

## II. THE STUDY AREAS

### General Features

The horticultural crop-dominated site (Naubise) is located in Ward No. 2 of Naubise *Panchayat* in Dhading District, Bagmati Zone. It is about 25 km south-west of Kathmandu and is connected by an all-weather highway which links Kathmandu with the *Terai* and a number of hill districts. The cereal crop-dominated site (Dhuskun) is located in Ward No. 2 and 8 of Dhuskun *Panchayat* in Sindhupalchok District, Bagmati Zone. It is about 6 km east of Barahbise which is connected to an all-weather road connecting Kathmandu with Kodari. The livestock-dominated site (Yelung) is located in Ward No. 5 and 6 of Shyama *Panchayat* in Dolakha District, Janakpur Zone. The site is about 5 km north of Jiri which is connected to Kathmandu by an all-weather road.

The elevation of the Naubise Site ranges from 970 m to 1,100 m with moderately sloping hill terraces. Since the site is located on a ridge, the aspect is variable. Soils of the area consist of loams and silty loams with good drainage. The altitude of Dhuskun Site ranges from 1,150 m to about 2,200 m. Lands are moderately to strongly sloping and soils are 50-100 cm deep and well drained. Loamy skeletal soils predominate in the area. The aspect of the site is mostly south-facing. The Yelung Site is located at an altitude ranging from 2,000-2,400 m with moderately to steeply sloping mountain terrains facing east and south-east. Well-drained loamy-textured soils are common in the area.

The climate of the Naubise Site is sub-tropical and sub-humid with an annual mean temperature of 21°C and a total annual rainfall of 1,585 mm. The Dhuskun Site is characterised by a warm temperate humid climate with an annual mean temperature of 19°C and a total annual rainfall of 2,230 mm. The Yelung Site has a cool temperate perhumid climate with an annual mean temperature of 14°C and an average annual rainfall of 2,139 mm. The distribution of rainfall is highly seasonal at all the sites. Of the total annual rainfall, about 87-90 per cent occurs during the five monsoon months (May-September). Hailstorms occur at all the sites, mostly during March-May and sometimes during October-November at an average interval of 3-4 years. There is generally no problem of frost and snowfall at Naubise and Dhuskun. However, both frost and snowfall are constraints for winter crops at Yelung. Frost occurs during December-February and snowfall during January-February.

The agricultural support services at the Naubise Site are provided through the Agricultural Development Bank (ADB/N), the Commercial Bank, the Cooperative Society and its Depot, the Agricultural Sub-centre, the Livestock Sub-centre, and the Horticultural Farm all located in the same *Panchayat*. Khanikhola and Dharke are the nearest market centres and Kathmandu, which is about 25 km away, is the biggest market centre where most of the fruits and vegetables produced on the site are sold. The agricultural support institutions serving the Dhuskun Site include a Small Farmers' Development Programme run by ADB/N, a livestock sub-centre, and an agricultural sub-centre in the same *Panchayat*. Barahbise and Lamosangu are the nearest market centres. The Yelung Site is served by a livestock sub-centre and three seasonally-operated sub-branches of the Cherdum Cheese Factory all located in Shyama *Panchayat*. In addition, the Livestock Farm, Veterinary Dispensary, and sub-branch offices of the ADB/N and Nepal Bank Limited at Jiri also provide services to the farmers in the study area. Jiri is the nearest market centre. Among the three study sites, Naubise is the most privileged one in terms of accessibility and availability of inputs, services, and market facilities.

The Naubise Site consists of some newly established forests and very little grazing land. The site does not have any access to well-grown forests within the vicinity of 7-8 km. The Dhuskun Site consists of both newly established as well as well-grown forests. However, there is limited grazing land in the area. There are abundant forests and pastures at the Yelung Site. The actual area of forests and pastures at different sites could not be estimated due to paucity of reliable data.

### Socioeconomic Characteristics

The information on socioeconomic characteristics of the sample households at the three study sites are shown in Table 1. The average family size ranges from 5.07 persons at Dhuskun to 5.5 persons at Yelung and 7.13 persons at Naubise. Females constitute about 51 per cent of the family members at Naubise and Dhuskun and about 45 per cent at Yelung. The average number of economically active members per household ranges from 3.13 at Dhuskun to 3.77 at Yelung and 4.77 at Naubise. The proportion of economically active household members with agriculture as their main occupation is the highest at Dhuskun (90%), followed by Yelung (75%), and Naubise (69%). The remainder are engaged in study, services, business, and other activities.

**Table 1: Socioeconomic Characteristics of the Sample Households at Different Study Sites (Per Household Average Unless Indicated Otherwise)**

Particulars	Naubise	Dhuskun	Yelung
Average Family Size (persons)	7.13	5.07	5.50
Male/Female Ratio	0.96	0.97	1.20
Literacy (%)	64.00	49.00	48.00
Economically Active Members per Household (No.)	4.77	3.13	3.77
Dependency Ratio (Dependents/Economically Active Members)	0.49	0.62	0.46
Occupations of Economically Active Members:			
Agriculture (%)	69.00	90.00	75.00
Study (%)	28.00	0.00	17.00
Services (%)	3.00	5.00	1.00
Others (%)	1.00	5.00	8.00
Average Size of Operated Land Holding (ha):	0.97	0.54	0.28
Lowland (ha)	0.39	0.17	0.28
Upland (ha)	0.58	0.37	0.00
Average No. of Parcels per Farm	4.64	4.06	11.90
Average Size of Parcels (ha)	0.21	0.13	0.02
Average Size of Livestock Holding (LSU)	3.68	2.45	6.95
Draught Animals per Household (No.)	0.53	0.57	1.07
Population Density per ha of Cultivated Land (Persons)	7.35	9.39	19.64
Livestock Density per ha of Cultivated Land (LSU)	3.79	4.54	24.82

The average sizes of operated land holdings at Naubise, Dhuskun, and Yelung are 0.97 ha, 0.54 ha, and 0.28 ha respectively. Rented-in lands constitute about 20, 13, and 11 per cent of the operated land at the three sites respectively. Share-cropping is the most common system of tenancy. While lowlands constitute about 40 and 31 per cent of the operated land at Naubise and the Dhuskun respectively, there is virtually no lowland at Yelung. At Naubise, all the lowlands are perennially irrigated and some parts of the uplands are seasonally irrigated, whereas only



lowlands are seasonally irrigated at Dhuskun. There exist no irrigation facilities at Yelung. The average number of fragments per farm is the highest at Yelung (11.9), followed by Naubise (4.60), and Dhuskun (4.06).

The average sizes of livestock holdings are 3.68 LSU (Livestock Unit) at Naubise, 2.45 LSU at Dhuskun, and 6.95 LSU at Naubise. Both human and livestock population densities per hectare of cultivated land are highest in Yelung followed by Dhuskun and Naubise.

## Agricultural Characteristics

### Crop Production

Crop production in the study area is highly diversified with dominance of cereals. In general, maize-based cropping patterns predominate on uplands and paddy-based on lowlands. The data on crop areas, cropping intensities, and the number of farm trees at different study sites are included in Table 2. Of the total cultivated land per household in Naubise, maize occupies about 62 per cent followed by paddy (43%), wheat (27%), vegetables (17%), and other crops (16%) with an average cropping intensity of 165 per cent. At the Dhuskun Site, maize occupies about 78 per cent of the operated land followed by millet (57%), paddy (32%), and other crops (5%) with an average cropping intensity of 172 per cent. However, at the Yelung Site, wheat is the most important crop occupying about 38 per cent of the cultivated land followed by maize (28%), potato (22%), millet (19%), and other crops (8%) with an average cropping intensity of 115 per cent. While paddy is not grown at Yelung due to lack of lowlands and prevalence of low temperature, vegetables are grown on a commercial scale at Naubise only, where perennial irrigation and reliable market facilities are available. Lower cropping intensity at Yelung may be attributed to longer growing period of crops due to prevalence of relatively lower temperatures and problems of frost and snowfall in winter.

**Table 2: Information on Crops and Farm Trees at Different Study Sites  
(Per Household Averages Unless Indicated Otherwise)**

Particulars	Naubise	Dhuskun	Yelung
Cultivated Land for Household (ha)	0.97	0.54	0.28
Crop Areas (% of cultivated land):			
Early Paddy	3.00	0.00	0.00
Normal Paddy	40.0	32.00	0.00
Wheat	27.00	3.00	38.00
Maize	62.00	78.00	28.00
Millet	4.00	57.00	19.00
Potato	3.00	0.00	22.00
Barley	0.00	0.00	4.00
Buckwheat	0.00	0.00	4.00
Sugarcane	4.00	0.00	0.00
Oilseeds	5.00	2.00	0.00
Vegetables	17.00	0.00	0.00
Cropping Intensity (%)	165.00	172.00	115.00
Total Trees per Farm (No.)	119.00	15.00	96.00
Fruit Trees (No.)	58.00	2.00	*
Fodder Trees (No.)	24.00	5.00	24.00
Other Trees (No.)	37.00	8.00	72.00

\* Less than 0.5

The average number of trees per farm at Naubise is estimated to be 119 of which about 49 per cent are fruit trees, 20 per cent fodder trees, and the rest fuelwood/timber trees. The number of farm trees per household at Dhuskun averages only 15, of which about 13 per cent are fruit trees, 33 per cent fodder trees, and the rest fuelwood/timber trees. At the Yelung Site, each farm consists of 96 trees of which about 25 per cent are fodder trees and the rest are fuelwood/timber trees. Trees are more common on upland terraces and around homesteads at all the study sites.

**Table 3: Crop Production: Per Hectare Input-use and Outputs at Different Study Sites**

Crops	Seed (kg)	Manure (mt)	Ferti- lizer (N:P:K kg)	Pesti- cides (Rs)	Human labour (man- days)	Bullock Power (pair- days)	Yields (MT)	
							MP	BP
<b>Naubise</b>								
Early Paddy	61.8	2.29	63:18:00	130	223	38	2.97	3.24
Normal Paddy	62.5	1.49	64:29:00	101	194	41	2.70	3.21
Wheat	112.0	1.79	66:35:00	12	157	39	1.68	2.72
Maize	29.3	4.76	49:27:00	142	179	43	1.77	3.38
Millet	19.8	1.06	16:07:00	-	158	15	1.03	1.72
Potato	983.8	9.91	39:29:00	280	231	40	5.95	-
Sugarcane	4186.0	4.74	57:17:00	-	197	33	15.40	7.50
Mustard	14.9	0.36	38:38:00	-	112	39	0.66	0.82
Vegetables (Rs)	1125.0	11.42	71:44:23	1355	354	49	17.81	-
<b>Dhuskun</b>								
Normal Paddy	69.0	1.46	13:00:00	-	167	43	1.72	1.97
Wheat	88.0	2.16	22:10:00	-	143	37	1.23	2.27
Maize	33.0	5.07	17:08:00	-	172	46	1.49	2.55
Millet	16.2	0.61	1:00:00	-	164	-	0.95	1.71
Mustard	9.0	0.65	6:00:00	-	89	32	0.51	0.74
<b>Yelung</b>								
Wheat	97.3	2.61	-	-	148	41	1.15	2.10
Maize	24.5	6.10	-	-	167	44	1.53	2.83
Millet	17.8	1.66	-	-	149	-	0.88	1.69
Potato	1083.0	10.19	-	-	252	48	5.54	-
Barley	69.9	1.23	-	-	109	37	0.66	1.19
Buckwheat	62.2	2.60	-	-	107	36	0.90	1.39

Note: MP = Main Product  
BP = By-Product

The average rates of input-use of different crops, and crop outputs per hectare are shown in Table 3. While the uses of organic manure, human labour, and bullock power are common at all the study sites, the use of chemical fertilizer is the highest at Naubise and nil at Yelung. Similarly, the coverage of improved seeds with different crops is the highest at Naubise followed by Dhuskun. At the Yelung Site, some areas under potatoes are using improved seeds, but only local seeds are used for all the other crops grown at the site. The use of pesticides for plant protection is practised at Naubise only. The average crop yields are observed to be higher at Naubise compared to those at the other two sites. This can be mainly attributed to better irrigation facilities and higher uses of modern inputs at Naubise.



## Livestock Production

Livestock production is an integral part of the farming system in the study areas. Like crop production, livestock enterprise is also highly diversified with dominance of cattle at all the study sites. The information on livestock production at different study sites is included in Table 4. On an average, each farming household keeps 3.39 cattle, 1.67 buffaloes, 2.44 goats, and 1.77 poultry birds at Naubise; 2.20 cattle, 0.86 buffaloes, 2.73 goats, and 3.70 poultry birds at Dhuskun; and 6.47 cattle (including *Chauries*), 2.33 buffaloes, 2.96 goats, 0.07 sheep, and 2.20 poultry birds at Yelung. While all species of livestock produce manure, male cattle and buffaloes are primarily kept for draught power, female cattle and buffaloes for milk, goats and poultry for meat, and sheep are kept for both wool and meat. Discussions with the farmers revealed that the total number of livestock has declined over time at all the study sites, mainly due to increased scarcity of livestock feed that resulted from deterioration of the off-farm feed resources.

**Table 4: Information on Livestock Production at Different Study Sites  
(Per Household Averages Unless Indicated Otherwise)**

Particulars	Naubise	Dhuskun	Yelung
Size of Livestock Holding (LSU)	3.68	2.45	6.95
<b>Herd Composition (No. of Animal Heads):</b>			
Cattle:			
Adult Male	0.53	0.57	1.07
Adult Female	0.53	1.10	0.60
<i>Chauries</i>	0.00	0.00	4.04
Calves	1.20	0.53	0.76
Buffaloes:			
Adult Male	0.00	0.07	0.03
Adult Female	1.10	0.56	1.43
Calves	0.57	0.23	0.87
Goats	2.44	2.73	2.96
Sheep	0.00	0.00	0.07
Poultry	1.77	3.70	2.20
<b>Animal Feed Consumption:</b>			
Stall-fed Green Roughages (TDN kg)	676.00	792.00	1405.00
Stall-fed Dry Roughages (TDN kg)	1379.00	913.00	253.00
Stall-fed Concentrates (TDN kg)	244.00	54.00	41.00
Grazing (hours)	298.00	686.00	2018.00
Bedding Materials (kg)	1182.00	757.00	797.00
<b>Milk Yields per Lactation (litres):</b>			
Cows	428.00	225.00	254.00
<i>Chauries</i>	-	-	307.00
Buffaloes	1065.00	524.00	595.00

Livestock in the study area are both grazed as well as stall-fed. In the existing practice, livestock feed mostly comprised of roughages derived from both farm and off-farm resources and partly of concentrates mostly produced on farms. The contribution of roughages to total feed (TDN) consumption, except those obtained from grazing, ranges from about 89 per cent at Naubise to 98 per cent at Yelung. Given the size of livestock holding, the feed (TDN) consumption through stall-feeding at Yelung works out to be quite low. Since there are abundant pastures, and grazing is most widely practised at this site, it is expected that feed supply from grazing makes up for lower TDN supply through stall-feeding.

In general, livestock productivities are low in the study area. The average per lactation yields of cows and buffaloes, respectively, are reported to be 428 and 1,065 litres at Naubise, 225 and 524 litres at Dhuskun, and 254 and 595 litres at Yelung. The average milk production of *Chauries* is estimated at 307 litres per lactation.

### III. LINKAGES AMONG THE COMPONENTS OF THE FARMING SYSTEM

#### Concepts and Assumptions

For the purpose of analysing the linkages, the components of the farming system have been identified as crops, livestock, forests and pastures, farming households, and the market. Any biomass of plant origin produced on the farmland is considered to be the contribution of crops. Thus, crop production encompasses the production of cereals, cash crops, vegetables, fruits, fodder, and fuelwood on the farm lands. The terms, forests and pastures, have been used to indicate public resources unless specified otherwise. Any output from the farm or the household that is sold or hired-out is assumed to go to the market. Similarly, any input into the farm or the household that is purchased or hired-in is assumed to come from the market.

All the estimations for quantifying the linkages are based on field data except the production of livestock manure which has been estimated at the rate of 4,000 kg fresh manure per LSU per annum (Dasgupta 1945). The ratio of livestock manure to grazing land has been estimated on the basis of time spent on grazing per annum. After deducting the quantity of manure for grazing land, handling and other losses have been considered at 15 per cent and the balance is assumed to go to crops. For converting feed materials into TDN, the TDN contents of various feed stuffs have been taken as follows: grass fodder - 13.56 per cent; tree fodder - 19.40 per cent; rice straw - 45.20 per cent; maize stover - 54.70 per cent; millet straw - 50.10 per cent; wheat, barley, and buckwheat straw - 44.10 per cent; maize grains - 84.90 per cent; wheat grains - 83.0 per cent; and barley grains - 77.7 per cent (Sen and Ray 1971). Similarly, for converting food commodities into calories, the calorie values per kg of food items in edible form have been taken as: rice - 3,600, wheat - 3,340, maize - 3,560, millet - 3,320, potato - 830, barley - 3,320, buckwheat - 3,320, oilseeds - 5,740, sugarcane - 600, fruits - 550, vegetables - 250, milk - 1,010, and meat - 710 (ILACO B.V. 1981 and Burton 1978). For bringing the raw food items into edible form, conversion has been done at 60 per cent for rice and 90 per cent for other crops (Asian Development Bank 1982).

The linkages among the different components of the farming system and contribution of each component to others and vice-versa are shown in Tables 5, 6, and 7.