RESEARCH METHODOLOGY

The Conceptual Framework of Mountain Farming Systems

Resource endowments, their management, and extraction rates are probably the three most important variables of a sustainability matrix of any system. To some extent, abundance of one component may redress the frailness of the other variables, but excessive deterioration, even in one component, may cause irreparable damage to the whole system. At this stage, it may be difficult to clearly define the strengths and weaknesses of these three components of the matrix. However, it is assumed that heavy extraction rates (exceeding regenerative yield) and weak management are more problematic in the system and sensitive to the sustainability matrix. Extraction rates, in general, are influenced by the demand made by members of the system. Therefore, the demand function of goods and services will explain the nature and extent of the extraction rate.

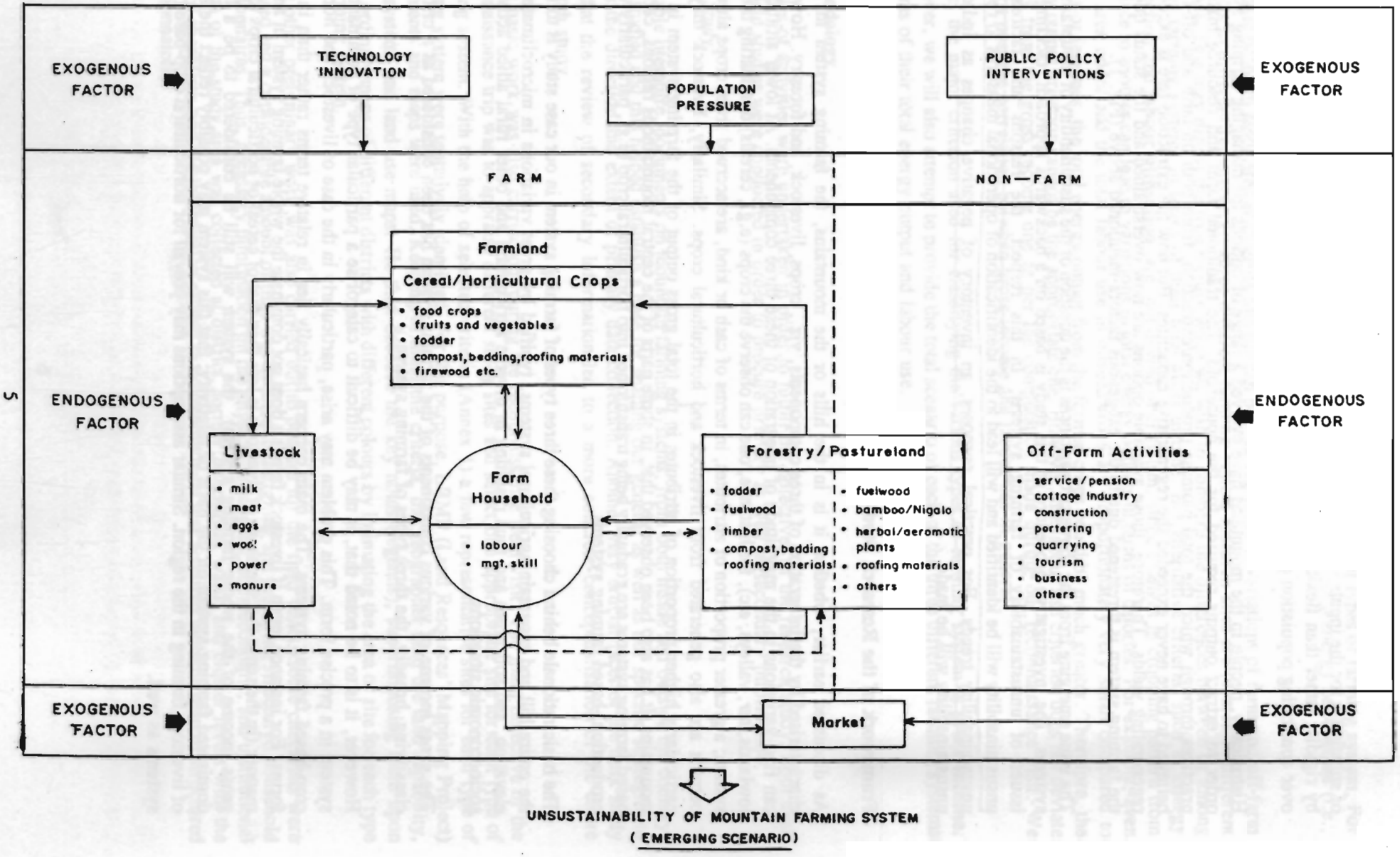
Traditionally, farmers in the mountains have been blending crop, livestock, and forestry components into one in order to satisfy their demands for various commodities. Considerable detailed sectoral analyses and well-documented reports on the Nepalese economy advocate that there is no other single sector that can absorb the upcoming labour force. This implies that the majority of people will have to be adjusted into agriculture for many years to come. This is more so in the mountain region where even the minimum level of industries and other manufacturing services has been constrained by the geo-physical settings. It becomes explicit that the mountain people do not have any other option but farming - which is also their 'niche'.

Figure 1 depicts that farmer-heads of households are the cynosure of the whole mountain farming system and that they manoeuvre the essential components: crops (farmland), livestock, and forestry. The realisation of the necessity for the integration of forestry by concerned people, including researchers, is, in fact, recent. These components are much interwound. However, the magnitude of attributes of each of these three components may differ as per the variation in altitude, microclimate, and other socioeconomic settings of a locality. For instance, if crop production has a greater role in the household economy in low altitude areas then livestock may be the major activity in high regions.

It has also been conceptualised that mountain farming systems are not only limited to farm activities but are also influenced by 'sideline' activities since supplemental farm inputs also come from the income accrued from the latter. As the conceptual model (Fig. 1) depicts these two farm and non-farm activities are within the control of farmers and thus the factors involved in both production systems are considered to be endogenous. Because the farmer has full authority over the three important variables of the sustainability matrix: accessible resource base, its management, and the extraction rate, he has command over factors of production, either in farm or non-farm activities. For instance, he may choose any activity, from construction work to quarrying and tourism, if these opportunities are available to him.

There are also certain factors that can heavily influence the whole farming system, but they are completely out of the farmer's control. Technology innovation, changes in demography, and public policy interventions are some examples. Let us take the case of hybrid maize which comes under technology intervention. In this case farmers have little option to manoeuvering the factors of production if they desire to obtain the expected output from the crop; they have to strictly follow a set of cultural practices which may be very difficult because of any number of reasons, viz., shortage of labour during a critical time period, lack of capital to purchase inputs, unavailability of inputs in time, and so on. Unavailability

FIG. I SCHEMATIC DIAGRAM OF CONCEPTUAL MODEL OF MOUNTAIN FARMING SYSTEM



of substitutes for the inputs is also a constraint in this respect. In such a situation farmers can be fortified by rigidity rather than flexibility through new technology interventions. Similarly, individual influence over controlling population pressure is trivial. The same is applicable in the case of market forces.

Historically, people in the mountains have evolved a range of options for managing farming systems in order to extract outputs required for the household. The traditional farm and resource management practices through which the total biomass production/extraction, from both on-farm and off-farm, are believed to have never exceeded the regenerative capacities. But now the extraction rate is exceeding the regenerating yields. Therefore, those available options are now overstrained and the status quo ante of the farming system is threatened due to the exogenous factors mentioned above (Fig. 1).

The issue emerging from the above circumstances is the question of the sustainability of mountain farming systems. The investigative procedure of this study is based on a backwards approach; tackling first the issues of unsustainability of farming systems. In this respect, the reasons and factors behind unsustainability will be identified and will lead to the identification of operational measures to reverse the unsustainability trends. For practical purposes, an inventory of negative changes as indicators of unsustainability will be made.

Framework of the Research Study

As discussed earlier, whether it is in the hills or the mountains, the farming system in Nepal is characterised by the integration of three components, viz., crops, livestock, and forestry. However one can find variations in the magnitude of integration of these three components. At lower altitudes (e.g., lowlands, *tar*, valleys, etc), for instance, one can observe the crops (e.g., cereals) dominating the farming system; a greater proportion of attributes, in terms of cash or kind, are accrued from crops although the outputs are also generated from livestock and horticultural crops. Similarly, livestock may have a particularly higher proportion of attributes in the total gross output of the farming system in the high mountains. It has also been observed that, in some parts of the central mountainous regions, cereal crop-based farming systems are gradually being transformed into horticultural crop (e.g., particularly vegetable production)-based farming systems.

The basic rationale behind choosing these three types of farming system in our case study is to represent the entire hill and mountain agricultural systems, typified by great variations in microclimates, slope, elevation, and soil types and thus resulting in diverse agricultural and other rural allied activities and socioeconomic situations.

The **gross income** of various components of the farming system has been considered as a criterion for classifying, broadly, the three types of farming system.

However, it is to be noted that, it may be difficult to categorise a particular type of dominant farming system in a precise form. This problem may arise, particularly in the case of livestock and horticultural crop-based farming systems. The main concern basically lies in relative terms rather than in absolute forms. For instance, even if livestock farming does not dominate the whole farming system in an absolute manner (in the sense that the share of livestock is less than that of cereal or horticultural crops to the total gross income of the whole farming system) the system will still be considered to be a livestock-dominated farming system on the basis of relativity; that this system may possibly reflect the best form of livestock farming in the region. Similar assumptions may prevail for horticultural crop-based farming systems as well.

No one can deny that there could be other criteria in categorising different types of farming system. For instance, outputs generated by each component, measured in terms of their total **energy production** (i.e., calories) and **labour use** (in terms of mandays).

The basic problem associated with gross income can be referred to price variations of farm and off-farm products in different regions (e.g., three different farming system research sites are located in different regions). This may distort the true picture when we wish to compare the differences between or among various farming systems in terms of their total gross income. But alternative criteria, such as **energy production** and **labour utilisation**, are not devoid of criticism, since changes in cropping pattern from one place to another can lead to variations in total energy outputs in terms of calories. For example, even if the area under and the total labour use in oilseed crops are proportionately very small compared to cereals or legumes, the total energy output from the former crops could be much greater. Therefore, the energy output criterion cannot be the appropriate one. However, the labour use criterion does not deviate greatly from the gross income one as per the computation made during our reconnaissance visit. We found a positive correlation between gross income and labour use in general.

Hence, the major criterion used for classifying the various types of farming system is **gross income**. However, we will also attempt to provide the total scenario of each of the three different farming systems in terms of their total energy output and labour use.

Methodology

A series of activities were undertaken in order to fulfill the objectives of the research study. Both desk and field studies were conducted in order to procure primary as well as secondary information.

Desk Study

Available literature, documents on mountain farming systems, from both inside and outside the country, were studied and this helped establish a base for shaping our general as well as our specific strategies to assess the direction and extent of primary data collection. Another very crucial facet of the desk study was that the review of secondary information led to a more concrete conceptualisation of the entire research study.

Some basic work was also carried out during the reconnaissance field visit. The main objective of the reconnaissance trip was to appraise different study sites and select one appropriate site for each type of farming system. With the help of selected criteria (Annex 1) a few representative sites for each type of farming system were tentatively identified. For this purpose, LRMP (Land Resources' Mapping Project) documents and maps were used. Keeping in mind the criteria, the geographer read the land capability, land system, and land use maps. He then decoded the key notes (legends), superimposing them upon other ordinary maps of different districts with different colours by intimating the area or site for each type of farming system.

Some other preliminary work was also carried out to prepare for the field visits. Some checklists were prepared and a considerable amount of time was devoted to designing and preparing structured household questionnaires. Thus, necessary information on the physical, biological, socioeconomic, and institutional aspects of the study area was collected at district, former *panchayat*, ward, and cluster levels with the help of checklists, and the information related to household level was acquired with the help of structured questionnaires.

Survey Procedure

Two kinds of surveys were carried out during the field visits.

Reconnaissance Field Visit. The research study sites/locations - Kavre, Sindhupalchowk, and Dolakha districts of the Central Development Region - were visited during the reconnaissance survey visit with the principal aim of confirming and assessing the conditions and situations of those sites in order to select the most appropriate (representative) sites for detailed study.

During the course of the reconnaissance, each district headquarters was visited and discussions held with the concerned government/non-government authorities (e.g., agriculture, livestock, forestry). The discussions included assessments of identified sites in line with the prevalence of selected criteria. The visits also included the exploration of other suitable areas for undertaking different farming research studies. Subsequent visits were made for further confirmation of decisions, once ratified by earlier discussions. During this time period, more sites than identified during desk study were visited. Further computations and assessments were made with regard to selecting the appropriate site once the study team, comprising of one agricultural economist, one agriculturalist, and one or two research assistants, returned to the centre after spending three weeks in the field.

Data and information on each of these various Village Development Committees (VDCs) (former *panchayats*) and specific sites were tabulated and computed. As per the study site selection criteria, the sites were rated according to the merits and demerits. For example, whether a particular site was within the range of elevation, slope, aspects, accessibility/inaccessibility, and cropping patterns that were being looked for in the context of a particular type of farming system for detailed survey had to be determined. In this context, all the visited sites were rated according to a rough score as per the prevailing conditions of the sites against our desired level. Lastly, one specific site was selected for each of the three different farming systems (Table 2.1) on the basis of highest merit.

Table 2.1: Locations of Research Study Sites

Types of Farming Systems	Locations of Study Sites		
	Specific Site (Village)	Village Development Committee	District
1. Crop-dominated	Ekle Gaon	Dhuskun	Sindhupalchowk
2. Horticultural Crop-dominated	Bhadure	Naubise	Dhading
3. Livestock-dominated	Yelung	Shyama	Dolakha

Pretesting of structural household questionnaires was also carried out during this preliminary field visit, and the questionnaire redesigned to make it compact and concise while incorporating all necessary enquiries related to household activities.

Detailed Field Visit. After completion of the necessary background work, a detailed field visit was conducted to acquire primary information. The general investigation procedure adopted was the same for all research sites. However, some specific criteria and activities were also considered and taken into consideration, owing to variations in the nature of the farming system. These are briefly discussed in the following sections.

A. Cereal Crop - dominated Farming System

Selection of Study Site

The study site - Ekle *Gaon*" under Dhuskun VDC in Sindhupalchowk District - was finally selected for detailed study as a cereal crop-dominated farming system after a rigorous selection procedure. The Ekle *Gaon* study site consists of Ekle *Gaon* along with other two adjoining villages, i.e., Ekle *Salle* and Ekle *Birta*. The total number of households in the site or cluster is estimated to be 140.

Selection of Households for Survey

A list of households falling into the Ekle *Gaon* cluster was prepared, indicating the name of the chief of each household along with the size of owned landholding and operated landholding. Then the households were classified into five categories, viz., large, medium, small, marginal, and landless as per the criteria developed by the National Planning Commission (1977) A total of 30 households were then selected, employing a stratified random sampling method. The ethnicity issue was also considered in selecting the sample households. Tables 2.2 and 2.3 show the total number of households considered in the Ekle *Gaon* cluster and the total sample size by farm size and ethnicity respectively.

Table 2.2: Total Number of Households, Their Proportion and Sample Size By Farm Size in Ekle *Gaon* Study Site (Dhuskun)

Farm Size[1]	Total Households		Sample Size Household
	No.	%	No.
Large	18	13	4
Medium	43	31	9
Small	56	40	12
Marginal	17	12	4
Landless	6	4	1
Total	140	100	30

Source : Household Survey, APROSC 1989.

[1] Farm Category — Operated Landholding Size (*ropani* [1.0 ha = 19.8 *ropani*])

Large	-	abobe 20.0
Medium	-	10.0 to < 20.0
Small	-	4.0 to < 10.0
Marginal	-	less than 4.0

A farmer who owns less than one *ropani* of operated land, excluding the area covered by house kitchen garden, is assumed to a landless farmer.

Table 2.3: Total Number of Households and Their Proportions By Farm Size and Ethnic Group in Ekle *Gaon* Study Site (Dhuskun)

	Farm Size											
Ethnic group	Large		Medium		Small		Marginal		Landless		Total	
	No	%	No	%	No	%	No	%	No	%	No	%
Brahmin	-	-	-	-	8	12	-	-	-	-	8	6
Chhetri	12	70	20	7	14	27	4	20	-	-	50	36
Newar	4	20	2	4	-	-	-	-	-	-	6	4
Thami	2	10	20	7	26	47	8	50	-	-	56	40
Kami	-	-	-	-	4	7	5	30	5	100	14	10
Bhujel	-	-	1	2	5	7	-	-	-	-	6	4
	18	100	43	100	57	100	17	100	5	100	140	100

Source : Household Survey, APROSC 1989.

Data Acquisition

(a) Household Level Information. Heads of sample households, irrespective of sex, were interviewed with the help of a structured questionnaire. Single to multiple visits to a sample household were made in order to collect information with the best possible precision. The recall method was the principal means of data recording. The questionnaire was exclusively designed to acquire all necessary technical and socioeconomic implications/settings of various farms and 'sideline' activities performed by various household categories and ethnic groups. Generally, household level data/information were recorded for one complete year. However, some attempts were also made to acquire time series data on, for instance, fuelwood, fodder, and water-fetching time; number of crops grown per year; differences (e.g., increased/decreased) in agricultural inputs used; changes in stall-feeding practices; and household expenditure. The time series data included the situation of production, consumption, and management practices of five years, 10 years, and before 20 years.

(b) Cluster Level Information. The study site - Ekle *Gaon*, was considered to be a cluster of households. Some key informants and local leaders were contacted and interviewed with the help of checklists in order to document all necessary information which includes from demography to agriculture and from water resources and forestry to environmental aspects of the cluster. Special importance has been attached to this cluster level information since it has, to the best possible extent attempted to capture a historical perspective of all aspects, directly or indirectly related to the resource base, resource management practices, and their implications on the environment of the whole cluster area. Information about the situation of the cluster area five years, 10 years, and 20 years ago, for example, in the case of population density, people's migration patterns (seasonal/ permanent), family size, and resource base holding size per household (e.g., cultivated land, grazing/pasture land, forest, livestock holding, etc) in addition to information on agricultural inputs and outputs (e.g., seed, fertilizer, FYM, crop yields, etc) were also acquired. A series of enquiries on the indicators of unsustainability of mountain agriculture, which form a very important part of the whole research study, were carefully made. The indicators include - frequency of landslides, soil erosion, flooding and the extent of damage, hunger gap period, and the extraction rate of natural resources (e.g., fodder, fuelwood, water,) and the time taken collecting them. Historical background information regarding changes in crop-cultivation practices, cropping patterns, cropping intensity, and the rationale behind shifting to new types and varieties of crops and animal husbandry practices were collected. The cluster level enquiries also attempted to gather information on the implications of public interventions and rural institutional arrangements as well as changes in the overall quality of life between then and now.

These enquiries were addressed primarily to elderly and informative persons in the villages who could provide historical background information covering a period of 30 years or more.

(c) Ward Level Information. Ward level information on population, land use, agriculture, and the livestock situation, including resource management practices, were collected with the help of checklists. This information was collected as background information of the cluster area.

(d) Village Development Committee (former *Panchayat*) Level Information. Similar information including other socioeconomic and institutional aspects, of Naubise *Panchayat* (former) were collected. Where and whenever possible, time series data on the use of agricultural input use (e.g., seeds, fertilizers, etc) and institutional credit were also acquired from AIC and ADB/N. The acquisition of this level of information also included the existing physical and institutional infrastructure.

(e) District Level Information. District level information on land use, agriculture and its allied activities, population, and other socioeconomic settings were gathered from the concerned government and non-government offices located at the district headquarters.

B. Horticultural Crop-dominated Farming System

The study was carried out in Bhadaure Village area of Naubise *Panchayat* (former) of Dhading District (Table 2.1).

Selection of Study Site

Based on the discussions held with local leaders, key informants, and the information provided by the agricultural sub-centre located at Naubise Bazaar, a profile on fruit and vegetable cultivation in Naubise *Panchayat* (former) was prepared by estimating the number of growers and the area under various horticultural crops by ward and also by village within the wards. The total number of households in the site or cluster is estimated to be 90.

Selection of Households for Survey

Again, a brief profile of the Bhadaure Site was formulated by mentioning heads of household and the size of the total landholdings, including the area under vegetable production. A total of 30 households was then selected for interview by employing a stratified random sampling method* which is not only representative by farm size but also by ethnicity - factors which play a substantive role in the adopting a particular type of occupation or farm activity. Tables 2.4 and 2.5 depict the number of vegetable growers and non-growers and the sample size by farm size and also by ethnicity.

Data Acquisition

The data acquisition procedure for this farming system is similar to that employed in the cereal crop-dominated farming system. Necessary data/information were compiled and documented, similarly, through the district, *panchayat* (former), ward, cluster, and household levels. Input and output coefficients of agricultural resource base/management and other allied activities for one complete year were compiled and computed through multiple visits to the households.

C. Livestock-dominated Farming System

For the livestock-dominated farming system several similar steps were employed to acquire necessary information.

Selection of Study Site

Once the Shyama *Panchayat* (former) of Dolakha District was selected, comprehensive discussions, held particularly with the *Pradhan Panch*, district vice-president, and other key informants were held on the overall settings (including agriculture, livestock, and forestry conditions) of the *panchayat* by ward and in some cases even by village. In addition, a rapid rural appraisal was also made by employing concise, structured two or three page questionnaires relating to the socioeconomic setting of the community. This

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* First of all a list of vegetables and non-growers was prepared. This first stratum was then classified into various farm categories: large, medium, marginal, and landless, based on landholding size. Farmers were also categorised by ethnicity.

Table 2.4: Vegetable Growers and Non-growers and Sample Size By Farm Size in Bhadaure Study Site (Naubise)

Farm Category	Vegetable				Sample Size			
	Growers		Non-growers		Growers	Non-growers	Total	Proportion
	Household No	Proportion (5%)	Household No	Proportion (5%)	Household No	Household No	Household No	%
Marginal Farmer	-	-	-	-	-	-	-	-
Small Farmer	20	26	9	75	7	3	10	33.4
Medium Farmer	23	29	-	-	7	-	7	23.3
Large Farmer	35	45	3	25	12	1	13	43.3
	78	100	12	100	26(87)	4(13)	30	100.0

Source : Household Survey, APROSC 1989.

Note : Figures in parentheses are in percentages.

Table 2.5: Number of Households and Sample Size By Ethnicity in Bhadaure Study Site (Naubise)

Ethnicity	Households Production		
	No.	%	No
Brahmin	68	75	22
Chettri	6	7	2
Newar	3	3	1
Bhujel	3	3	1
Tamang	4	5	2
Kami/Sunar	6	7	2
Total	90	100	30

Source : Household Survey, APROSC 1989.

process facilitated the satisfactory selection of the "**Yelung**" site of Shyama *Panchayat* (former) Yelung includes some adjoining villages named Sharba Khasha, Bagdung, and Chyane from ward number 5 and Gepung, Changam, Gyamnel, Parma, and Lhacha from ward number 6. The total number of households in the site or cluster is estimated at 130.

Selection of Households for Survey

With the help of the present as well as the former ward chairman, local leaders and key informants, a small profile was prepared by enlisting heads of households, their landholding sizes (own and operated) by type of land, and the size of livestock holding by type of animal. Firstly, landholding sizes were converted into standard units - *ropani* - from the local unit indicated by seed rate. Similarly, all kinds of livestock were converted into a single but standard unit - Livestock Unit (LSU). Based on stratified random sampling a total of 30 households was finally selected, keeping in mind three representative criteria: farm size, livestock holding size, and ethnicity (Table 2.6).

Data Acquisition

The data aquisition procedure employed for this farming system was also the same as for the previous two.

Analytical Procedure

Simple tools were used to analyse the data. In the absence of time series data, cross-sectional data have been used for cross-tabular analysis.

Limitations of the Study

The absence of baseline/benchmark studies was recognised realised as a severe handicap, particularly in comparing the present situation of the mountain farming systems with the past three or four decades and in drawing the sustainability implications of farmers' strategies in response to mountain charactersitics and public

interventions made by the Government. At this juncture, historical background information compiled through the memory recall method was solicited. Another major problem of this present study has been the premise of non-sampling error, and it was particularly so in the case of the livestock-dominated farming system study site where farmers were not conversant in the Nepali language, although one or two key informants (adequately educated) were hired to help the study team members throughout the study period at the site. However, the best possible efforts have been made to overcome these problems by having extensive and comprehensive discussions with farmers, local leaders, and key informants, particularly with those who could recall the past situation of farming and resource management systems adopted both during normal and abnormal as well as odd periods (e.g., drought, hailstorm, flooding, insect and disease infections, and other natural calamities - landslides).

Table 2.6: Total Number of Households and Sample Households by Farm Size in Yelung Study Site

Farm Size	Total No. of Households (No.)	Proportion of Households (%)	Sample Households (No.)
Marginal	61	47	14
Small	60	46	14
Medium	9	7	2
Large	-	--	
Total	130	100	30

Source : Household Survey, APROSC 1989.