey), rearing stands, sacks and nets as well as eggs to the sericulturists at free of cost. Deducting the variable cost from value generation, the profit of sericulture was calculated. The annual profit of sericulture per household was low in the villages, with most marked in Mahakaldara but it was high for the sericulturists. In per hectare terms, the profit of mulberry plantation land was high in the silkworm rearing villages, while this would be very low when costs of eggs, equipment and materials are considered. Hence, sericulture was not spreading in the nearer villages, especially in villages with better irrigation access where the opportunity cost of mulberry plantation land was high.

In the locality, the Regional Sericultural Research Station of the Central Government and the State Silk Board played complementary roles in spreading sericulture. The former looked after the Research & Development activity and proliferation of improved technology in silkworm rearing, while the latter mainly provided extension services to sericulture. The sericulturists had got credit, technology and buy-back support as well as Rs 500 for undertaking training from the State Silk Board. Half of the sericulturists had received subsidised loan of Rs 54000 in all from this Board and 20 per cent of the sericulturists applied for loan. Hence, the sericulture activities in the study region were primarily based on state subsidy. The sericulture played a crucial role in empowering women, since the silkworm rearing women mainly used the sericulture income as pocket money and the entire work effort for silkworm rearing was provided by them. For rearing silkworm, the women provided 153, 23 and 87 mandays to the villages of Mahakaldara, Yogda and Bimbong respectively. The autumn crop of this

region was used as seed crop in the plain region, and thus the sericulture in this region sustained the sericulture in the plains of the state. The sericulture also had no adverse effects on environment, rather the perennial mulberry plants tightened the soil particles and acted against soil-erosion.

The status and economics of sericulture across the holding-sizes are shown in Table 7.22**.**

Table 7.22: Status and Economics of Sericulture across Holding-size Categories

Land-Holding-size Categories	Engage-ment of Hhs in Silkworm Rearing		Mulberry Plantation							Silkworm Rearing		Sericulture									
				Leaf-yield		Fruit-yield		Cash Earning [Rs/yr]		Sto-ck of Eggs [dfls]	Cocoon yield (Sold)		Vari-able Costs [Rs/yr]	Value of Output [Rs/yr]			Cash Earning [Rs/yr]		Net Return [Rs/yr]		
	Tot-al	Per-cen-tage	Area (ha)	[kg/ yr]	[Rs/ yr]	[kg/ yr]	[Rs/ yr]	Leaf Sale	Fruit Sale		[kg/ yr]	[Rs/ yr]		Total	Per Hh	Per ha Land	Tot-al	Per Hh	Total	Per Hh	Per ha Land
≤1 acre	1	*0.9*	0.016	720	1440	2	80	0	0	75	17	1980	1220	3500	33	216216	1980	19	2280	22	140850
1-3 acres	2	*1.3*	0.304	4980	9960	21	840	1700	400	210	82	8770	5243	19570	129	64478	10870	72	14328	94	47205
>3 acres	7	*16.7*	0.563	8760	17520	49	1960	3200	1080	505	191	20561	12664	40041	953	71182	24841	591	27377	652	48668
All Sizes	**10**	***3.3***	**0.882**	**14460**	**28920**	**72**	**2880**	**4900**	**1480**	**790**	**290**	**31311**	**19127**	**63111**	**210**	**71537**	**37691**	**126**	**43984**	**147**	**49856**

Source: *Sample Survey*

The silkworm rearing activity was mainly practised by the farmer households in large-sized holdings compared to the households in small-sized holdings, since with decrease in holding-size, the cropland was more scarce, and the opportunity cost of mulberry plantation land rose gradually with holding-size. Consequently, the annual value, income and profit per household from sericulture increased sharply with growing holding-size. Hence, the sericulture also reinforced the farm-size dependent inequalities in the distribution of rural income as revealed in other land-based activities.

7.3.3 Status and Economics of Pisciculture

In the study region, the *jhora* water also provides income generation opportunities through pisciculture to the households who have access to perennial *jhoras.* However, because of the necessity of eco-fragile environment for practising pisciculture, concrete fish pond is needed to be constructed for safe guard against possible water leakage and the consequent landslide. Thus, the size of fish pond and scale of fish production of the regional pisciculturists were many folds lower than those of a plain pisciculturist. The poor households initially faced difficulties in building such fish pond. Consequently, in the region, pisciculture practice started lately since the 1980s through government effort. Table 7.23 analyses the status and economics of pisciculture in the study villages. Despite having made enthusiastic attempt by the local fishery department through spreading pisciculture in the region by providing training and subsidised loan, very low proportion of households practised pisciculture through rearing varieties of fingerlings like those of American *rohu*, grass carp and *mrigal* in the study region. Most of the households practising pisciciculture had followed it from the past 5 years and thereby pisciculture was gradually gaining grounds in the region. At sample farms, pisciculture was not practised in the well irrigated hamlets of Chisopani, Poshyore and Sundung and in the less irrigated hamlet of Bimbong. With low household participation rate in pisciculture and the small size of fish pond in the fish rearing villages, their fish-yield, value, income and profits from pisciculture per household were low. Household participation rate in pisciculture was relatively more in most of the villages with greater access to *jhora* like Lepcha Gaon and lower in the most of the villages with lower access to *jhora* like Poshyore.

Besides the quantity and quality of fingerlings, the fish-yield per household in the villages depended upon their size of fish pond which varied from 290 to1800 cubic feet. The maximum annual weight of a

fish was 2 kg as mentioned by the pisiculturists. The annual yield, value and income generation from pisciculture per grower were high in most of the fish rearing villages. With relatively greater fish pond

Table 7.23: Status and Economics of Pisciculture across Villages

Hamlet	Hhs Having Pisciculture: Number	Hhs Having Pisciculture: Proportion To Total Hhs [%]	Growers Introduced within 5 years [%]	Average Area of *Jhora* Fishery [qb. ft.]	Fish-yield [kg/yr]: Total	Fish-yield [kg/yr]: Per Grower	Fish-yield [kg/yr]: Per Hh	Fish-yield [Rs/yr]: Total	Fish-yield [Rs/yr]: Per Grower	Fish-yield [Rs/yr]: Per Hh	Proportion of Fish Sold [%]	Earning through Fish Sale [Rs/yr]: Total	Earning through Fish Sale [Rs/yr]: Per Grower	Earning through Fish Sale [Rs/yr]: Per Hh	Variable Inputs: Fish-finger [No./yr]	Variable Inputs: Fish-finger [Rs/yr]	Variable Inputs: Time Involved Man-days [No./yr]	Variable Inputs: Time Involved Wage Costs [Rs/yr]	Net Return [Rs/yr]: Total	Net Return [Rs/yr]: Per Grower	Net Return [Rs/yr]: Per Hh
High Diversification Trend																					
Chisopani	0	*0.0*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Poshyore	0	*0.0*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ramitay	2	*8.0*	*50.0*	290	64	32.0	2.6	3776	1888	151	*0.0*	0	0	0	460	410	12.0	480	2886	1443	115
Moderate Diversification Trend																					
Mahakaldara	1	*4.0*	*0.0*	560	80	80.0	3.2	4800	4800	192	*75.0*	3600	3600	144	3200	1600	4.0	200	3000	3000	120
Lamini Gaon	2	*8.0*	*50.0*	440	90	45.0	3.6	5400	2700	216	*61.1*	3300	1650	132	1900	750	6.0	300	4350	2175	174
Lepcha Gaon	5	*20.0*	*60.0*	468	89	17.8	3.6	5251	1050	210	*0.0*	0	0	0	285	250	7.0	280	4721	944	189
Yogda	2	*8.0*	*50.0*	680	240	120.0	9.6	12360	6180	494	*58.3*	7000	3500	280	12150	1400	10.0	300	10660	5330	426
Low Diversification Trend																					
Lwr Gairi Gaon	2	*8.0*	*100.0*	312	30	15.0	1.2	1770	885	71	*0.0*	0	0	0	250	150	3.0	150	1470	735	59
Khawas Gaon	1	*4.0*	*100.0*	1800	80	80.0	3.2	5200	5200	208	*50.0*	2600	2600	104	1500	450	4.0	160	4590	4590	184
Upr Gairi Gaon	1	*4.0*	*100.0*	800	15	15.0	0.6	885	885	35	*0.0*	0	0	0	20	90	1.5	75	720	720	29
Bimbong	0	*0.0*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sundung	0	*0.0*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Selected Villages	**16**	***5.3***	***62.5***	**559**	**688**	**43.0**	**2.3**	**39442**	**2465**	**131**	***42.9***	**16500**	**1031**	**55**	**19765**	**5100**	**47.5**	**1945**	**32397**	**2025**	**108**

Source: *Sample Survey*
– absence of Pisciculture

depth and more economic distress in villages with inferior slope aspect, in both per household and per grower terms, the annual yield, value and income generation of the pisciculture were higher in such villages, and lower in most of the villages with moderate to superior slope aspects. Only in the superior slope aspect hamlet of Khawas Gaon and in the villages with inferior slope aspect, the pisciculturists caught and sold a part of the fishes between July to November, particularly during the *Bhai Tika* festival. Consequently, over the whole sample, only 42.9 per cent of the fish product was sold. Less area of fish pond, subsistence mode of production, lack of proper training and professional attitude towards rearing fish, and poor quality of fingerlings were primarily responsible for the low fish-yield and income from pisciculture for the pisciculturists.

The profit of pisciculture was computed by subtracting the wage cost of operating pisciculture and the cost for fingerlings from the fish product value. The annual profit per pisciculturist was high in most of the fish rearing villages, and it was higher in most of the villages with inferior slope aspect. Hence, in the region, the pisciculture had potential in improving the living standards of the people. However, because of lack consciousness, training and credit, most of the households did not practise pisciculture. Experiencing the problems of landslide, attacking by snake and stealing of fishes, some households had abandoned pisciculture. Despite receiving subsidised loan of Rs 12000 for introducing pisciculture by three households, they did not build fish ponds yet.

Table 7.24 depicts the status and economics of pisciculture across the holding-sizes. The household participation rate in pisciculture was very low in the holding-sizes, and it was found to be the highest in

medium-sized holdings and to be the lowest in small-sized holdings. Consequently, the annual fish production and profits from pisciculture and the number of fingerlings per household and per grower, as

Table 7.24: Status and Economics of the Pisciculture across Holding-size Categories

Land-Holding-size Categories	Hhs Having Pisciculture		Grow-ers Introd-uced with-in 5 years [%]	Aver-age Area of *Jho-ra* Fish-ery [qb. ft.]	Fish-yield [kg/yr]			Fish-yield [Rs/yr]			Pro-por-tion of Fish Sold [%]	Earning through Fish Sale [Rs/yr]			Variable Inputs				Net Return [Rs/yr]		
															Fish-finger		Time Involved				
	Propo-rtion To Total Hhs					Per			Per				Per				Man-days	Wa-ge Costs		Per	
	Num-ber	[%]			Tot-al	Gro-wer	Per Hh	Total	Gro-wer	Per Hh		Tot-al	Gro-wer	Per Hh	[No./ yr]	[Rs/ yr]	[No./ yr]	[Rs/ yr]	Tot-al	Gro-wer	Per Hh
≤1 acre	3	*2.8*	*66.7*	392	98	32.7	0.9	5782	1927	55	*0.0*	0	0	0	500	330	8.8	370	5082	1694	48
1-3 acres	11	*7.2*	*63.6*	641	505	45.9	3.3	28575	2598	188	*48.5*	13500	1227	89	17715	3990	33.2	1315	23270	2115	153
>3 acres	2	*4.8*	*50.0*	360	85	42.5	2.0	5085	2543	121	*58.8*	3000	1500	71	1550	780	5.5	260	4045	2023	96
All Sizes	**16**	***5.3***	***62.5***	**559**	**688**	**43.0**	**2.3**	**39442**	**2465**	**131**	***42.9***	**16500**	**1031**	**55**	**19765**	**5100**	**47.5**	**1945**	**32397**	**2025**	**108**

Source: *Sample Survey*

well as the income from pisciculture per household were higher for medium-sized farmer households and lower for small-sized farmer households. The entire fish product was consumed by the family members in smallholding sizes, while a greater proportion of it was sold in the holdings of large-size compared to the medium-sized holdings. So, the annual income of the pisciculture per grower was relatively higher in large-sized holdings compared to the holdings of medium-size. Hence, the medium-sized farmers harnessed the pisciculture opportunity more than the farmers of other holding-size categories, and thereby the pisciciculture slightly reduced the farm-size dependent inequalities in the distribution of income as revealed in field cropping activities among the households in medium and large-sized holdings.

7.4 Implication of Agriculture in Economics and Environment

The principal objective of this study is to design strategic mechanisms for agriculture and rural development that operate in the highly constrained mountain region. Hence, after analysing the economic potential of the agricultural enterprises separately, the contribution of hill farming in terms of value and income as well as their relative contribution to farm value and income in the villages have been evaluated. For sustainable development, the influence of the agricultural enterprises on environment has also been analysed.

7.4.1 Value Generation from Agricultural Enterprises & Agricultural Diversification

Table 7.25 explores the absolute and relative value generation of the agricultural enterprises in the study villages. The annual value generation of traditional and total farming operations per household was high in the study region. However, the annual value generation of non-traditional farming operations per household was low in most of the villages. All of these were relatively greater in the nearer villages and lower in the more distant villages. Hence, the variations in access to markets between the villages played crucial roles in their differences in value generation from both the traditional and non-traditional farming operations.

The traditional farming activities dominantly contributed to the total farm value generation in the study villages. Mainly with low value generation from floriculture in the villages dominated by the tribal communities, the dominancy of the traditional farming operations over the total farm value generation was higher in the tribal villages and lower in the non-tribal villages. Conversely, with high value generation from floriculture in the nearer villages, the proportion of value generation from traditional

farming operations to the total farming operations was relatively lower in these villages than in the remote villages. It was also lower in the villages with better irrigation access. The proportion of value

Table 7.25: Absolute and Relative Value Generation of Agricultural Sub-sectors across Villages

Hamlet	Value Generation of Traditional Agricultural Sub-sectors [Rs/yr.]							Value Generation of Non-traditional Agricultural Sub-sectors [Rs/yr.]				Value Generation of Agricultural Sector [Rs/yr.]	Per Household Value Generation [Rs/yr.]		
	Crops	Live-stock$	Fruits	Forestry*	Misc. Items**	Api-culture	Total	Floriculture	Sericulture	Pisciculture	Total		Traditional Sub-sectors	Non-traditional Sub-sectors	Agricultural Sector
High Diversification Trend															
Chisopani	650137	470540	30773	167627	49884	7383	1376343	1204658	0	0	1204658	2581001	55054	48186	103240
Poshyore	1090685	489368	355748	65250	41169	886	2043106	54030	0	0	54030	2097136	81724	2161	83885
Ramitay	446705	691505	88674	124344	45338	440	1397005	374372	0	3776	378148	1775153	55880	15126	71006
Moderate Diversification Trend															
Mahakaldara	534589	649757	68825	117184	73211	6803	1450367	107525	44011	4800	156336	1606703	58015	6253	64268
Lamini Gaon	384018	713321	39871	214625	65807	4123	1421764	148400	0	5400	153800	1575564	56871	6152	63023
Lepcha Gaon	680962	579405	55535	98279	33368	332	1447881	44140	0	5251	49391	1497272	57915	1976	59891
Yogda	551385	537444	80976	78720	72499	4082	1325105	9450	3330	12360	25140	1350244	53004	1006	54010
Low Diversification Trend															
Lwr Gairi Gaon	429542	611763	22313	89728	44610	1883	1199839	36500	0	1770	38270	1238109	47994	1531	49524
Khawas Gaon	496056	317681	34464	60729	30516	554	939998	265210	0	5200	270410	1210408	37600	10816	48416
Upr Gairi Gaon	298293	650608	18660	86524	31321	3363	1088768	84513	0	885	85398	1174166	43551	3416	46967
Bimbong	337500	465234	95680	85556	54833	850	1039654	35505	15770	0	51275	1090929	41586	2051	43637
Sundung	277483	240876	29719	50628	23137	222	622063	92247	0	0	92247	714310	24883	3690	28572
Total Selected Villages	**6177354**	**6417500**	**921236**	**1239193**	**565689**	**30921**	**15351893**	**2456548**	**63111**	**39442**	**2559101**	**17910993**	**51173**	**8530**	**59703**

Hamlet	Relative Value Generation of Agricultural Sub-sectors in Percentage Terms											Diversification Indices of Agricultural Sub-sectors	
	Traditional Sub-sectors							Non-traditional Sub-sectors					
	Crops	Live-stock$	Fruits	Forestry*	Misc. Items**	Api-culture	Total	Floriculture	Sericulture	Pisciculture	Total	B.I.	C.E.I.
High Diversification Trend													
Chisopani	*25.2*	*18.2*	*1.2*	*6.5*	*1.9*	*0.29*	*53.3*	*46.7*	*0.00*	*0.00*	*46.70*	0.681	0.589
Poshyore	*52.0*	*23.3*	*17.0*	*3.1*	*2.0*	*0.04*	*97.4*	*2.6*	*0.00*	*0.00*	*2.60*	0.644	0.556
Ramitay	*25.2*	*39.0*	*5.0*	*7.0*	*2.6*	*0.02*	*78.7*	*21.1*	*0.00*	*0.21*	*21.30*	0.732	0.626
Moderate Diversification Trend													
Mahakaldara	*33.3*	*40.4*	*4.3*	*7.3*	*4.6*	*0.42*	*90.3*	*6.7*	*2.74*	*0.30*	*9.70*	0.711	0.614
Lamini Gaon	*24.4*	*45.3*	*2.5*	*13.6*	*4.2*	*0.26*	*90.2*	*9.4*	*0.00*	*0.34*	*9.80*	0.706	0.613
Lepcha Gaon	*45.5*	*38.7*	*3.7*	*6.6*	*2.2*	*0.02*	*96.7*	*2.9*	*0.00*	*0.35*	*3.30*	0.636	0.521
Yogda	*40.8*	*39.8*	*6.0*	*5.8*	*5.4*	*0.30*	*98.1*	*0.7*	*0.25*	*0.92*	*1.90*	0.665	0.540
Low Diversification Trend													
Lower Gairi Gaon	*34.7*	*49.4*	*1.8*	*7.2*	*3.6*	*0.15*	*96.9*	*2.9*	*0.00*	*0.14*	*3.10*	0.628	0.514
Khawas Gaon	*41.0*	*26.2*	*2.8*	*5.0*	*2.5*	*0.05*	*77.7*	*21.9*	*0.00*	*0.43*	*22.30*	0.711	0.598
Upper Gairi Gaon	*25.4*	*55.4*	*1.6*	*7.4*	*2.7*	*0.29*	*92.7*	*7.2*	*0.00*	*0.08*	*7.30*	0.617	0.522
Bimbong	*30.9*	*42.6*	*8.8*	*7.8*	*5.0*	*0.08*	*95.3*	*3.3*	*1.45*	*0.00*	*4.70*	0.705	0.618
Sundung	*38.8*	*33.7*	*4.2*	*7.1*	*3.2*	*0.03*	*87.1*	*12.9*	*0.00*	*0.00*	*12.90*	0.711	0.631
Total Selected Villages	***34.5***	***35.8***	***5.1***	***6.9***	***3.2***	***0.17***	***85.7***	***13.7***	***0.35***	***0.22***	***14.30***	**0.725**	**0.606**

Source: *Sample Survey*

* incl. Bamboo also; ** miscellaneous other crops and collected items; and $ value addition

generated by the livestock to the total farm value was higher in most of the non-tribal villages, although higher farm value was generated from crop cultivation in most of the tribal villages. Only in the nearer village of Chisopani with better irrigation access, floriculture generated greater farm value. However, because of crop and livestock dominancy over the total farm value in the villages, the agricultural diversification measured in terms of both Berry and entropy indices was moderate in the villages with higher diversification when measured in terms of the former than in terms of the latter. Despite having lower farm value in the villages with lower irrigation access, farm diversification was higher in these

villages, while despite having higher farm value in the well irrigated hamlet of Chisopani, its farm diversification was lower. Hence, such agricultural diversification indices failed to capture farming complexity in the study villages.

Table 7.26 shows the absolute and relative value generation of the agricultural enterprises across the holding-sizes.

Table 7.26: Absolute and Relative Value Generation of Agricultural Sub-sectors across Holding-size Categories

Land-Holding-size Categories	Value Generation of Traditional Agricultural Sub-sectors [Rs/yr.]							Value Generation of Non-traditional Agricultural Sub-sectors [Rs/yr.]				Value Generation of Agricultural Sector [Rs/yr.]	Per Household Value Generation [Rs/yr.]		
	Crops	Live-stock$	Fruits	Forestry*	Misc. Items**	Api-culture	Total	Floriculture	Seri-culture	Pisci-culture	Total		Traditional Sub-sectors	Non-traditional Sub-sectors	Agricultural Sector
≤1 acre	1342214	1627964	188789	282958	87682	3445	3533052	376114	3500	5782	385396	3918448	33331	3636	36966
1-3 acres	3316039	3686544	315417	626301	324168	21235	8289703	1558384	19570	28575	1606529	9896232	54538	10569	65107
>3 acres	1519101	1102992	417030	329935	153839	6240	3529137	522050	40041	5085	567176	4096313	84027	13504	97531
All Sizes	**6177354**	**6417500**	**921236**	**1239193**	**565689**	**30921**	**15351893**	**2456548**	**63111**	**39442**	**2559101**	**17910993**	**51173**	**8530**	**59703**

Land-Holding-size Categories	Relative Value Generation of Agricultural Sub-sectors in Percentage Terms											Diversification Indices of Agricultural Sub-sectors	
	Traditional Sub-sectors							Non-traditional Sub-sectors					
	Crops	Live-stock$	Fruits	Forestry*	Misc. Items**	Api-culture	Total	Floriculture	Seri-culture	Pisci-culture	Total	B.I.	C.E.I.
upto 1 acre (≤0.405 ha)	*34.3*	*41.5*	*4.8*	*7.2*	*2.2*	*0.09*	*90.2*	*9.6*	*0.09*	*0.15*	*9.80*	0.693	0.566
1-3 acres (0.405-1.214 ha)	*33.5*	*37.3*	*3.2*	*6.3*	*3.3*	*0.21*	*83.8*	*15.7*	*0.20*	*0.29*	*16.20*	0.718	0.592
above 3 acres (>1.214 ha)	*37.1*	*26.9*	*10.2*	*8.1*	*3.8*	*0.15*	*86.2*	*12.7*	*0.98*	*0.12*	*13.80*	0.755	0.650
All Sample Households	***34.5***	***35.8***	***5.1***	***6.9***	***3.2***	***0.17***	***85.7***	***13.7***	***0.35***	***0.22***	***14.30***	**0.725**	**0.606**

Source: *Sample Survey*
* incl. Bamboo also; ** miscellaneous other crops and collected items; and $ value addition

The annual value generation of both traditional and non-traditional farming operations per household rose sharply with growing holding-size. The contribution of traditional farming operations to the total farm value generation was dominant in all the holding-sizes, while this dominancy was the highest in small-sized holdings and the lowest in medium-sized holdings. For generating farm value, the households were more dependent on the livestock in small-sized holdings, while the households were more dependent on crop cultivation in larger-sized holdings. Along with increase in agricultural diversification measured in terms of both Berry and entropy indices, the annual farm value per household increased gradually with growing holding-size. Hence, the accumulation motive of diversification was reflected in the diversification patterns of the households in larger-sized holdings, and it resulted in acute inequalities in farm value generation across the holding-sizes.

7.4.2 Income Generation from Agricultural Sub-sectors

Table 7.27 below examines the absolute and relative income generation of agricultural sub-sectors in the villages. In per household term, the annual income generation from traditional and total farming operations was moderate, while income generation from non-traditional farming operations was low in most of the villages. These were relatively higher in the villages located closer to the market centres primarily because of more income generation from floriculture, and lower in the villages located at a distance from the market centres. With subsistence characteristics in farming operations, especially in traditional farming, the farm income was substantially lower than farm value in the study villages. In

most of the villages, the highest proportion of farm income was generated from traditional farming activities. With relatively lower income generation from floriculture in the tribal villages, the

Table 7.27: Absolute and Relative Earning from Agricultural Sub-sectors across Villages

	Earning from Traditional Agricultural Sub-sectors							Earning from Non-traditional Agricultural Sub-sectors [Rs/yr.]				Earning from Agricul-tural Sector [Rs/yr.]	Per Household Earning [Rs/yr.]		
Hamlet	Crops	Live-stock	Fruits	Forestry*	Misc. Items**	Api-cul-ture	Total	Flori-culture	Seri-cul-ture	Pisci-cul-ture	Total		Tradi-tional Sub-sectors	Non-tradi-tional Sub-sectors	Agricu-ltura Secto
High Diversification Trend															
Chisopani	308929	269275	10716	79250	15740	5490	689400	952755	0	0	952755	1642155	27576	38110	65686
Poshyore	782455	301102	322860	400	16798	0	1423615	49300	0	0	49300	1472915	56945	1972	58917
Ramitay	133320	448669	63180	57265	1540	220	704194	318270	0	0	318270	1022464	28168	12731	40899
Moderate Diversification Trend															
Mahakaldara	271067	557655	49440	23655	67980	4170	973967	58014	27351	3600	88965	1062932	38959	3559	42517
Lamini Gaon	196301	589957	15880	81210	55760	2610	941718	118214	0	3300	121514	1063232	37669	4861	42529
Lepcha Gaon	378390	350541	24389	10010	6214	0	769544	27500	0	0	27500	797044	30782	1100	31882
Yogda	307790	443604	56405	3336	65210	2980	879325	350	2210	7000	9560	888885	35173	382	35555
Low Diversification Trend															
Lwr Gairi Gaon	142200	440036	1090	7210	17238	0	607774	34500	0	0	34500	642274	24311	1380	25691
Khawas Gaon	152585	188219	11380	1790	2900	0	356874	173240	0	2600	175840	532714	14275	7034	21309
Upr Gairi Gaon	116695	511526	1484	15130	25620	1100	671555	72900	0	0	72900	744455	26862	2916	29778
Bimbong	158016	377711	75692	3452	48598	640	664109	29800	8130	0	37930	702039	26564	1517	28082
Sundung	35758	159460	10602	3810	7910	0	217540	66300	0	0	66300	283840	8702	2652	11354
Total Selected Villages	**2983506**	**4637755**	**643118**	**286518**	**331508**	**17210**	**8899615**	**1901143**	**37691**	**16500**	**1955334**	**10854949**	**29665**	**6518**	**36183**

	Relative Earning from Agricultural Sub-sectors in Percentage Terms										
	Traditional Sub-sectors							Non-traditional Sub-sectors			
Hamlet	Crops	Livestock	Fruits	Forestry*	Misc. Items**	Apiculture	Total	Floriculture	Sericulture	Pisciculture	Tota
High Diversification Trend											
Chisopani	*18.8*	*16.4*	*0.7*	*4.83*	*1.0*	*0.33*	*42.0*	*58.02*	*0.00*	*0.00*	*58.0*
Poshyore	*53.1*	*20.4*	*21.9*	*0.03*	*1.1*	*0.00*	*96.7*	*3.35*	*0.00*	*0.00*	*3.3*
Ramitay	*13.0*	*43.9*	*6.2*	*5.60*	*0.2*	*0.02*	*68.9*	*31.13*	*0.00*	*0.00*	*31.1*
Moderate Diversification Trend											
Mahakaldara	*25.5*	*52.5*	*4.7*	*2.23*	*6.4*	*0.39*	*91.6*	*5.46*	*2.57*	*0.34*	*8.4*
Lamini Gaon	*18.5*	*55.5*	*1.5*	*7.64*	*5.2*	*0.25*	*88.6*	*11.12*	*0.00*	*0.31*	*11.4*
Lepcha Gaon	*47.5*	*44.0*	*3.1*	*1.26*	*0.8*	*0.00*	*96.5*	*3.45*	*0.00*	*0.00*	*3.5*
Yogda	*34.6*	*49.9*	*6.3*	*0.38*	*7.3*	*0.34*	*98.9*	*0.04*	*0.25*	*0.79*	*1.1*
Low Diversification Trend											
Lower Gairi Gaon	*22.1*	*68.5*	*0.2*	*1.12*	*2.7*	*0.00*	*94.6*	*5.37*	*0.00*	*0.00*	*5.4*
Khawas Gaon	*28.6*	*35.3*	*2.1*	*0.34*	*0.5*	*0.00*	*67.0*	*32.52*	*0.00*	*0.49*	*33.0*
Upper Gairi Gaon	*15.7*	*68.7*	*0.2*	*2.03*	*3.4*	*0.15*	*90.2*	*9.79*	*0.00*	*0.00*	*9.8*
Bimbong	*22.5*	*53.8*	*10.8*	*0.49*	*6.9*	*0.09*	*94.6*	*4.24*	*1.16*	*0.00*	*5.4*
Sundung	*12.6*	*56.2*	*3.7*	*1.34*	*2.8*	*0.00*	*76.6*	*23.36*	*0.00*	*0.00*	*23.4*
Total Selected Villages	***27.5***	***42.7***	***5.9***	***2.64***	***3.1***	***0.16***	***82.0***	***17.51***	***0.35***	***0.15***	***18.0***

Source: *Sample Survey*

* incl. Bamboo also; ** miscellaneous other crops and collected items

dominancy of traditional farming activities over non-traditional farming activities was higher in these villages than in most of the non-tribal villages. With relatively more income generation from floriculture in the nearer villages, the proportion of income generated from traditional farming operations to the total

farming operations was relatively lower in the villages. The livestock generated highest farm income in most of the villages, and thereby the households were more dependent on livestock than other agricultural enterprises for income generation.

The income generation from the agricultural sub-sectors across the holding-sizes is shown in Table 7.28.

Table 7.28: Absolute and Relative Earning from Agricultural Sub-sectors across Holding-size Categories

Land-Holding-size Categories	Earning from Traditional Agricultural Sub-sectors							Earning from Non-traditional Agricultural Sub-sectors [Rs/yr.]				Earning from Agricul--tural Sector [Rs/yr.]	Per Household Earning [Rs/yr.]		
	Crops	Live--stock	Fruits	Forestry*	Misc. Items**	Api--cul--ture	Total	Flori--culture	Seri--cul--ture	Pisci--cul--ture	Total		Tradi--tional Sub-sectors	Non--tradi--tional Sub-sectors	Agricu--ltural Sector
≤1 acre	684596	1153448	100252	60325	49028	1810	2049459	320124	1980	0	322104	2371563	19335	3039	22373
1-3 acres	1451913	2671927	177551	123791	171582	12300	4609064	1194189	10870	13500	1218559	5827623	30323	8017	38340
>3 acres	846997	812380	365315	102402	110898	3100	2241092	386830	24841	3000	414671	2655763	53359	9873	63232
All Sizes	**2983506**	**4637755**	**643118**	**286518**	**331508**	**17210**	**8899615**	**1901143**	**37691**	**16500**	**1955334**	**10854949**	**29665**	**6518**	**36183**

Land-Holding-size Categories	Relative Earning from Agricultural Sub-sectors in Percentage Terms										
	Traditional Sub-sectors							Non-traditional Sub-sectors			
	Crops	Livestock	Fruits	Forestry*	Misc. Items**	Apiculture	Total	Floriculture	Sericulture	Pisciculture	Total
upto 1 acre (≤0.405 ha)	*28.9*	*48.6*	*4.2*	*2.54*	*2.1*	*0.08*	*86.4*	*13.50*	*0.08*	*0.00*	*13.6*
1-3 acres (0.405-1.214 ha)	*24.9*	*45.8*	*3.0*	*2.12*	*2.9*	*0.21*	*79.1*	*20.49*	*0.19*	*0.23*	*20.9*
above 3 acres (>1.214 ha)	*31.9*	*30.6*	*13.8*	*3.86*	*4.2*	*0.12*	*84.4*	*14.57*	*0.94*	*0.11*	*15.6*
All Sample Households	***27.5***	***42.7***	***5.9***	***2.64***	***3.1***	***0.16***	***82.0***	***17.51***	***0.35***	***0.15***	***18.0***

Source: *Sample Survey*

* incl. Bamboo also; ** miscellaneous other crops and collected items

The annual income generation from the traditional and non-traditional farming operations per household rose sharply with growing holding-size. The annual farm income per household was 2.8 and 1.6 times higher for households in the large-sized holdings than for households in the small and medium-sized holdings respectively. The annual income from the traditional farming operations per household was 2.8 and 1.6 times higher for the large farmers compared to the small and medium farmers respectively. The annual income from non-traditional farming operations per household was also 2.8 and 1.8 folds greater for households in large-sized holdings than for households in the small and medium-sized holdings respectively. Hence, sharp farm-size related inequalities in the distribution of agricultural income prevailed across the holding-sizes, and these inequalities prevailed more in non-traditional farming operations than in traditional farming operations. For generating farm income, the households were more dependent on traditional farming operations in all the holding-sizes, while the dependency was the highest for small farmers and the lowest for medium farmers. In generating farm income, the livestock played dominant roles in the small and medium-sized holdings, while the crop sub-sector played dominant role in the holdings of large size.

7.4.3 Ecological Implication of Agriculture

Over the whole sample, for generating a crop value of Rs 100, the households bore the cost of Rs 49, of which the cost of fertilisers and pesticides was below 2 per cent. For generating a value of Rs 100 from fruit cultivation, the cost borne was Rs 22, of which the cost of chemical fertilisers and pesticides was below 2 and 7 per cent respectively over the whole sample. In the study region, for generating a value of Rs 100 from floriculture, the households on the average bore the cost of Rs 33, of which the cost of chemical fertilisers and pesticides was below 3 and 2 per cent respectively. In per hectare terms, the

intensity of chemical fertilisers and pesticides of traditional crops and fruits, even floriculture, was very low in the villages. Conversely, the households used high degrees of manure for regaining soil fertility of the cropland, and applied organic pesticides such as *titepati* and a mixture of kerosene with charcoal based on indigenous knowledge.

Based on indigenous knowledge, the households did not use all operational land for cultivation, rather they used more sloping land for agroforestry as well as for growing *amliso*. For lessening the usage of bamboo culms, they also utilised *amliso* stick for the creeper crops like pea. Instead of cultivating field crops on the entire cropland, sometimes they grew fruit trees on the whole or a part of the cropland for safe guard against landslide. Some households also abandoned wet land cultivation in fear of probable landslide, despite having their access to *jhora*. With zero tillage the households grew plants of forest species, bamboos, *amliso* and most of the fruit trees, which prevented soil erosion. The long, robust roots of most of such trees helped them in tightening the soil particles. This was also true for mulberry plantation and silkworm rearing practice of the households. The apiculture practice of the households had favourable positive influence on environment and crop-yields. For safe guard against landslide, the pisciculturists built concrete fish pond. The resource-utilisation and management practices of the households over the agricultural subsectors, especially land allocation among different crops and plant species as well as integration of agricultural enterprises of the households reflected their environmental and ecological consciousness. Hence, the practice of indigenous land resource-use of the mountain farmers acted as bulwark against resource degradation and natural hazards.

7.5 Conclusion

Despite having low crop-yields in hill agriculture, the agro-climatic and physiographic diversity in mountain regions offered different production 'niches' for developing various agro-enterprises. Of them, fruits and floriculture were dominant in terms of household participation, value, income and profits. Although many varieties of fruits were grown in the study villages, the main commercial fruit was orange as reflected in its higher contribution to value, income and profit of the total fruits in most of the villages. However, with the necessity of suitable agroclimate for orange cultivation and the low economic potential in the cultivation of most fruits like banana, the annual value, income and profit of the total fruits and oranges per household were low in most of the villages. These were comparatively higher in villages with inferior slope aspect because of their lower diurnal duration of sunshine and limited winter cropping. The intercropping, wholesale and low management cost of mandarin orange primarily resulted in the low yield and value of oranges in the villages, especially in the more distant villages with inferior slope aspect. The plantation of substantial fruit seedlings, especially those of orange and avocado, in the past five years pointed towards future augmentation of the output of fruit in the villages, particularly in the nearer villages.

For fulfilling the needs of fodder, fuelwood and timber as well as for assisting in crop cultivation and smoothing rural life, large species of trees and many varieties of bamboo plants were grown in the villages. The bamboo plants and agroforestry trees and plants, annual yield and value of bamboo culms, fodder and fuelwood per household were high, but the value of timber and non-timber forest products per household was low in the villages. These were higher in villages with more uncultivated, sloping land and high land gradients. Because of low access to road and transport, the annual income generation from bamboo and agroforestry trees and plants per household was low in most villages but higher in the nearer villages.

Amliso and paddy straw were the main items among the miscellaneous crops and collected items. The annual value and income from *amliso* per household were high in most of the villages. These were higher in less irrigated villages with more uncultivable land than in villages with better irrigation access. However, the opposite was true in case of paddy straw. Nevertheless, despite apiculture being the

traditional enterprise in the region, mainly because of limited scientific knowledge and management, only few households practised it with less number of apiaries for honey-yielding in the villages. Consequently, the annual honey yield as well as value and income from the subsistence apiculture per household and per grower were low in the villages but higher in the less irrigated villages.

The sericulture and apiculture enterprises developed in the region greatly due to state patronage. With low economic potential in sericulture, it was practised by limited households only in the more distant villages with inferior slope aspect where the opportunity cost of cropland was low. It played a crucial role in empowering the women and in sustaining the sericulture of the plains through provision of seed crop, while its growth was stagnant in the region without any reeling activity. Because of lack of consciousness and necessity of concrete *jhora* fish pond, small scale pisciculture was practised by very few households in most of the villages, but the participation rate in *jhora* fishery was relatively higher in villages with greater *jhora* access. So, the annual fish-yield, value and income from pisciculture per household were low, but these per grower were moderate in the pisciculture practising villages. With greater pond depth, these were comparatively higher in villages with inferior slope aspect.

Of the various floriculture items, only gladiolus spread more to ordinary farm households. With necessity of more technical knowledge and finance as well as access to market, marketing channels and irrigation, the household participation rate in the production of floriculture items and gladiolus was low in the villages. However, because of the high economic potential in the production of most floriculture produces, the annual value, income and profit of floriculture and gladiolus per household were high in most villages, but these varied widely between the villages. Generally, these were higher in well irrigated villages located closer to market centres. Hence, the floriculture items, especially gladiolus, had substantial economic potential of diversification in the villages, especially in the nearer villages with better irrigation access. Nevertheless, because of the commitment of low proportion of cropland and labour to non-traditional agro-enterprises in the villages, higher proportion of agricultural value and income was generated from traditional agro-enterprises, particularly from crops and livestock, in most villages. Thus, farm diversification was moderate in the villages. The annual value and income of traditional and non-traditional farming operations per household were relatively higher in the nearer villages.

The annual value, income and profit of most agro-enterprises per household rose sharply with increased holding-size. Agricultural diversification indices also slightly increased with growing holding-size. Hence, accumulation motive of diversification was reflected in the diversification patterns for households in larger holding-sizes. However, such farm diversification resulted in acute inequalities in rural assets and income distribution.

Despite greater economic potential of diversification in floriculture and higher-valued commercial crops like ginger and cherry pepper, they had more adverse effect on soil fertility and environment in terms of the intensity of use of chemical fertilisers and pesticides. However, other niche-based agro-enterprises had favourable influence on environment, and all of them acted against soil erosion. The distribution of cropland among the agro-enterprises by households reflected their consciousness regarding physiographic conditions. For reducing such adverse effect on environment, the households adopted measures based on indigenous knowledge.