DETERMINANTS OF HOUSEHOLD FOOD SECURITY UNDER SUBSISTENCE AGRICULTURE IN THE MID HILLS OF EASTERN NEPAL

PUSTAK RAJ OJHA

A THESIS SUBMITTED TO THE GRADUATE SCHOOL IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
MASTER OF SCIENCE (AGRICULTURE)
IN AGRICULTURAL SYSTEMS

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ABSTRACT

The thesis presents the outcomes of a study on factors determining household food security under the subsistence production systems. The study examines the key resource and demographic variables determining household food security, and further explores the constraints to and households' strategies for food security.

The study was based on the concept of availability of and access to food as a prime indicator of household food security. The research was conducted in Fakchamara village located in the mid-hills of eastern Nepal. The analysis was based on the cross sectional survey data obtained from 135 households selected using stratified random sampling technique, coupled with the information obtained through interviews with key informants and farmers' group discussions.

The study found that there was a remarkable difference in availability of and access to food among the households. The average number of calorie available for

consumption was 2,414 Kcal per adult equivalent (AE) per day, which is nearly at subsistence requirement level of 2,500 Kcal per AE per day. However, more than 40 per cent of households were found under severe food insecurity, obtaining less than 80 per cent of their subsistence energy requirement. Major three cereal crops namely rice, maize and millet were found to be the most important food source supplying more than 90 per cent of household dietary energy. It was also revealed that there was marked reliance on own farm production to meet household food requirement that supplied more than 80 per cent of total dietary energy.

Generalized Least Square (GLS) multiple regression analysis with semi-log functional form was employed for estimation of relative contribution of demographic and resource variables on household food security defined in terms of dietary energy availability for consumption. With the overall R^2 of 59 per cent, the findings affirmed that cultivated land holding (hectare per AE), livestock holding (LSU per AE), proportion of economically active female household members to the total household size, and adoption of modern varieties of cereal crops were the significant determinants of household food security in the study area. Contrary to expectation, significant negative relationship between the number of economically active household members and food availability for consumption was found which could be the results of excess labor force available or lack of productive employment opportunities in the study area.

Apart from the result, the study suggested that land-man and livestock-man ratios were too low among those food insecure households to ensure their food security. Furthermore, the study points to relative importance of women in household food security as producers and managers. Under the present land constraint, food security intervention through crop and livestock productivity enhancement will be significant means to improve food security in the study area.

This study identified several key areas having direct implications for designing development and research intervention with the objective of ameliorating poverty and food insecurity. Well-envisioned agrarian reforms with the objective of improving access to land resource among the small farm size holders deemed imperative. Fundamentally, broad-based rural development efforts enhancing agricultural productivity through technological intervention and improving livestock resources, and diversifying employment opportunities are some of the ways out of poverty and food insecurity trap in the study area.

ชื่อวิทยานิพนธ์: ปัจจัยกำหนดความมั่นคงด้านอาหารในครัวเรือนเกษตรแบบยังชีพ ในเขตภูเขาตอนกลาง ภาคตะวันออกของประเทศเนปาล

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บทคัดย่อ

งานวิจัยนี้แสดงผลของการศึกษาปัจจัยที่กำหนดความมั่นคงทางอาหาร ภายใต้ระบบการผลิตแบบยังชีพ การศึกษาสำรวจตัวแปรทางทรัพยากรและประชากรที่สำคัญที่เป็นตัวกำหนดความมั่นคงทางอาหารในครัวเรือน นอกจากนี้ยังสำรวจข้อจำกัด และกลยุทธ์ของครัวเรือนเพื่อบรรลุถึงความมั่นคงทางอาหารอีกด้วย

การศึกษาครั้งนี้ใช้แนวความคิดว่า การมีและสามารถหาอาหาร เป็นตัววัดที่สำคัญที่บ่งบอกถึงความมั่นคงทางอาหารในครัวเรือน พื้นที่ที่ทำการสำรวจอยู่ในหมู่บ้าน Fakchamara ในภูเขาตอนกลาง (mid-hills)ทางด้านตะวันออกของประเทศเนปาล ทำการวิเคราะห์จากการเก็บข้อมูลแบบ cross sectional survey จำนวนทั้งหมด 135 ครัวเรือน โดยใช้วิธีการสุ่มแบบแบ่งชั้น ร่วมกับข้อมูลที่ได้จากการสัมภาษณ์ผู้รู้ และการสนทนากับกลุ่มเกษตรกร

การศึกษาพบว่ามีความแตกต่างอย่างชัดเจนในด้านการมีและสามารถหาอาหารของครัวเรือน ปริมาณแคลอรีโดยเฉลี่ยที่ครัวเรือนได้รับมีค่าเท่ากับ 2,414 กิโลแคลอรี่ ต่อผู้ใหญ่ 1 คนต่อวัน ซึ่งใกล้เคียงกับระดับความต้องการพลังงานในระดับยังชีพ คือ 2,500 กิโลแคลอรี่ต่อผู้ใหญ่ 1 คนต่อวัน อย่างไรก็ตาม มากกว่าร้อยละ 40 ของครัวเรือนอยู่ในภาวะที่ต่ำกว่าระดับความมั่นคงทางอาหารอย่างรุนแรง โดยได้รับอาหารน้อยกว่าร้อยละ 80 ของระดับที่เพียงพอต่อการยังชีพ ธัญพืชที่สำคัญอันได้แก่ ข้าว

ข้าวโพด และข้าวฟ่างเป็นแหล่งอาหารที่สำคัญให้พลังงานมากกว่า 90% ของพลังงานในอาหารประจำวันของครัวเรือน พบด้วยว่าครัวเรือนพึ่งพาผลิตผลในไร่นาของตนเอง เพื่อเป็นแหล่งอาหารโดยได้พลังงานร้อยละ 80 จากแหล่งนี้

การศึกษาครั้งนี้ใช้การวิเคราะห์พหุแบบถดถอย Generalized Least Square (GLS) โดยมีสมการในรูปของ semi-log เพื่อหาสหสัมพันธ์ของตัวแปรทางด้านประชากรและทรัพยากรกับความมั่นคงทางอาหารของครัวเรือน ซึ่งวัดโดยแปลงปริมาณการบริโภคอาหารของครัวเรือนเป็นพลังงาน ผลการวิเคราะห์พบว่าค่า R^2 มีค่าเท่ากับ 0.59 โดยมีพื้นที่การถือครองที่ใช้ในการเกษตร (เฮกตาร์ต่อคน) จำนวนสัตว์เลี้ยงที่ครอบครองต่อคน และสัดส่วนของผู้หญิงที่ทำงานได้ต่อสมาชิกทั้งหมดในครัวเรือนและการยอมรับพันธ์พืชใหม่ เป็นปัจจัยที่มีผลต่อการกำหนดความมั่นคงทางอาหารอย่างมีนัยสำคัญ อย่างไรก็ตาม ตรงกันข้ามกับที่คาดเอาไว้ จำนวนสมาชิกที่สามารถทำงานได้ในครัวเรือนมีความสัมพันธ์ไปในทางตรงกันข้ามกับการมีอาหารเพื่อการบริโภคอย่างมีนัยสำคัญ ซึ่งอาจมีสาเหตุจากการมีแรงงานมากเกินไป หรือการขาดแคลนโอกาสในการจ้างงานอื่นในพื้นที่ศึกษา

นอกจากผลการศึกษาจะระบุว่า สัดส่วนของที่ดินต่อคนและปศุสัตว์ต่อคนในครัวเรือนที่ศึกษาต่ำเกินไปที่จะประกันความมั่นคงด้านอาหารให้แก่ครัวเรือนแล้ว การศึกษายังชี้ให้เห็นถึงความสำคัญของกลุ่มผู้หญิงที่จะเป็นผู้ผลิตและผู้จัดการด้านความมั่นคงทางอาหาร ในสภาพขนาดจำกัดของที่ดินในปัจจุบัน การแทรกแซงผ่านทางการเพิ่มผลผลิตทั้งทางด้านพืชและสัตว์ จึงเป็นวิธีสำคัญที่จะเพิ่มความมั่นคงทางอาหารในพื้นที่ศึกษา

การศึกษานี้บ่งประเด็นหลายประการที่สามารถมีผลต่อการวางแผนการพัฒนาและการวิจัยเพื่อบรรเทาปัญหาความยากจนและความไม่มั่นคงทางอาหาร ควรมีการปฏิรูปทางการเกษตรที่ได้รับการวางแผนอย่างดีเพื่อวัตถุประสงค์ให้เกษตรกรที่มีที่ดินน้อย สามารถมีที่ดินใช้มากขึ้น การพัฒนาชนบทในวงกว้าง เพื่อเพิ่มประสิทธิภาพการเกษตรผ่านทางเทคโนโลยีใหม่และการเพิ่มทรัพยากรด้านปศุสัตว์และการขยายโอกาสและความหลากหลายของการจ้างงาน เป็นหนทางหนึ่งเพื่อขจัดความยากจนและความไม่มั่นคงทางอาหารในพื้นที่ศึกษา

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ABBREVIATIONS AND ACRONYMS

ADB	:	Asian Development Bank
ADB/N	:	Agricultural Development Bank of Nepal
AE	:	Adult Equivalent
AHFSI	:	Aggregate Household Food Security Index
AIC	:	Agricultural Inputs Corporation
APROSC	:	Agricultural Project Service center
ASC	:	Agricultural Service Center
CBS	:	Central Bureau of Statistic
CI	:	Cropping Intensity
FAO	:	Food and Agriculture Organization
FFW	:	Food-For-Works
GDP	:	Gross Domestic Product
ha	:	Hectare
HDEAR	:	Household Dietary Energy Adequacy Ratio
hh	:	Household
HMG/N	:	His Majesty'sGovernment of Nepal
ICIMOD	:	International Center for Integrated Mountain Development
IFAD	:	International Fund for Agriculture Development
IFPRI	:	International Food Policy Research Institute
JMA	:	Johan Mellor Associates
Kcal	:	Kilocalorie
Kg	:	Kilogram
KHARDEP	:	Koshi Hill Area Integrated Rural Development Project
LSC	:	Livestock Service Center
LSU	:	Livestock Unit
NAC	:	Nutritional Advisory Committee of India
NARC	:	Nepal Rgricultural Research Council
NEFAS	:	Nepal Foundation for Advanced Studies
NGOs	:	Non-Government Organizations
NPC	:	National Planning Commission
NRs	:	Nepalese Rupees (one US $ equivalent to 68 NRs)
NLB	:	Nepal Bank Limited
PAC	:	Pakhribas Agricultural Center
PRA	:	Participatory Rural Appraisal
RONAST	:	Royal Nepal Academy for Science and Technology
SFDP	:	Small Farmers Development Project
UNICEF	:	United Nations Children's Fund
VDC	:	Village Development Committee

LOCAL TERMS

Adhiya	:	Rental arrangement of land in which 50 % of crop produce is given to landlord
Adilo	:	Bulkiness and lasting
Amio	:	Like vinegar locally made from citrus juice
Bari	:	Up land normally cultivated with maize
Besi	:	Low altitude settings
Brahmin/ Chhetri	:	A caste group belongs to Indo-Aryan group
Damai	:	A caste group with traditional occupation of tailoring
Doko	:	Basket like made from bamboo slits
Gundruk	:	Dried and fermented radish and rayo leaves
Gurkha army	:	Nepalese recruited regiment in British or Indian army force
Hal	:	A pair of oxen; area ploughed by one pair of oxen in one day
Haat	:	Local market hold weekly or fortnightly
Jaad	:	Local beer made from grain (mostly from millet)
Kami	:	A caste group with traditional occupation of iron works
Khet	:	Low land paddy cultivated area
Lekh	:	High altitude settings
Limbu	:	A ethnic group of eastern hills belongs to Mongoloid group
Mana	:	Volumetric local measurement unit
Marcha	:	Locally made media (yeast) used for making local alcoholic beverage
Muri	:	Volumetric local measurement unit
Nanglo	:	A tray like made from bamboo slits
Panchayat	:	The village level political unit of the then Panchayat system
Pakho	:	Dry and less fertile marginal up land
Pathi	:	Volumetric local measurement unit
Rai	:	A ethnic group of eastern hills belongs to Mongoloid group
Raksi	:	Local sprit made from grain (mostly from millet)
Ropani	:	Unit of land area
Sharki	:	A caste group with traditional occupation of leather works
Sinki	:	Dried and fermented radish
Shiwalik	:	Mountain immediately after the southern plain
Terai	:	Southern plain area in the of Nepal (topography extension of Gangetic plain)
Thekka	:	Rental arrangement of land in which a fixed amount of kind or cash is given to landlord
Ward	:	Smallest unit of local political boundary. A village development committee is divided into nine wards

CHAPTER I

INTRODUCTION

1.1 Background

Nepal is a small landlocked country wedged between China and India. It lies between 27^0 and 30^0 N latitude and 30^0 and 88^0 E longitude. Its rectangular shape covers a length of roughly 800 km and a width of 130-140 km. Nepal has been ranked as one of the least developed countries in the world, inhabited by large masses of people living under abject poverty. The population of the country is more than 21 million with largely rural based economy where almost 95% of the total poor population are getting their sustenance from the agriculture (Dahal and Guru-Gharana, 1993). Therefore, poverty in the country can be considered as a rural phenomenon. The rural poor lack the most important asset in agricultural setting, the land. They have small unproductive plots or no land at all and the estimated per capita annual income of the rural poor is less than 45 percent of that of the rural non-poor (Guru-Gharana, 1993)

Low level of production, low income, unemployment, illiteracy, food insecurity and malnutrition are the major attributing factors of poverty in the country. Although, agriculture remains as the basis of livelihood and backbone of national economy, it is still traditional and subsistence in nature. Agriculture as the major source of income and employment, which contributes about 61 % in the real GDP, has now, however, stagnated for the last 15 years (Chaudhuhry and Garcia, 1993). Because of the dismal performance of agricultural sector in the past two decades, Nepal once a net grain exporter country has now shifted to partially grain importer in the recent years [Agricultural Project Service Center and John Mellor Associates (APROSC and JMA), 1995]

The diverse geographic condition consisting of plain alluvial low land (*terai*) to the gigantic rocky Himalayan zone and many small valleys in the country magnify the multiform of agricultural systems. The physiographic domain of the country are readily defined by the five parallel ranges that transverse the country from east to west in the ascending order of elevation. The *terai* land (southern plain averaging 30 km in width with altitude range from 60 to 300m), which is considered as the 'grain bowl' of the, comprises 17 percent of the total country land, and constitutes the most productive area relatively with better infrastructure (Baskota, 1992). Adjacent to *terai* in the north a small strip of *siwalik* foothills extends from east to the west with the elevation range of 120 to 200 masl, comprising dry, friable and immature soils with a very few dispersed settlement. After *shiwalik* a gigantic middle mountain extends from the altitude range of 200 to 3500 masl, consisting of about 65 per cent of the total land where more than 45 percent of the total country population reside (Thapa, 1996). High mountains with the elevation of about 1000 masl in the river valley to 4000 masl in the upper ridge further to the high Himalayas extending beyond the altitude of 4000 masl (Sill and Kirkby, 1990).

About half of the total population in the country are below the poverty line and the daily supply of calorie per capita was estimated 2,126 Kilocalorie per day in 1992-94 (FAO, 1995) which is slightly less than minimum calorie requirement of 2,250 on an average (Gautam, 1990). So far as food production and consumption is concerned, for the last two decades food production has not been able to keep pace with population growth, and the agricultural productivity has declined by virtue of degrading environments (Islam, 1984 and Pudasaini, 1993).

Out of roughly three million hectare of cultivated land in the country, the *terai*, hills and mountains account for 41.6, 49.9 and 8.5 per cent respectively. Although the population density in the hills and mountain seems comparatively less in terms of per unit area of land, it comes to be perhaps very high in terms of unit area of cultivated land (Thapa and Rosegrant, 1995). Declining productivity and growing population are the

major challenge of agricultural development and poverty alleviation issues in the country. The increasing demand of food for the ever growing population has, therefore, accelerated the encroachment on natural resources which further exacerbate the environment degradation in the hills resulting rapid depletion of non-renewable natural resources like forest to meet the growing demand of food and fuel (Bajracharya, 1983 a)

Despite the array of changes in agricultural development approaches during the past two decades in the country, no remarkable change has been achieved towards meeting the needs of farmers. This could be in one way, due to poor impact of agricultural extension which in turn is due to lack of clear set of priorities geared to achieving national objective through agricultural growth (APROSC and JMA, 1995). The poor agricultural performance has further been reflected by the low level of research expenditure, which is in fact significantly lower (i.e. 0.69 per cent of agricultural GDP) than that of other developing countries (ibid.). Data records for the past two decades showed declining productivity of major cereals crops (rice, maize, millet, wheat and barley) and natural resources (forest and pasture). This situation has further aggravated the quality of life in the hills and mountain reducing the per capita availability of food grain and animal products (Shrestha and Yadav, 1992).

1.2 Statement of problem

Nepal, where more than 80 per cent of the economically active population are engaged in agricultural, imports a significant quantity of food grain. Small cultivable land holding against increasing population pressure has been threatening the food security situation of the country (UNICEF, 1992). Slow agriculture growth coupled with high population growth and unmanageable urbanization converting agricultural land into human settlement has resulted in higher demand for food with decreasing food production (Koirala *et al*, 1995). Analysis of population growth and per capita calorie availability for the last 25 year shows that food availability has lagged behind the

population growth (Table1.1). Taking 1975 as the base year, population growth has far exceeded the growth in per capita calorie availability during the past 25 years (1961-94). If the trend continues in the same way, there seems a serious threat on the national food security in the next millennium.

Table 1.1. Index of population and per capita calorie availability in Nepal during 1961-1994 (three years average)

(1975=100)

	Year										% increased
	1961 -63	1964 -66	1969 -71	1974 -76	1979 -81	1982 -84	1984 -85	1987 -89	1989 -91	1992 -94	1961-94
Population	78	83	91	103	118	129	135	145	153	165	111.5
Calorie /capita	91	90	91	90	89	93	95	105	109	101	10.9

(Source: Calculation based on FAO food balance sheets (Nepal), 1980 and 1995)

By the same token, analysis of the past two decades data on expansion of cultivated area and production revealed that the increased supply of food grain was just by way of expansion of agricultural land rather than technological improvement. The data pertaining to growth rate of major cereal production and area of production during 1967-1989 indicate the growth rate of cereal production lagged behind the growth in the area of cereal cultivation (Thapa and Rosegrant, 1995). When compared the growth in food grain production between the regions, the growth rate of cereal production during the same period (1967-1989) was negative in the hills and mountain (Table1.2). This scenario indicates a poor performance of agriculture production both in *terai* and hills aggravating the food deficit in the hills and reducing the exportable surplus in the *terai* (Khadka and Gautam, 1981). Furthermore, Khadka and Gautam (1981) have projected

balance between supply and demand of food in the country using linear trend for 1980-2000, which indicates a big gap between production and demand of food in the hills.

Table 1.2 Growth rate (percentage) of area, production and yield of major food crops by ecological zones (1967/68-1989/90)

Crop		Ecological Zone		
		Mountain	Hills	*Terai*
Paddy	Area	3.86	3.45	0.35
	Production	2.35	2.28	1.17
	Yield	-1.51	-1.17	0.82
Maize	Area	1.41	3.50	0.27
	Production	-0.24	1.32	0.38
	Yield	-1.65	-2.18	0.11
Wheat	Area	1.17	5.87	5.60
	Production	0.39	5.93	8.43
	Yield	-0.78	0.06	2.83
Millet	Area	2.36	2.56	-2.29
	Production	1.26	1.40	1.81
	Yield	-1.30	-1.16	0.48
Barley	Area	0.79	2.16	-4.28
	Production	-0.30	1.37	-2.92
	Yield	-1.09	-0.79	1.36
Potato	Area	2.80	2.41	2.49
	Production	4.25	1.80	3.33
	Yield	1.45	-0.61	0.84

(Source: Thapa and Rosegrant, 1995)

Because of high altitude and rugged mountain, Nepal has small percentage (16%) cultivating land thereby creating extremely unfavorable land-man ratio, particularly in the hills and mountain, where nearly 60 per cent of the total country's population reside. The cultivated area on an average per rural household in the hills is only 0.125 hectare (Islam, 1984). Therefore, with the overwhelming proportion of the population depending on

agriculture, a hectare of land has to sustain over six people. Because of high rate of population growth (2.1% annual), availability of land steadily decreased from 0.6 hectare per person in 1954 to 0.24 in 1990 (UNICEF, 1992). In addition, due to high degree of inequality in land distribution, a large section of rural population in the hills has to eke out their living from the very tiny land holding. Therefore, the hills and mountain of Nepal as a whole have been facing intricate problem of rapid population growth, dwindling natural resource base and the consequent problem of food insecurity in the recent decade (Banskota, 1992).

There are wide range of microclimatic variations within the same village in the hills arising from the interaction of elevation and aspect. Generally there is monsoon climate and more than 80 percent rainfall occurs between June to September with a great spatial variation (Sill and Kirkby, 1991). The diverse topography, erratic rainfall, draught, multi-ethnicity, less access to road and market has made the rural hills more disadvantaged. Therefore, it has now been developed a general understanding that the agricultural systems in the hills of Nepal are complex, diverse, risk prone in nature.

Agriculture in the hills is largely undertaken in valleys and slopes carved into innumerable terraces with intensive land use systems. The limited infrastructure and high variation in the micro-climatic condition accompanied by the large family size with less than one hectare of arable land per farm household has led the hills farmers to adopt a complex set of mixed farming for their subsistence living. The hill farming systems, therefore, are characterized as low productive, substantially diverse and a high degree of self-reliance (Yadav, 1990).

Agriculture in the hills heavily depends on monsoon, and productivity is low because of inadequate supply of agricultural inputs, technologies and finance. Those may be the factors partly responsible for rural poverty and wide spread food insecurity in the hills. Uneven access to food is another detrimental factor intensifying the rural poverty.

It has been estimated that about 36 per cent of the total population in Nepal consume less than minimum calorie requirement. The percentage of households consuming less than the required calorie is 47 in rural hills, 40 in urban areas, and 31 in the mountain. When compared with hills the calorific intake in *terai* region is higher, as only 23 per cent people living in the rural *terai* consume less than calorie requirement (UNICEF, 1992).

The mid hills of the country suffer from the extreme population pressures in-terms of availability of cultivating land and economic resources (Sill and Kirky, 1991). It is estimated that in the eastern hill districts, the amount of cultivable land has remained static for over the past 50 years. With continued population pressure, the land is unable to support people at the existing level of technology and the farming systems as increasing population pressure on cultivated land places greater demand on the physical environment. The expansion of cultivation on the marginal land has, therefore, virtually reduced the average agricultural yield and pronounced the soil degradation due to increasing erosion and reducing soil fertility. As a result of worsening population pressure and food deficit in the eastern hills during the eighties, permanent migration from the hills to the *terai* was rapidly enhanced.

The eastern hills of Nepal have an amazing diversity of climatic zones on its wide rage of elevation. Majority of inhabitant of the eastern hills can be characterized as having low income, small land holding (<0.5 ha) and food deficit (Gautam, 1994). Since food insecurity is the major problem among the rural poor, poverty alleviation and food security can thus be interpreted almost synonymously in the context of eastern hills.

The above mentioned scenario of deteriorating environment and worsening economy worsening of the hills further exacerbate the increasing problem of food insecurity and miserable livelihood of the hill people. As a result, about 70 per cent of the hill districts confront with food deficit. (APROSC and JMA, 1995). Therefore, the

present situation of the hills demands an urgent strategic program in order to combat with the worsening situation of poverty and food insecurity.

1.3 Rationale of the study

It is obvious that food security at higher level does not necessarily translate as the security at the lower level of aggregation. Therefore, a country which is food secure at the national level will almost certainly contains groups of people which are severely food insecure and vice versa. Since the attainment of national food sufficiency comprises aggregate supply and demand of food in the country level, which some times do not reflect the food security of all regions within the country. Staatz *et al* (1990) have therefore warned the consequences of national food sufficiency policies, which some times create regional disparity where there is poor market integration. Therefore, despite the attainment of national food sufficiency, in some case it does not translate into the household food security if the households are not able to afford for the available foods. The concern on household food security has, therefore, been shifted from macroeconomic production oriented to microeconomic consumption oriented concept at the household-level analysis (Maxwell and Frangerburger, 1992, Von Braun, 1988).

Nepal development efforts in the past were not based on the empirical analysis of the situation. Thus many policy instruments in the past particularly related to food grain and fertilizers distribution has not been able to reach to the targeted poor people; instead, the actual beneficiaries of those policies were politically important groups, urban residents and the government officials (Thapa and Rosegrant, 1995). The food policy of the government in past was to grow more food to meet the basic calorie requirement of the population. But the increased production has not been able to improve the food situation of the poor. This milieu occurred due to lack of integrated approach in food production (.Ustribution as well as income and employment generation (UNICEF, 1992). To improve the effectiveness of poverty alleviation and food security program, it

is, however, essential to understand underlying factors of poverty and food insecurity in order to address the real problem of the target sector of the society. The Agricultural Perspective Plan (APP) of Nepal has now, therefore, been taken up as main foundation of a long-term strategy to increase food production, food security, employment and income generation thereby ameliorating poverty situation in the country. In order to bring about desirable changes in the food security and peoples' prosperity it is important to target the development activities to the needy. It is perceived that there are gradations in poverty and food security level in the societies, and understanding of the dimensions of the problem is essential to analyze the situation in order to make any research and development interventions effective. Therefore, the present study on factors determining the household food security will provide a basis for setting priorities of research and development activities. Moreover, this study will fill the household level information gap on of the rural hills, which will provide basis for further research.

Small fragmented pieces of landholding, high population density per unit area of cultivating land, lack of off-farm employment opportunities, lack of transport and marketing networks, and the vagaries of unreliable monsoon add to the problem of the hill inhabitants. Because of tiny farm size, it can be assumed that no marketable surplus can be produced and the subsistence living from the present level of resource base is barely possible in the hills. On the other hand, skewed distribution of cultivating land further aggravates the problem of subsistence living to the poor peasant in the hills. From the small parcel of land, the poor hill farmers can not support even the minimum subsistence living of their family, therefore, they have to either supplement by agricultural laboring or non-farm laboring. Which may be the reasons partially responsible to declining productivity due to seasonal migration of agricultural labor to seek non-farm works out side (Waldie, 1993). Therefore, the problem of household food security revolves around a complex set of agriculture production, distribution, and its interrelationship within and between the systems components. The problem of household food security is not simply a problem of agricultural outputs, but encompasses all factors

affecting a household assess to supply of food (Falconer and Arnold, 1991). Seemingly, food security is the most important goal of household activities particularly in the subsistence systems. It is, therefore, imperative to understand the linkage between the food production and the general livelihood systems of the people in order to understand the problem adherent with household food insecurity.

The significance of food security at the farm household level can be depicted by an example of household categorization exercise conducted by PAC in the eastern hills of Nepal during 1991-93. The outcomes of farmers' categorization exercise had indicated 'food availability' from own on-farm production as the cut off point of household categorization (KC and Rood, 1993). This indicates that farmers are aware of existing socioeconomic differences between the households, usually described in terms of the availability of food. Furthermore, this opened an area of thinking to explore why and how those differences exist and what could be the determining factors behind? which will eventually be useful to design and implement need based and client oriented research and development activities. Additionally, many study related to food security are primarily from the regions of starvation, famine and war affected countries in Africa and sub-Saharan regions. Therefore, there is lack of information from the areas where the problem of food insecurity is of different nature than famine and starvation. The present study, therefore, been has designed to answer those issues in food security pertaining to the situation of subsistence farming where agriculture production is isolated from the market integration, and food situation has not worsened to the level of famine and starvation so far. Therefore the present study serves as a part of understanding the dimensions of household level food security particularly addressing the problem of subsistence agricultural production systems of the eastern mid hills of Nepal.

1.4 Objectives of the study:

Given the above background, the overall objective of this study was to understand the household food security situation and its key determining factors under the subsistence production systems of the eastern mid-hills of Nepal. The specific objectives of this study were:

1. to characterize the farming systems of the study area in relation with household food security.
2. to investigate and analyze the relationship between per capita food availability for consumption and resource and demographic variables.
3. to identify constraints to household food security and understand the household food strategies

CHAPTER II

LITERATURE REVIEW

2.1 Concept and definition of food security

One of the very basic and essential needs of human being is adequate supply of food. The entire structure and function of the human population, therefore, revolves around the acquisition food (Pimentel and Pimentel, 1979). High priorities given to food by human being are documented in many historical books and arts. Historically, food value has been accorded top priority among all, and evidence shows that many festivals and ceremonies celebrate the successful harvest. Those may be the reason that Maslow put food for survival as the first and foremost basic need in the hierarchy of human needs. Similarly, the universal declaration of basic human right has recognized the right of adequate attainment of food as one of the basic human right (Maxwell and Frankenburger, 1992). Therefore, the importance of food security can be traced back to the history of human civilization and can be found interlinked with every sphere of human activities.

The definition of food security has been broadened since the First World Food Conference in 1975, immediately after the world food crisis of 1972-74. However, the global interest on food security has continued to grow after the mid eighties (Staaz *et al.* 1990). Food security being an emerging issue, its definition has a great controversy and became a widely debated and much more confused. As the topic on food security grown up, it also became complex on conceptualization and definitional issue (Maxwell and Frankenburger, 1992). However, while conceptualizing the food security issue we always face two complex terms: food and security. Many literature on food security have referred to 'food' with the main concern on calorie based on the principle that other nutrients are usually satisfied when calorie intake is satisfactory. The second term

'security' has the concept of securing access to enough food over the time. So the term security has both entitlement and time dimension (ibid.). Colman and Nixon (1994) use the term food security as access to enough food for active and healthy life, and food insecurity as the lack of access to food. They differentiate malnutrition and food insecurity, as the former one is pathological symptom of the undernourishment. The committee on world food security has, however, given a basic definition of food security as the economic and physical access of food of all people at all time (FAO, 1989). Therefore, food security can be taken as the physical means of food sufficiency in the broader term of agricultural products. Food security at household level can further be defined as the ability of the household to secure enough food for its entire member (FAO, 1989). Sustainable food security, therefore, aims to achieve this goal without compromising the production capacity of natural resources, the integrity of biological systems and/or environmental quality (Gills, 1997). The food security concept address as people's risk of not having access to needed food, which may arises both from income and food production (Von Braun *et al.*, 1996).

2.2 Dimensions of food security

As discussed earlier food security is achieved when all people at all time have access to food for healthy and productive life. Food security, however, means enough food access by all people at all time for an active and healthy life; its essential elements are, therefore, availability and ability to acquire it (Reutlinger, 1987 cited in Hossain, 1995). Food security relies on a number of factors and involves major three components: food availability (supply), stability (time) and accessibility (entitlement). Firstly, food availability is the basic concern of food security, which remove the fear of not enough supply of food. It refers to the need of producing sufficient food without compromising the depletion of natural resources (Haddad, 1997). Therefore, adequacy of food production and its supply is an important parameter of assessing food security. Based on the theme of food availability, Maxwell (1990) defines a country and its people as food

secured when their food system operates efficiently without threat of deficit food supply. Stability in the food supply, on the other hand, is another equally important aspect of ensuring food security. It is particularly important, when we are concerned with long-run food security. Sharp fluctuations in food supply seriously intensify the problem of food insecurity, malnutrition and hunger. Much of instability arises due to natural calamities, such as extreme weather variations, heavy infestation of diseases and pest etc. (National Academy of science, 1977). Since the frequent variations in food production can easily upset the stability of food supply and thereby its consumption, simply narrowing down the gap between the requirement and availability of staple food will be incapable of improving food security, if the enhanced supply is subject to year-to-year fluctuations. Supply stability is therefore, a major concern while analyzing the national level food security (Singh and Satis Babu, 1998). Furthermore, the time dimension of food security is equally important to determine the nature of food security problem. When individual or group of people suffers from food insecurity for all the time, they are considered as suffering from chronic food insecurity. Transitory food insecurity occurs when household faces temporary decline in the access to food. This may be due to temporary shortfall in food production because of drought, pest attack, and sudden unemployment. Transitory food insecurity may be either temporary for the short duration of seasonal/cyclical, which occurs, in a regular pattern (Maxwell and Frankenburger, 1992; Thomson and Metz, 1997). Therefore, under the transitory food insecurity there is a high chance of reversibility of the situation.

As, the core concept of food security relied on availability of and access to required food, it is entirely associated with the production, supply and purchasing power of household or nations or individuals. Increased physical availability is only a necessary condition to ensure food security unless it is backed up by the increased entitlement to food. Johnson (1984) cited in Perman *et al.* (1996), noted that a major change, which had taken place over the four or five decades to increasing access to food, was primarily dependent upon the increase in the family income. The noble laureate Amrtya Sen (1980) as cited in Maxwell and Frankerburger (1992) did the pioneering work on 'food

entitlement'. Although, food availability remains the key issue in food security, production and supply alone do not ensure food security, unless it is accessible to the needy. Based on the notion of Sen's 'entitlement' Maxwell and Frakerburger (1992) have define the most food secured household as those which achieve adequate access to food using a small fraction of their available resources. The most food insecure households, on the other hand, fail to achieve adequate food even in the expense of large proportion of their resources.

Hindle (1990) explains five major components of the World Bank approach of food security analysis; macroeconomics, microeconomics, food availability, food consumption, and markets (goods, labor and land). The macroeconomic aspect relates with global and national level food security, and the micro aspects deals about inter and intra household level food security issues (Singer, 1997). As food security analysis involves both macro and microeconomics concept of supply and demand analysis, food security can be seen basically at three levels: national and regional food security, household food security, and individual food security (Thomson and Metz, 1997). The interaction between all three level of food security analysis is depicted in Figure 2.1.

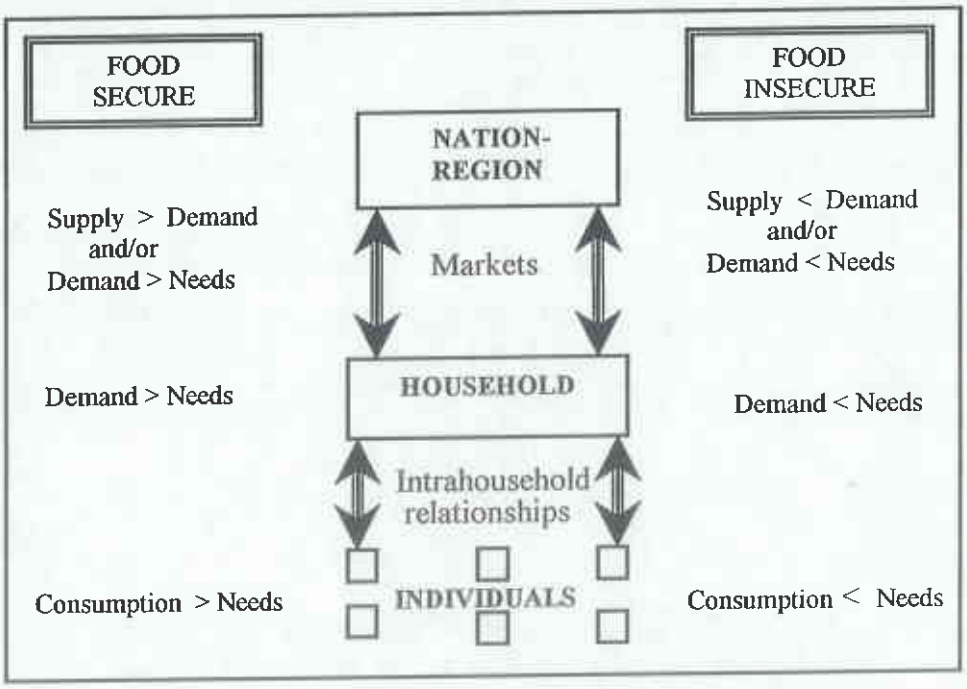

Figure 2.1. Different levels of food security analysis
(Adopted from Thomson and Metz, 1997)

Since individuals or households with sufficient resources will have access to sufficient food, food insecurity and poverty can be seen as intertwined phenomenon (Von Braun *et al.*, 1996) as food insecurity is almost inevitable as a result of poverty. Therefore, poverty can be considered as one of the main determinants of food insecurity, as the poor do not have adequate means and entitlements to secure their access to food, even though there are ample supplies of foods in the market. Moreover, poverty leads disguised food insecurity through decreasing labor productivity and inefficient allocation of available resources (ibid.).

2.3 Gender and household food security

Literature on gender roles in the household food security describe that women's time allocation within the household is mostly devoted to feeding and care of household member, as it is considered that food management in the household is the social obligations and ritual duties of the women. According to the FAO (1996) report in the 'World Food Summit 1996 ' titled 'Women Feed the World' has clearly explained that women produce more than half of all the world food grown. Women in the rural areas are most exclusively responsible for the nutrition of their children and they are the principal producers and preparers for the rest of the family (ibid.). Therefore, women's role has assumed to be of central importance for the overall household welfare in general, and ensuring household food and nutritional security, meeting household basic needs in particular. The women's role in the household activities varies from society to society, and generally women activities are revolved more around the subsistence needs of the household (Falconer and Arnold, 1991). Instead of household daily chores, women's contribution accounts significant in the household cash generation from small scale cottage industries (e.g. weaving) particularly in the rural community (ibid.). In a study of five villages in India, Dasgupta and Maiti (1986) cited in Falconer and Arnold (1991), found that women contribute 19-50 per cent of the total household's income, in addition to spending about 4.8 hours/day in cooking and fuel-wood collection. Women play sequence of crucial role in the household food acquisition; they are concerned with the matter of cooking, feeding and processing. In many region of the world, women spend up to five hours per day on collecting fuel-wood and water, and up to four hours to prepare food (FAO, 1996.a). Regarding women's role in household food management, it is worth mentioning here a saying of a Bangladeshi woman quoted by Rizvi (1983). " It is getting dark, time for my husband to get back from work, and the children are asking for food, but I don't have any rice for the next meal. I have already borrowed yesterday form X. I don't know whom to app to app. I am really embarrassed to do it". Khare (1984) in his study on women's role in domestic food acquisition and food use in the

northern India has explained that women not only distribute cooked food but also control food waste and manage food storage, which has direct impact on household feeding management. A woman allocates her time and energy on food management, cooking and feeding according to the household circumstances and its priorities. In addition, rural women provide most of the labor for farming, from soil preparation to harvesting, storage, handling and processing. A woman's economic, biological and social roles cause conflicts when resources are inadequate. If food is inadequate, she must allocate it among family members. As a wife she is supposed to give her husband preference above herself and her children, but as a mother she should feed her more vulnerable children (McGuire and Popkinhe, 1988).

Many controversial statements can be found in many pieces of literature that whether women managed households are more prone to food deficit. Allen and Thopsom (1988) had concluded that the female headed households are significantly more likely to be in poverty than those households headed by the male. Although, many female-headed households are poorer than their male counterpart, there is impression that household food security and nutritional status of individual member in the household is significantly better in household headed by women (Kennedy and Peters 1992). Contrary to the above statement, the same authors in their study on households' food security and child nutrition in Malawi and Kenya have found higher calorie intake in male-headed households compared to female-headed households. Despite their findings, they have argued citing Von Brawn *et al.* (1991) that keeping household income constant, female managed households consume more calorie intake than male managed households. Similar argument is found in Kennedy and Cogill (1987) stating that children from the female-managed household consistently have better nutritional status. The logic behind this proposition has been explained as the higher proportion of women's income is spent on food compared to the income of their male counterpart. FAO (1989) reported that compared to men's spending pattern, women spending tend to be more on basic food supply. Appleton (1996) has, however, argued that when analyzing household welfare in

terms of consumption expenditure it does not significantly differ by the gender of household head but by the size of household. He found that the mean private consumption per capita was identical both in men-headed and women-headed households.

2.4 Household food security and ethnicity

Ethnicity and culture has great influence on household food production and consumption in the rural area. Therefore, their agricultural production and consumption behavior might have been influence by the ethnic value and culture. Khare (1984) in his study in Northern India has found that *Brahmin* households had higher income and better living with smaller family size when compare with the schedule caste. Similar results has been reported by Conlin and Falk (1979) in the eastern hills of Nepal, indicating that *Brahmin/Chhetri* have better living standard and access to resources than other ethnic groups. Blakikie *et al.* (1980) in their study in the western hills of Nepal reported a serious problem of declining food grain among the occupational caste groups, particularly leatherworker and tailor whose critical amount of food grain used to come from the obligatory payment (Locally called *Bali*). This situation has obliged many leatherworkers, tailors, and blacksmiths to become either laborers and/or porters (ibid.) for which they are not accustomed. This has virtually led to decreasing labor-productivity and access to food among the occupational groups of people.

2.5 Household food security and technological change

IFPRI (1989) research results has explored the mechanism that influence household food and nutritional security associated with technological change. It focussed on identifying those intermediate factors that affect nutrition and food security. Those included were land tenure, access to inputs, extent of off-farm employment, women's workloads etc. In many cases it was found that even when the agricultural technologies

had improved, the food and nutritional security did not improve because of deterioration of those intermediate factors. Adoption and adaptation of agricultural technologies are important to improve agricultural production, which ultimately improve the income level and the household consumption. Von Braun *et al.* (1989) in their study on irrigation technology and commercialization of rice, and its effects on income and nutrition reported that adoption of modern rice varieties increased per capita food production and income, and the additional income generated by the poor households translated into more food energy consumption and improvement of nutritional level. They also argued that any additional income regardless of sources of income equally expended on food and non-food consumption. Therefore, under the market accessible condition, in order to alleviate rural poverty and food insecurity through agriculture-based program, it is not necessary to be limited to food crops but need to focus on the most effective way of promoting income growth among the rural poor (ibid.). On the other hand, Kennedy and Cogill (1987), and Von Braun *et al.* (1989) in their separate studies on effect of agricultural commercialization in income and nutrition reported that transformation of traditional agriculture to cash oriented agriculture has increased the income level of the farm household, but expenditure in food consumption increased less than non-food expenditures. Increased in food expenditure from additional income was at decreasing rate and was relatively less than expected.

2.6 Household food security and access to productive resources

Access to productive resources like land and livestock, and off-farm employment opportunities are the key to identifying food security status of households in the rural areas. Land holding is important factor determining the total household production and consumption. Tschirley and Weber (1994) reported that land area cultivated is the principal determinant of calorie production and has positive or neutral effect of off-farm income and cash crop income on household food security. Livestock on the other hand are important from the households' income as well as household dietary diversification

point of view. Small livestock, which are often raised with small investment by feeding with household scraps are important source of cash and food, and are therefore considered important from the perspective of hedging against cash and food insecurity. Results from a study in Ecuador showed that at small-scale level, guinea pigs, which have very short reproductive cycle and fast growing were a more economical source of meat than pigs and cattle (FAO, 1984).

Livestock is one of the major forms of wealth and investment in the rural societies in the developing world, and is the major determinant of agricultural productivity in the subsistence farming (Castro *et al.*, 1981). It plays important role in farming systems in the developing countries: providing food, income, power, manure, and a means of disposing unwanted crop residues (FAO,1996.b). In other way, we can say livestock as an important means of converting other unused vegetation and crop by-products into high value milk and meat (FAO,1996.c). Citing the study results of Colclough and Fallon (1979) from Botsawana, Castro *et al.* (1981) stated that in the rural community, most of the total household income came from the contribution of animal. This Study had concluded that cattle ownership is the key determinant of total household income through: (a) increased income due to the total returns from animals; and (b) increased income form other sources made possible through cattle, e.g. increased area of cultivation, and increased agricultural productivity. Therefore, Livestock make an important contribution to the household food security directly providing animal food and indirectly through income generation and supporting crop production systems. FAO (1996.b) has clearly stated importance of livestock at farm level, characterizing livestock as liquid assets, a hedge against inflation, a means of reducing risks associated with crops, a source of regular income, a source of sporadic income, a source of power and an opportunity to increase off-farm employment.

2.7 Income and household food security

Income is often considered as the most influential economic factor affecting consumption. Consequently, higher income households have greater range of choices, and consume higher quality and quantity of food than do the poorer households. Diversifying income may reduces the risk to the household of any one source (Bilsborrow, 1991). Explaining the effect of increased income on food expenditure, De Vega and Fisher (1993) have described the Engel's law. As the income increases, the proportion of expenditure on different items in the budget changes, and the proportion to basic need (food for example) decreases and the higher proportion of budget goes to services and other non-food items. However, to the certain level expenditure on the food items increases as the income increases, since at the low economic level, demand for food is income elastic. Von Braun *et al.* (1989) and Kennedy (1983) reported that effect of increased income level had significant contribution on calorie availability at household level.

Non-agricultural sources of income are important to enhance food security as they increase the household's access to food. Among the poor households non-farm income sources are considered as the main sources of livelihood and are undertaken for sheer survival (Castro *et al.*, 1981). Non-farm income may also be an important source of capital, which can be invested in agriculture. Non-farm jobs like school teachers, government official and other officials are important not only from cash earnings point of view but also to increase individual access to information (ibid.). Von Braun (1995), however, argued that non-farm employment is not a panacea of poverty reduction and food security, it should be combined with the increasing labor productivity and assets generation (for example land improvement infrastructure) through utilization of technology.

2.8 Poverty and household food security

The link between poverty and food insecurity often found in many literatures, and the problem of food insecurity is almost always entangled with the poverty. Poverty analysis particularly in the developing world basically deals with income, consumption, and nutrition based on the notion of minimum income requirement to attain minimum calorie intake, below which the poor are classified as ultra-poor (Lipton, 1983 cited in Reardon and Vosti, 1995). Food insecurity and poverty are widely prevalent in those areas with unfavorable land like up-land condition for increasing agricultural productivity. The green revolution technologies were able to increase supplies of food grain only in the favorable climatic condition with sufficient irrigation infrastructures. Therefore, people living in the rainfed condition could not harvest the benefit of green revolution technologies. The situation has further aggravated by increasing population growth and dwindling natural resources coupled with lack of purchasing capacity and alternative opportunities for productive employment. As the demand for food grew with increased population, many developing land-scarce countries like Nepal, found difficulties to sustain the gain that they have made in achieving food security in the past (Hossain, 1995)

Poverty is the major determinant of household food insecurity. The poor do not have adequate means to secure their access to food. Increasing incomes of households can improve the food security status (Von Braun *et al.*, 1996). Therefore, Sen (1987) as cited in Hossain (1995) has emphasized the importance of people's purchasing capacity to ensure food security. He added, although, food may be available a segment of population might not have capacity to acquire it because of lack cash which is magnified by the lack of employment opportunity, low labor productivity, low wage rate, and finally the low level of income. Many rural poor households, therefore, diversify their income sources by spreading their labor time from own farm farming to seasonal or long-term off-farm and non-farm employment as part of their survival strategy.

2.9 Seasonality in household food security

Seasonal variation in the household consumption pattern can be found especially in the rural poor household. Amar-Klemesu *et al.* (1995) in their study on household food security and food consumption pattern in the rural community of Ghana stated that per capita calorie intake was lowered just before the harvest season and was increased just after harvest. Describing the seasonality of food insecurity among the poor under the subsistence farming, Nabarro (1984) explains quoting Longhurst and Payne (1978) "towards the end of the dry season the poorer people, who may have no land or small plots and/or weak family labor, begin to suffer than others. They have less food because they have been able to grow less, have fewer livestock and less money. They may eat less to save food for crucial time of cultivation". The ways in which the poor deal with seasonal fluctuations are diverse. During the pre-harvest season when resources are depleted, the poor may sell off their assets to buy food, and seasonal migration might be the another way of dealing seasonal food scarcity (IFPRI, 1989)

2.10 Forestry and household food security

Although own farm production always has been the mainstay of household food supply in many developing countries as it is a part of tradition and culture in the rural area, contribution of forest is also important from the household food security perspective. "Forests play crucial role in food security as they are the veritable source of biological diversity, and forest products are the mainstay of households worldwide" (FAO, 1996.d). Forests contribute to the diet of the forest dwellers and many others who live far from the forest. For the rural poor with little land or no land, forests may provide the main source of cash income. Jodha (1996) in his research results on common property resource management in India has explained that dependency of rural poor on the forest for fuel-wood, employment and income is quite higher than non-poor. Forest products like nuts, fruits, mushroom, rhizomes and leaves etc. are important sources of

food supplement in the rural areas and it is particularly important during the seasonal shortfall of food (FAO, 1989). Falconer and Arnold (1991) stated that other than direct contribution of forest product to household food supply, forests also contribute indirectly to the poor household through income and employment generation. The most direct link between forestry and food security is the food items produced by the forest trees; huge arrays of edible foods as the supplement of staple foods are gathered from the forest. In addition, forests play important indirect role in food security through improving soil fertility and supplying fodder and forage to the livestock (FAO, 1989). A great deal of works done in the past has made clear the important linkage between forest and food security, however, the nature of dependency on forest varies from place to place (Lonhurst, 1991). Wide range of people are dependent on forest food, but among those the most dependent on forest for food are the poor and land less (ibid.). A study carried out in a remote village near the forest with insufficient rice production in the North East of Thailand revealed that forest as the main source of vegetable and ranked as the second major source for animal food. In terms of total food quantity excluding the staple food rice, the forest was the main source of food, followed by the household production (Saowakontha *et al.*, 1991 cited in Lonhurst, 1991). Albeit, assessment of forest contribution to the overall households food supply is not easy to measure as forest food are gathered whenever and wherever available. Emphasizing the diversity of forest products and their role in food security, Lindsrrom and Kingamkono (1991) have explained that although, little information exits on the seasonality, frequency, amount and quality of forest foods consumed, their diversity alone plays significant role in supplementing the diet of certain population. Consumption of forest food increases palatability of bland staple food. Forest foods for example berries, nuts, and leaves make significant contribution on resolving specific nutritional deficiencies. Mostly the local inhabitants of forests consume such foods particularly in the food deficit period (ibid.). Therefore, importance of forest foods is greater amongst the poorer section of the society during the agricultural lean season.

2.11 Home gardening and household food security

Homestead garden adjoining the dwelling unit plays important role in the household food security. Homestead production system is generally considered as a subsystem of the whole agricultural systems aiming at producing fruits and vegetables for household consumption. Homestead gardens are highly intensified with large number of plant species, which provide households with multiple sources of food and nutrition. The products of homegardens are usually consumed in the households and the excess is often sell in the local market. Therefore, homegardens are considered as important source for both household nutrition as well as cash income (Thrupp, 1998). Falconer and Arnold (1991) emphasized the important role the homestead gardens played in household food security giving the example of Java in Indonesia, where about more than 40 % of the total calorie intake are supplemented from home garden in some areas. Abul Salam *et al.* (1998) has reckoned that the home gardens in the Kerala in India with multi-stories cropping have multi-purpose: food, fodder, fuel wood, organic mulch etc. Home gardens are often combined with the livestock rearing, where the system components interact synergistically to sustain productivity (ibid.).

CHAPTER III

RESEARCH METHODS

Household is a basic economic unit of production and consumption. The economic activities undertaken at the household level are objectively related with maximization of household's welfare at the aggregate. It is, therefore, important to analyze household level information in order to address the micro level food insecurity problem. 'Household' here is defined as groups of individuals residing together, pull all or most of the income and resources, and basically shares the same food (Guenat, 1991). Therefore, in the household level analysis existence of joint utility function is generally assumed (Pitt and Rosenzweig, 1985 cited in Senaur *et al.* 1988). Furthermore, it is of general presumption that income comes to the household as a whole, and resource allocation decisions are done at the household level at the best to maximize the households welfare, which finally determines the individual level welfare (Thomson and Metz, 1997). Therefore, individual level food security is largely determined by the household food security.

Household food system in the rural areas is complex and intertwined among many farm and non-farm components (Figure 3.1). The complexities in the food production and consumption have therefore led farmers to adjust their farming strategies to meet the basic households' needs. Relative contribution of different farm and non-farm components aggregates the household food supply and interrelationship among the system components determines household's food strategies. Therefore, the present study has been designed with the concept of assessing aggregate food availability at the household level in relation with available resource base. Basically household food security is defined using two different approach: nutritional approach and economic approach (Levin, 1993). The nutritional approach concerns with the anthropometric analysis (biological), whereas the economic approach deals with production, availability and access to food (food entitlement). This study primarily focuses on economic aspects

of food security analysis through system perceptive taking into account the aggregate food availability from different sources.

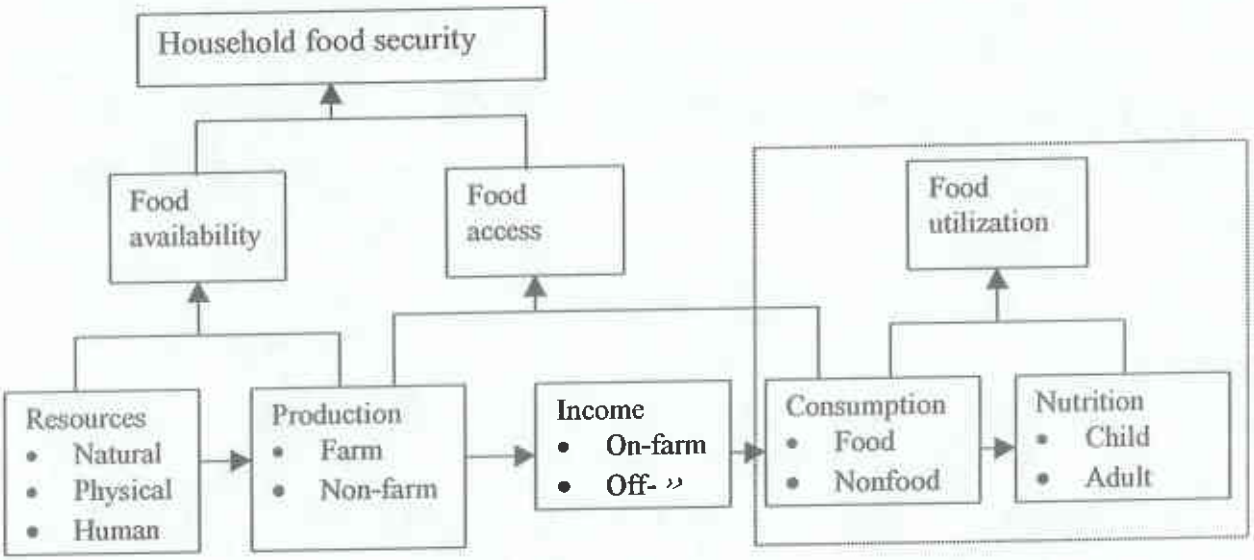

Figure 3.1. A conceptual framework for household food security analysis

3.1 Selection of study area

This study was carried out at Fakchamara outreach research site of Pakhribas Agricultural Center (PAC) that represents subsistence farming system area without access to road and market in the mid hills of eastern Nepal. This site was selected by the PAC in 1996 in order to carry out outreach research activities. PAC, under the auspices of Nepal Agricultural Research Council (NARC) has been designated as the research center responsible for developing appropriate agricultural technologies to the eastern hills farming systems. The center, therefore, undertakes multidisciplinary agricultural research and development activities addressing the problem of eastern hill farmers. Fakchamara is one of the outreach research sites of the center established to carryout on-farm trials and action oriented outreach research activities. This site covers about 650

households with multi-ethnic communities and is situated at an elevation range of 1100-1700 masl.

3.2 Sampling technique

Given the noticed differences among different households resources entitlements, stratified random sampling technique was administered in order to get representation from each social strata. Household categorization done by PAC in 1997 was used to stratify the sampling population. PAC has identified five different household categories[1] based on the aggregate food availability from own on-farm production. But for the purpose of this study only three categories: food surplus, food balance and food deficit were used merging categories C and D into one category, as they have somehow similar resource base. Owing to only five households and their sustenance entirely based on off-farm and non-farm laboring, category E (landless) households were excluded from the sampling frame.

3.3 Sample size determination

In household survey particularly dealing with production and consumption, information collected from the household might have both sampling and non-sampling error. To minimize the sampling error, standard sampling design suggested by Parel *et al.*, (1977) was employed. After stratifying the sampling population, total sample size was determined by using the Neyman allocation equation, assuming that stratum variance

---

1

Category A = Food produce more than household requirement (food Surplus)
Category B = Food balance in the normal season. May produce surplus if harvest is boom and face deficit if poor harvest (food balance)
Category C= Food insecure from less than six month (moderately food deficit)
Category D= Food insecure more than six month (severely food deficit)
Category E = Land less
(Source: Joshi *et al.* cited in Sharma *et al.* 1997).

of the key determining variable varies from stratum to stratum. The total sample size was therefore determined by using the formula:

$$n = \frac{(\sum N_h S_h)^2}{\frac{N^2 d^2}{Z^2} + \sum N_h S_h^{\,2}} \quad \text{----------} \quad (3.1)$$

Where

n = total sample size,
N_h = total sampling household unit in each stratum,
$S^2{}_h$ = variance within the stratum
d = the maximum error deemed acceptable, and
Z = standard normal variable.

After getting total sample size, the sample size by each stratum (n_h) were determined using equation:

$$n_h = \frac{N_h S_h}{\sum N_h S_h} . n \quad \text{----------} \quad (3.2)$$

Since, agriculture is the main source of living in the study area, total cultivating land per household was considered as the major determining variable of household food availability. After getting rough estimation of range of total cultivating land within each category, standard deviation within the category was roughly estimated deflating the range by four as a thumb rule. Employing the above equation (3.1) the total sample size of 135 was determined, and the sample by each stratum was determined by using equation (3.2). From each sampling stratum the required sample households were selected randomly using the random number. The sample size distribution by each stratum is presented in Table 3.1. The equal number of alternate sample was also selected in order to compensate the absentee interviewee.

Table 3.1. Sample size distribution by household category

Household Category	Total households (N_h)	SD (S_h)	variance (S_h^2)	N_hS_h	$N_hS_h^2$	Sample size (n_h)
Food surplus	70	0.84	0.71	58.94	49.63	30
Food balance	152	0.51	0.26	77.82	39.84	35
Food deficit	431	0.33	0.11	143.00	47.50	70

(Source: Computed from the data source of outreach site profile PAC, 1997)

3.4 Data collection

To obtain necessary information for qualitative and quantitative analysis data were gathered both from primary and secondary source. Primary data were collected combining household survey, key informant survey, group discussions and Participatory Rural Appraisal (PRA). Most of the primary data were collected in the conventional local unit and later converted into metric unit (conversion Table is given in Appendix Table 1). Similarly, relevant secondary information were collected both from published and unpublished documents of concerned government and non government organizations at village level, district level and from the PAC. Different publications from national level organizations, particularly the Central Bureau of Statistics (CBS), National Planning Commission (NPC), Winrock International and Ministry of Agricultural (MoA) were reviewed.

3.4.1 Household survey

Both structured and semi-structured questionnaires were administered to collect detailed household information from the sampled household. Due to the nature of study enumeration was strictly done with the household head who is responsible for overall household management. Questionnaire was exclusively designed in order to acquire all necessary data on household's demography, resources, production, consumption etc. Since the farm households generally do not keep farm record, information collected were exclusivusivsed on respondents' memory recall.

3.4.2 Key informant survey

Knowledgeable persons representing each household category were selected as key informants in order to obtain overall information of the study area. Information on cropping pattern, land use, resource availability, forest situation, food situation, infrastructure development, community welfare etc. were obtained through key informant survey using the checklist.

3.4.3 PRA and group discussion

In order to support the interpretation of the information gathered from household and key informant surveys, PRA exercises were done before and after the household survey. Particular attention was given to explore perceived problems, production systems, technologies, resources, inputs, infrastructures, institutional support, population and ethnic distribution and household food strategies etc.

In order to identify the priority problem associated with food insecurity group exercises were done. Problems identified from the group exercises were incorporated in the survey questionnaire and asked respondents to rank them on the basis of perceived severity of the particular problem. Three points scale 1 as the least severe and 3 the most severe was employed for problem ranking. The aggregate score of each identified problem was calculated multiplying the number of responses on each problem by the severity scale and adding them up.

3.5 The quantitative analysis

3.5.1 Household food availability model

In order to identify the key determining variables on household food availability, a linear regression model was designed incorporating food availability for consumption as the dependent variables and some pre-determined resource and demographic variables

as independent variables. Using age and sex as reference household members were converted into adult equivalent scale (Appendix Table 2). The net food availability for consumption in terms of Kilocalorie per adult equivalent (AE) per day was derived using disappearance equation (modified from Tschirley and Weber, 1994):

$$Ka = Kp - (Ks+Kd+Kl+Kr+Kpl) + (Ko+Kb) \text{ ----------(3.3)}$$

Where

Ka	=	Net calorie available for consumption per AE per day
Kp	=	Calorie produced
Ks	=	Calorie sold
Kd	=	Calorie used for seed
Kl	=	Calorie paid in kind to hired labor
Kpl	=	Calorie post harvest loss
Kr	=	Calories paid for religious and social obligations
Ko	=	Calories received in kind from off-farm work, and
Kb	=	Calories purchase

Standard conversion table was used to calculate the calorie conversion from different food products (conversion Table is given in Appendix Table 3). After getting net calories availability per AE per day for consumption, it was regressed against predefined explanatory variables. The resulting coefficients of the regression were used to interpret relative contribution of each variable included in the model on net food availability in order to draw empirical conclusion.

The model:

$$KCAL\_AE_i = \alpha_i + \sum \beta_i X_i, + \delta_1 D_1 + \delta_2 D_2 + u \text{ ---------- ----------(3.4)}$$

Where $KCAL\_AE_i$ is calorie availability per AE per day at the ith household, α_i is the constant term, X_i represents a vector of explanatory variables ((AGEHH, LNDSZ_AE, TADOPT, LSTUNIT_AE, ACTIVE SHEAFM, CASHREV_AE) to be defined latter. D1

and D2 represent dummy variables for literacy of household head and ethnicity respectively. The stochastic error term is defined by 'u'.

Definitions of the variables used in the model

LNDSZ_AE (Cultivated land holding per AE)

Land is one of the major factors of production. Many empirical studies shows that in an agricultural based economy, the total area of cultivating land has significant contribution on overall food production and income. All type of cultivating land privately operating by the farm household is therefore included in the model, and was expected to have positive effect on calorie availability per AE per day.

CASHREV_AE (Cash revenue per AE)

Incomes from different sources are generally used to purchase food and other necessary items for the household needs. Cash revenue earned from different sources including transfer money (remittances and pension) was therefore been taken as an important factor determining household food production and consumption. In this model, aggregate cash revenues per AE earned from both on-farm and off-farm sources was used as an explanatory variable and was expected to have positive effect on food availability.

TADOPT (Adoption of modern varieties of cereal)

Adoption and/or adaptation of agricultural technologies play important role in the total agricultural production. Adoption of major cereal crop varieties (improved varieties) was used to calculate adoption index, assuming that household adopting higher number of cereal crop technologies produces higher food. Varieties recommended and

widely adopted in the mid hills farming were taken as available technologies to construct an aggregate adoption index (I_i):

$$I_i = \sum_{i=1}^{n} \frac{Ta_i}{Tr_i} \times 100 \text{----------} (3.5)$$

Where Ta_I is the number of improved varieties adopted by the sample household in i^{th} crop, and Tr_i is the number of improved varieties recommended for the ith crop

LSTUNIT_AE (livestock holding)

Livestock is the integral component of Nepalese hill farming, which is considered as the major source of cash, food, draught power and manure. Furthermore, livestock in the rural area are considered as liquid asset and a means of hedging risk against cash insecurity. Agricultural productivity, particularly in the subsistence farming heavily depends on livestock. Therefore livestock holding per AE was included in the model and was expected to have positive relation with net calorie availability for consumption per AE.

SHEAFM (ratio of economically active female household member to the total household size)

Women's roles particularly in developing countries is considered the most important for the household food security and overall household welfare. It is recognized in many literature that women's roles in the rural households generally revolve around food production and consumption ensuring food and nutritional security in the household (Agnes *et al.*, 1995). Therefore, proportion of economically active female household member to the household size was used as a proxy variable to understand the women's contribution in household food security, and it was expected to have positive relationship with food availability.

ACTIVE (Number of economically active household members)

The total number of economically active household members is important for agricultural production and off-farm income earnings. In this study number of households member above 10 years and below 65 years of age were considered as economically active member and was expected to have positive effect on household food availability.

AGEHH (Age of household head)

From the household's resource management point of view age of household head is generally considered important, as it reflects the experiences in the resource management and maximization of household welfare. Positive relation of age of household head on food availability was therefore expected in the model.

3.5.2 Aggregate food security index

The aggregate food security situation of the study area was assessed using the aggregate household food security index (AHFSI) developed by the FAO. (Thomson and Metz, 1997). The AHFSI was calculated using following equation:

$$AHFSI = 100 - [H\{G+(1-G)I^P\}+0.5\,\Omega\,\{1-H[G-(1-G)I^P]\}]10 \quad (3.6)$$

Where

H is a head-count of the proportion of the total undernourished population.

G is a measure of the extent of the food gap of the average undernourished shortfall in dietary energy supply from the average requirements for dietary energy.

I^P is a measure of inequality in the distribution of the individual food gaps of the undernourished, based on the Gini coefficient

Ω is the coefficient of variation in the dietary energy supplies , which gives the probability of facing temporary food shortage.

In this study food security status was identified on the basis of household dietary energy adequacy ratio (HDEAR). The HDEAR is the ratio between average food available for consumption in terms of calorie and the average household's calorie requirement expressed in terms of adult equivalent. Taking subsistence requirement of 2,500 calorie per AE per day, households were classified as food-secure, marginally food-secure and food-insecure, if HDEAR is ≥1.0, 0.80-0.99 and less than 0.80 respectively.

3.6 Data analysis

Data collected using various methods were compiled, variables quantified and classified. After checking the consistence, data analysis was done using SPSS and LIMDEP statistical packages. Both inferential and descriptive statistical methods were employed to analyze the data. Descriptive statistics like average, frequencies, indices, and graphs and charts are used to present the results. Variance, mean differences, regression and correlation analysis were used as inferential statistics.

As land holding was considered cross-cutting variable to stratify sample, for the comparative purpose distribution inequality of land was represented by Lorenz diagram and its associated Gini coefficient. The Lorenz diagram is obtained by plotting cumulative percentage of number farms with respect to and the cumulative percentage of area. The Gini coefficient is the proportion of area between diagonal and the Lorenz curve to the area of whole triangle in which the Lorenz curve lies (Casley and Lury, 1982). The Gini coefficient lies between 0 to 1, implying the higher the ratio the greater the distribution inequality.

3.7 Scope and limitation of the study

This study focused particularly on household level food security defined in the broader term of agricultural products, assuming household as a basic unity of production and consumption. Household, therefore, was taken as a central unit of analysis for this study under the assumption that all members of household share the same pool of resources and have common interest of overall household welfare. Therefore, intra-household food distribution and anthropometric analyses were beyond the scope of this study. This study represents subsistence farming area without access to road and market in the eastern mid hills of Nepal, which may not represent the whole hill farming systems of the country. Subsistence farming in this study is defined as a farming system with no interaction or negligible interaction with market, and the production decisions are entirely based on household consumption needs. Information for this study were collected mainly from household survey, which are generally subject to respondent bias. As farmers do not have practice of keeping production and consumption record, quantitative data collected for study were based on the memory recall of the respondents. Therefore, the empirical results from this study should be taken as an indicative more rather than definitive.

CHAPTER IV

STUDY AREA AND ITS RESOURCE BASE

Resources availability determines the economic behavior of individual household. Therefore, assessment of household resource is importance from the perspective of household food security analysis. This chapter addresses the present situation of resources availability and their distribution pattern in the study area. Moreover, study site description and climatic condition are also discussed in this chapter.

4.1 Location of study area

Fakchamara outreach research site of PAC is located in the southwest of Terhathum district head quarter, Manglung Bazar. The site consists of twelve wards of four Village Development Committees (VDCs) namely Fakchamara, Okhre, Panchkanya and Hamarjung (Figure 4.1). PAC scientists and farmers' representatives had done delineation of outreach site boundary at the time of outreach site selection in 1996. Since, the site represents low production potential area without road and market access, agricultural production systems in the study site presumed to be subsistence in nature. The site covers about four per cent the total area of the districts (PAC, 1997) and is situated at five-hour walking distance from the road head.

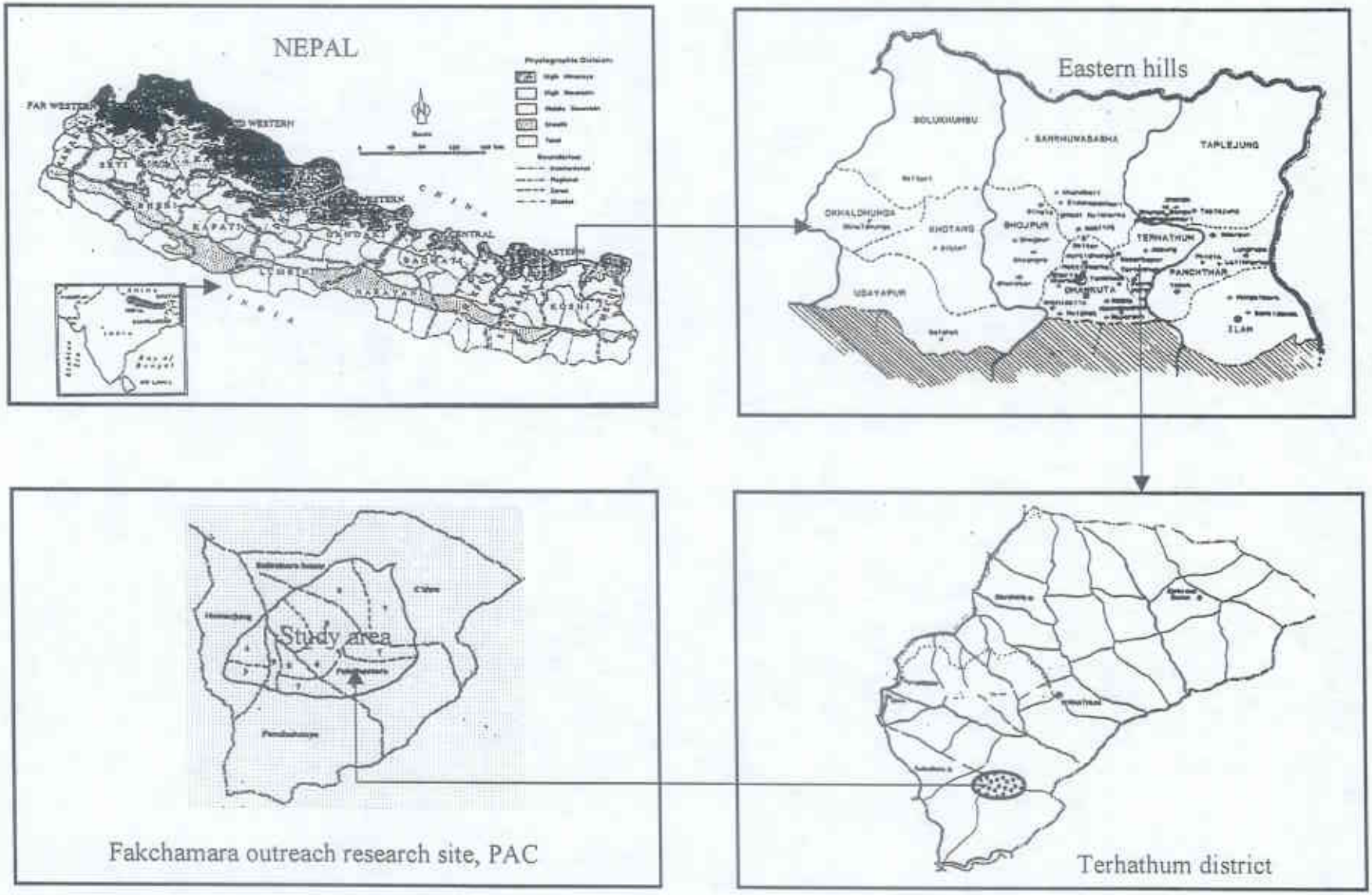

Figure 4.1 . Map showing study area

4.2 Climate

The study area is characterized by the sub-tropical to mild temperate climate with rainfall concentration in the monsoon season, however, rainfall distribution may vary with aspect and elevation. The temperature displays seasonal variation; the coldest month is January and the warmest is June. Difference between maximum and minimum temperature is smaller during the warm season but the temperature tends to vary largely in the winter. Moreover, the maximum temperature does not fluctuate as much as minimum throughout the year (Figure 4.2). Because of monsoonal climate, rainfall distribution shows almost unimodal pattern concentrating about 80 per cent of the total rain during April to August. This area receives relatively lower rain than other parts of the eastern mid hills.

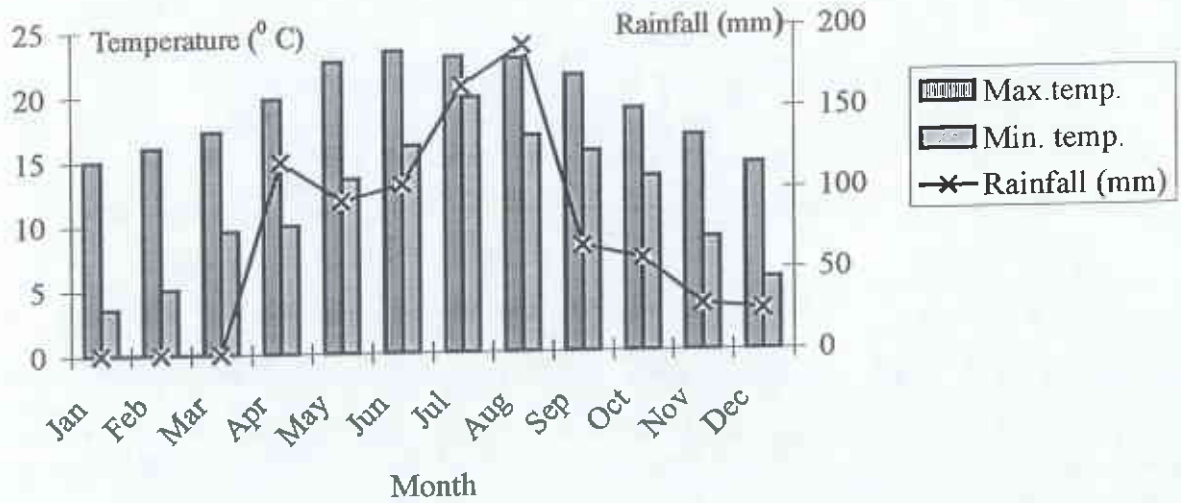

Figure 4.2 Average monthly temperature and rainfall of the study area, 1997
(Source: Meteorological record of PAC outreach site, Fakchamara)

4.3 Resources

4.3.1 Land resources

The study site covers about 2,184 ha of land, which accounts about four per cent of the total landmass of the district. Of the total land area about 54 per cent is cultivable land and rest 46 per cent consists of forest, rock, river etc. (PAC, 1997). Cultivation is done on the carved terrace made across the slope of the land. The total cultivating land consists of 409 ha *Khet* land, 430 ha *Bari* land and 334 ha. *Pakho* land. *Khet* land is considered the most preferred because of its high transactions and producing paddy rice, the most preferred staple food crop. Of the total *Khet* land, only about 18 per cent is fully irrigated and the remaining is either rainfed or partially irrigated (Figure 4.3). Irrigation increases value of land due to secured production potential, and therefore, preferences over such land are found higher. *Bari* land on the other hand is used for maize and millet cultivation during the summer and rainy season respectively. The *Pakho* (less fertile marginal land) lands, however, remain either fallow after the maize harvest or some minor crops are sown. Production of paddy rice heavily depends upon water availability and water retention capacity of the land. Many *Khet* lands particularly in the mid attitude remain fallow for the whole winter because of the lack of irrigation.

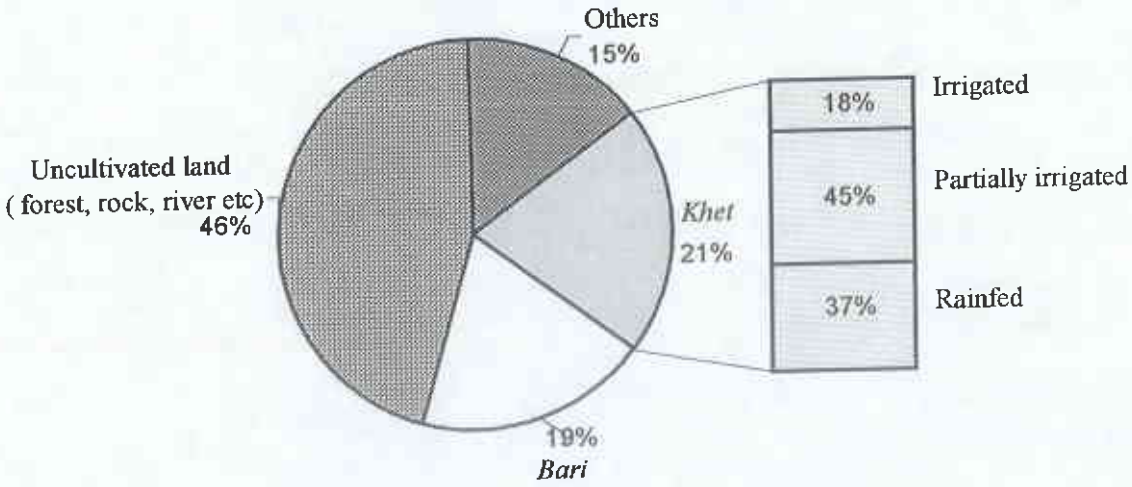

Figure 4.3 Land use pattern of the study area
(Source: PAC, 1997)

4.3.1.1 Land distribution

Assessment of land distribution pattern is an important aspect of analyzing subsistence rural economy where the maximum population are getting their livelihood from agriculture. The average size of cultivating land holding including own land and rented-in land per household in the study area was found 1.50 ha with the maximum of 5.5 ha. to the minimum of 0.20 ha. Most of the farms in the study area, however, were found in between of 0.51-1.50 ha. Farm size distribution was found moderately skewed. About 33 per cent of the farm households are operating only about 12 per cent of total cultivating land, and in contrast, 22 per cent of farm households are holding about 44 per cent of the total cultivating land. Furthermore, land distribution inequality when calculated in term of Gini coefficient and presented in Lorenz curve (Figure 4.4) shows that land distribution pattern in the study area is not in favor of small and marginal farm households.

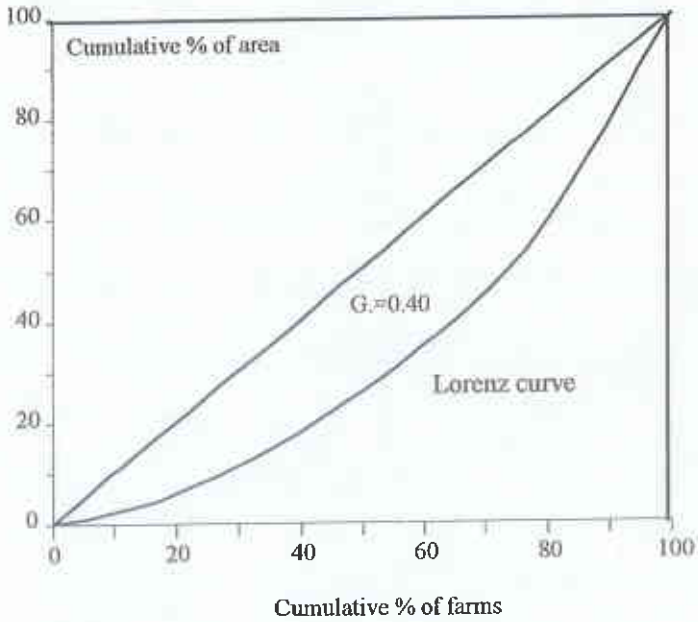

Figure 4.4 Lorenz curve showing land distribution pattern

(Source: Survey data, 1998)

4.3.1.2 Land tenure

A major portion of the total cultivating land in the survey area belongs to owner cultivators. However, it was found a common practice of both renting in and out lands by the same household, which is basically determined by the type of land owned, distance from the house and the family labor availability. In other words, the same household may rent in some parcels of land, and at the same time may rented out some other parcels. Nevertheless, *Khet* land renting is more common than other types of land. It was found that of the total sample households about 24 per cent have rented-in *Khet* land with the average area of 0.67 ha; whereas in the case of *Bari* land it was only 12 per cent with the average size 0.31 ha (Table 4.1). Similarly, among the sample households the average area and the number of households renting out the *Khet* land were found higher than that of *Bari* land renting out. This scenario further justifies higher transaction of the *Khet* land in the study area.

The normal share cropping system (*Adhiya*) was found widely accepted practice of land renting. However, mortgage and contract in fixed cash or kind (*Thekka*) were also found in practice. Under the share cropping system, 50 per cent of annual crop output should be given to the landowner as rent. In most cases the tenants themselves pay for all kind of inputs cost, but in some other cases the landowners may share seeds and fertilizers. The tenancy conditions are, therefore, subject to the social relationship between the tenant and the owner. The major problem related to land tenancy was that none of the tenants have written tenancy right certificate. Since those land can be taken back by the owner at any time, tenants obviously do not have any incentive to invest on the land, and hence land improvement is curtailed resulting in lower production and productivity

Table 4.1 Rented-in and out of *Khet* and *Bari* land in the study area by farm size category

Farm size (ha)	No. of households	Rented-in *Khet* (ha)	Rented-in *Bari* (ha)	Rented-out *Khet* (ha)	Rented-out *Bari* (ha)
≤0.50	17	0	0.13(11.7)	0	0
0.51-1.0	27	0.39 (33.3)	0.20(7.4)	1.22(7.4)	0
1.01-1.50	36	0.54 (27.7)	0.38(19.4)	2.48(11.1)	0.62(5.5)
1.51-2.0	26	0.61 (23.1)	0.32(7.6)	0.91(19.2)	0.60(3.8)
>2.0	29	1.29 (24.1)	0.32(6.8)	2.17(17.2)	1.10(6.8)
Total	135	0.67 (23.7)	0.31(11.8)	1.60(14.8)	0.86(4.4)

Note: Figures in the parenthesis are the percentage of the households of the respective farm size category

(Source: Survey data, 1998)

4.3.2 Ethnicity

Eastern hill of Nepal is inhabited by a number of different social groups of people classified by the ethnicity. Indo-Aryan (*Brahmin/Chhetri*) and Tebeto-Burman (particularly *Rai* and *Limbu*) groups are in the predominant number. Traditionally, study area belonged to Limbuwan (Historical territory of the *Limbu* ethnic group). Therefore, in the study area *Limbu* are in the dominant number (43 %), followed by *Brahmin/ Chetri* (35 %), and the remaining are Ocupational (*Damai*, *Kami* and *Sharki*) and others (PAC, 1997). *Limbu* ethnic group is said to be related to the large Magoloid population and are indigenous inhabitant of the eastern hills of Nepal. *Limbu* consists of heterogeneous group of people with distinct cultural rituals. Occupational castes on the otherhand are classified based on their traditional occupations. *Damai* (tailors), *Kami* (Black smith) and *Sharki* (Cobblers) are the major occupational groups of people inhabited in the study area. Although agriculture is the main occupation of all ethnic groups, a large number of households belonging to the occupational castes particularly *Damai* and *Kami* were found dependent on their occupational works to the greater extent for their sustenance. Caste discrimination is not legally accepted; however, the social relations between different castes of people are still found based on the Hindu caste hierarchy.

4.3.2.1 Ethnicity and land size distribution

The land size distribution among the different ethnic groups within the study area was found skewed in favor of *Brahmin/ Chhetri*. More than two third of farm households cultivating (includes own land cultivated plus rented-in land) more than 2.0 ha of farmland were from this group of people. The case was opposite in the occupational castes, where none of the household has more than two hectares of cultivating land (Table 4.2). Three out of nine households belonging to occupational caste in the sample have less than 0.5 ha of cultivating land. *Mangol* particularly *Limbu* are in between *Brahmin/Chhetri* and occupational groups in terms of cultivated land holding. It is

further revealed that the *Brahmin/Chhetri* cultivates about 58 per cent of the total *Khet* land, averaging 0.95 ha per household. This might be the reason for larger farm size holding in this ethnic group

Table 4.2 Farm size distribution by ethnicity

Ethnic group	Farm size (ha)				
	≤0.50	0.51-1.0	1.01-1.50	1.51-2.0	>2.0
	----------No. of sample households----------				
Brahmin/Chhetri	5(29.4)	14(51.8)	14(38.8)	16(61.4)	20(68.9)
Mangol	9(52.9)	10(37.0)	20(55.5)	8(30.7)	9(31.1)
Occupational and Others	3(17.6)	3(11.1)	2(5.5)	2(7.7)	0
Total	17(100)	27(100)	36(100)	26(100)	29(100)

Note: Figures in the parenthesis are the percentages of the column total

(Source: Survey data, 1998)

4.3.3 Demographic resources

4.3.3.1 Household structure

Considering household as a basic unit of production and consumption, member(s) living outside continuously for more than one year were excluded, and guest(s) and servant (s) living in for more than one year were counted as the household member, even though they are not kin to the household. So far as the total number of present household member is concerned, it was found 6 on an average, ranging from 2 to 12 persons per household. However, most of the households (75%) were of 4 to 7 members, and the households with more than ten and less than three members were only about three per cent (Figure 4.5b). Among the 804 total present household members in the sample

households, female population (52.2 %) was about four per cent higher than that of male population (47.8%). This could be due to temporary movement of the adult male household members for jobs and/or higher education in the city within or outside the country. Correlation coefficient between farm size and household size was positive ($r = 0.314$) and significant ($p<0.01$) implying that higher the land holding the greater the number of present household members in the study area.

Taking the dependency definition by Tschirley and Weber (1994) as children below 10 years and elderly above 65 years, the economically active population was defined within the age group of 10-65 years (inclusive) irrespective of sex. The average number of economically active member per household was 4.1 with the minimum of 2 to the maximum of 9 (Figure 4.5a). More than two third households have 3 to 5 economically active members, which shows abundance availability of agricultural labor force in the study site.

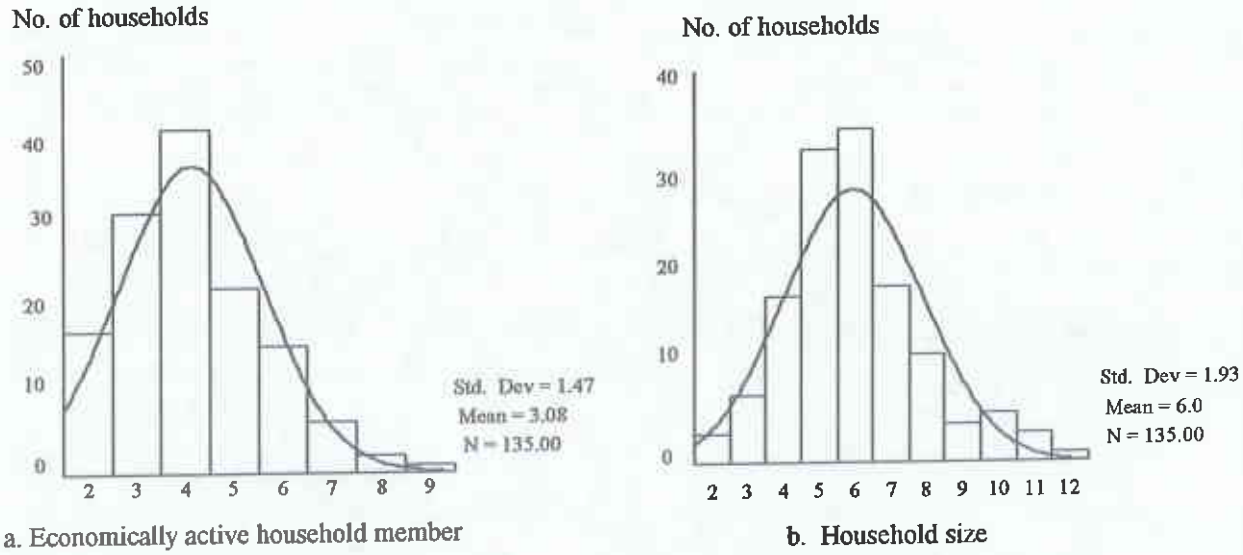

Figure 4.5 Households' demographic structure

(Source: Survey data, 1998)

4.3.3.2 Household structure and farm size

Under the subsistence production systems, farm size has great implication on the sustenance of the farm family. Since the presence of household member in the study area is positively related with the farm size, by virtue of the increased household size, number of economically active household members was also found significantly ($p<0.01$) higher in the larger farm size holders (r = 0.36). Contrary to those figures, household dependency ratio defined by the proportion of children below 10 years and the elderly above 65 years to the total economically active member has negative relation (r = -0.091) with the farm size. Cursory analysis of dependency ratio with respect to farm size revealed that five economically active household members have to support three dependent members in those households having less than 1.5 hectare of cultivating land. Where as in the case of those households having farm size greater than 2 hectares, nine economically active members have to support four members. The results connote that there is higher dependency pressure on land as well as man among small land size holders. Similarly, the land –man ratio calculated in terms of cultivated land (ha) per adult equivalent (AE) found to be 0.34 (Table 4.3) with the minimum of 0.06 to the maximum of 0.97. In other way, population pressure on land when calculated by number of adult equivalent person per hectare of land was revealed that on an average 4.55 AE are depending on one hectare of cultivating land. This scenario indicates a severe population pressure on land in the small farm size holders.

Table 4.3 Demographic structure by farm size category

Farm size Category(ha)	Household size	Land-man ratio (ha/AE)	Economically active member	Dependency ratio
≤0.50	4.8	0.09	2.29	0.59
0.51-1.0	5.3	0.21	2.85	0.52
1.01-1.50	6.1	0.29	3.08	0.60
1.51-2.0	6.5	0.35	3.30	0.48
>2.0	6.6	0.64	3.58	0.44
Overall	6.0	0.34	3.08	0.52

(Source: Survey data, 1998)

4.3.4 Livestock resources

Farming systems in the hills are complex and diverse integrating the major components: crop, livestock and the forest. Therefore, there is virtually an integral dependency of crop production systems and the livestock production systems in the subsistence farming, where agricultural production is almost entirely depends on livestock for manure and power (Chand, 1990). Livestock maintaining in the study area, therefore, has multiple objectives: livestock as a source of food, as a conditioner of crop production systems providing power and manure, and livestock as a sink of utilizing feedstuffs with no alternative use. Furthermore, livestock are considered as a means of handling the crisis since it acts as cushion for relieving foreseen (e.g. slack period) and unforeseen pressures e.g. due to any emergency etc. (Jodha and Shrestha, 1990)

4.3.4.1 Livestock holding

The number of livestock per farm household was found quite high compared to their farm size. More or less all households in the study area have at least one livestock species. The number of species owned by each household ranged from one to six excluding bees, pigeon, rabbit and dog. The maximum number of sample households owned three or more than three animal species, and none of the sample households was found without animal species (Figure 4.6).

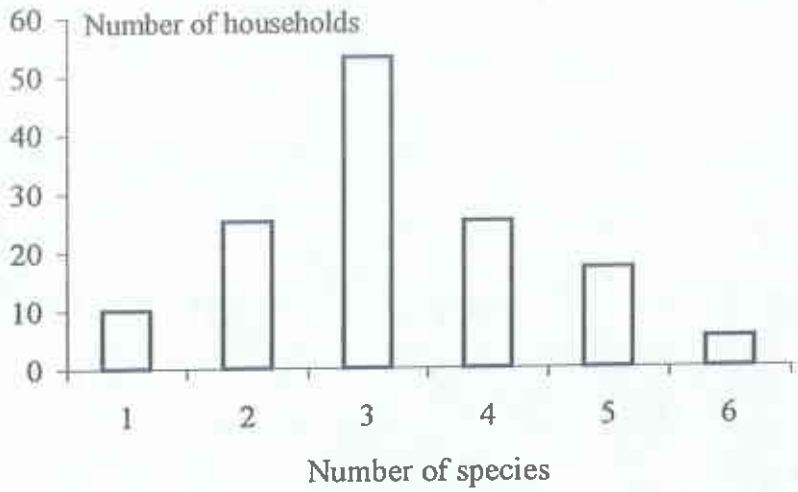

Figure 4.6 Number of livestock species hold by sample households
(Source: Survey data, 1998)

When livestock size in terms of livestock unit (Appendix Table 4) compared with farm size, the relation was found positive ($r = 0.546$) and significant ($p<0.01$). Table 4.4 shows a progressive increase in livestock unit (LSU) with increasing farm size. The average livestock size in the study area was found 3.84 LSU ranging from 0.22 to 10.43. The distribution pattern of livestock in the study area is illustrated in Figure 4.7.

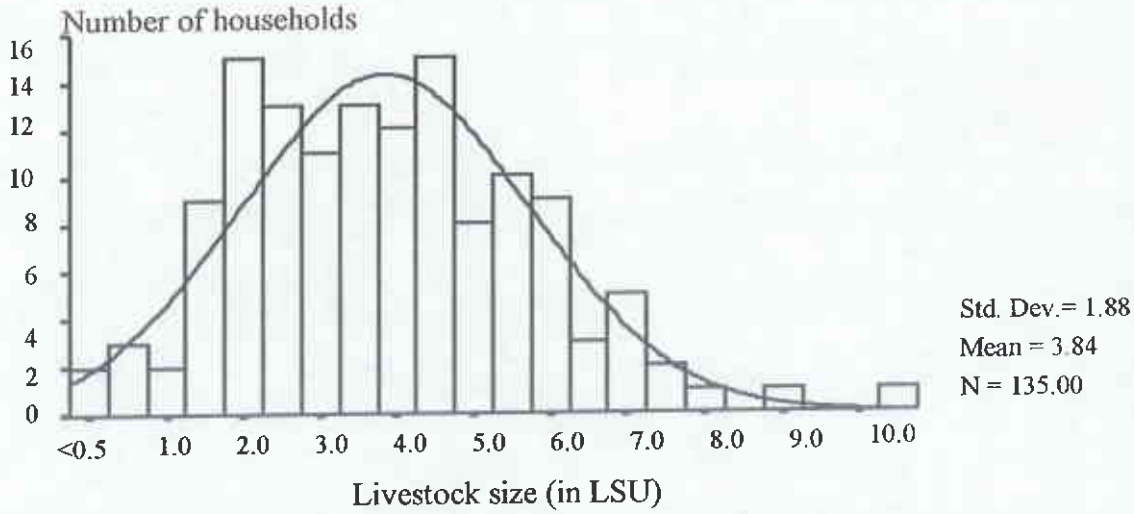

Figure 4.7 Livestock distribution pattern among the sample households (Source: Survey data, 1998)

Livestock production is entirely based on farm production. On an average, one hectare of cultivating land has to sustain about 3.28 LSU, which perhaps could be a higher livestock density with respect to livestock carrying capacity of the cultivating land. Contrary to increasing livestock unit by the increasing farm size, there was a significant ($p<0.01$) inverse relation (r =0 -0.55) of livestock density (LSU/ha) with respect to increasing farm size. This indicates that like population pressure, livestock pressure per unit of land is higher amongst the small land holders, which connotes that even under the limiting resource pressure small farmers are giving more importance on livestock rearing, which might be one of the strategies for their livelihood sustainability.

Table 4.4 Livestock holding (LSU) by farm size category

Farm size category (ha)	Livestock size (LSU)				
	Minimum	Maximun	Std.Dev.	Average	Density (LSU/ha)
≤0.50	0.22	4.35	1.43	1.98	6.58
0.51-1.0	0.52	5.81	1.26	2.98	4.09
1.01-1.50	0.40	6.96	1.72	3.58	2.77
1.51-2.0	1.47	7.56	1.39	4.75	2.71
>2.0	1.90	10.43	1.88	5.21	1.75
Overall	0.22	10.43	1.88	3.84	3.28

(Source: Survey data, 1998)

4.3.4.2 Livestock type

Livestock being an inherent part of Nepali culture, almost exclusively, the farm households in the study area were found maintaining a mixed livestock herd comprising major livestock species like cattle, buffalo and goat. However, very few households have improved (crossbreed) livestock breed. The average livestock holding by livestock species excluding pigeon, rabbit, bees and dog is sown in Table 4.5. The average size of dairy cattle was found 1.35 LSU in 76 per cent of the total sample household, but households owning crossbred cattle were only five per cent among them. Similarly, about 64 per cent farmers have buffalo with the average holding of 1.68 LSU. Sheep are almost absent in the study area, but more than 95% of the sample households were found rearing goat. The encouraging numbers of chicken were found in the study area accounting for 0.13 LSU (i.e. 6.5 adult chicken) per household. There is a distinct variation in the livestock herd composition among the households basically defined by the ethnicity. Since poultry and pig keeping among the so-called higher caste group *Brahmin/Chhetri* was culturally restricted in the past, and even now none of the

Brahmin/Chhetri farm households kept pig in their farmstead. However, in the case of chicken the caste restriction has now been relaxed. Evidently, almost 85 per cent of the sample households owned chicken irrespective of ethnic variation. But on the other hand, pig is considered almost indispensable livestock species for the *Limbu* ethnic group for their religious ceremonies; therefore, almost exclusively *Limbu* households have pig in their farmyard. Having no alternative draught power, farmers are obliged either to keep oxen themselves or hire from the villagers. More than two thirds of the sample households, therefore, owned at least a pair of oxen.

Table 4.5 Average livestock size by type of livestock species

Livestock species	Type and number		LSU
	Improved (x-breed)	Local	
Cattle			
• Adult	1.00(7)	1.27(74)	
• Heifer	1.25(4)	1.32(28)	1.35(103)
• calves	1.45(8)	1.38(75)	
Buffalo			
• Adult	1.06(16)	1.07(58)	
• Heifer	1.00(4)	1.30(17)	1.68(87)
• calves	1.11(9)	1.09(44)	
Pig			
• Adult	1.60(5)	1.47(53)	0.21(58)
• Piglets	3.25(4)	3.22(90)	
Goat/sheep			
• Adult	0	4.34(122)	0.52(129)
• Small	0	3.46(80)	
Chicken (Large only)	0	6.47(114)	0.13(114)
Oxen (bullock)	0	1.88(93)	1.88(93)

Note: Figures in the parenthesis are number of households
(Source: Survey data, 1998)

Despite the larger number of livestock size in the area, apparently there was predominance of low productive local breed. However, the numbers of crossbreed

livestock particularly cattle, buffalo and pig were found increasing. The existing livestock herd structure revealed that of the total livestock number only about 9, 19 and 17 per cent of cattle, buffalo and pig respectively were crossbreed. But in the case of goat, improved breed was found completely absent in the study site. Recently, after the establishment of PAC outreach research site in 1996, the crossed breed *Giriraja*[1] chicken has been found extending gradually.

4.3.5 Forest and pasture resources

Forest is an indispensable component of subsistence rural livelihood systems in the hills of Nepal, providing fuel, food, fodder, litter (bedding materials), and wood for building materials as well as agricultural equipment (poles and ploughs). Therefore, there is micro-level interaction between farm production systems and the forests. Forest directly supports crop production by supplying compost materials and indirectly by supporting farm animals, which provide manure and draught power for crop production. Besides, forest provides protection against soil erosion and landslide. Despite those realized importance of forest and its live interaction with agricultural production systems, a rapid deforestation had occurred during the past three decades, resulting in a marked decline in the agricultural production and productivity (Gurung, 1987; Yadav, 1990).

From the data sources the overall forest areas in the study site sound quite higher than the apparent area observed during the field visit. This might be due to inclusion of uncultivated public land, which might have covered by the forest previously. Therefore, the estimated forest area by the secondary sources may not reflect the exact area existed within the study area. Fakchamara range posts office has recorded about 39 per cent of forest cover within and adjoining villages of the study site (Fakchamara range post's official record, 1997). But from farmers groups discussions it was understood that at present about 20 per cent of the area within the study site is actually covered by the

[1] A dual purpose giant Indian native chicken introduced by PAC and crossed with local chicken

forest, which are scattered into different forest patches. The key informants said that forest degradation in the past was virtually occurred due to ill public policy of taking over the responsibility of forest management from the then *Panchayat* forest management by the government. Due to government control over the forest, principally the forest became as an open access resource as a result of uncontrolled deforestation happened converting a large area of forest into the barren land. The another practical reason for declining forest resources, however, could be the high demand for fuel wood and expansion of farmlands due to increased population pressure.

Because of dwindling access to forest resources particularly fuel, fodder and forest leaves for litter, farm households in the study area are now obliged to keep a patch of their farmland as private forest for their subsistence. Firewood, the only source of energy in the village is getting scarce, therefore, particularly affluent households in the village have now started to install bio-gas plant as an alternative sources of energy. At present about five percent of the sample household have bio-gas plants under the credit assistance of Agricultural Development Bank of Nepal (ADB/N). Although, this technology seems easy and environmentally sound, poor farm households can not afford it unless there is heavy subsidy from the government or other agencies.

Since the inception of community and private forest management policy in the country, significant improvement can be observed in the forest management and protection particularly in the hills (Prasai *et al.,* 1987). The impact of private forest liberalization policy and community forest management has been found encouraging in the study area too. About 35 per cent of the total forest area in the study site at present are under the community management. Those forests, however, were severely exploited in the past and are located far from the community settlement area. Therefore, the economic use of those forests has so far been reported almost negligible for the rural dwellers. The community initiative of managing forests was started too late with regard

to the forest degradation, nevertheless, the forest managed by the community manifest better regeneration in the study area.

Household forestry plays an important role in the sustainable management of forest resources. Looking at the small privately managed forests, a more comprehensive picture emerges of forest resource management. The current forest policy has liberalized privately owned forests, which enhanced the household forestry in this area. Among the 135 sample households, 22 per cent owned privately managed forest with an average area of 0.28 ha. Household managed forests are often small plots and are located adjoining to the farm boundary. Nearly fifty per cent of the lager farm size holder (>2 ha.) have maintained their private forest, but households with less than 0.5 ha cultivating land have virtually no privately owned forest.

In fact, there is no pasture area within the study site. A few small sporadic patches of open areas are available as public grazing land. Most of the available lands in the past were already brought into cultivation. Because of lack of adequate areas for animal grazing, farmers let their animals to graze along the stream and their farm boundary during the summer. But in the winter season, starting after the harvest of main season rice and millet (Nov-Dec) open grazing is practiced, which might be one of the important reasons responsible for minimizing winter cropping in this area.

4.3.6 Water resources

There are no perennial river systems in the study area. 'Telia Khola' (a small parennial stream) in the west of the Hamarjung VDC irrigates some lower parts of this VDC. However, small streams scattered different parts of the village are being used for seasonal irrigation, but their irrigation potentiality are very limited. Sporadic marshy areas (Locally called *Seem*) found particularly in the upper elevations providing in-situ irrigation systems for the main season rice crop. Small natural streams located nearby the community are tapped for drinking water purpose.

4.3.7 Institutions

As Fakchmara area is situated far from the road head and the district head quarter, there are very limited institutional infrastructures within the site. Shukrabare Bazaar located in the north of Fakchmara is the main service center for this area. Agricultural Development Bank of Nepal (ADB/N) has sub-branch office at Sukrbare, which is the only one source for institutional credit in this area. Agricultural Service and Livestock Services Centers (ASCs and LSCs) are located at Sukrabare Bazar and Okhre are responsible for providing technical services on agricultural, livestock and veterinary. A private dealer of Agriculture Input Corporation (AIC) located at Sukrabare provides limited amount of agricultural inputs, particularly the chemical fertilizers. The cooperative society, which was principally established to supply agricultural inputs, small agricultural credit, and to purchase farmer's agricultural product, is almost non-functional. For the last two years PAC has started its outreach research program with its limited area of working, which is confined within the twelve wards of four VDCs (Fakchmara, Okhre, Hamarjung and Panchkanya), where this study was carried out. The PAC outreach program has major two activities: conventional on-farm verification of agricultural technologies, and the action oriented agricultural research and development. The existing network of Government and Non-government organization working in the study area for agricultural and community development is shown in Figure 4.8

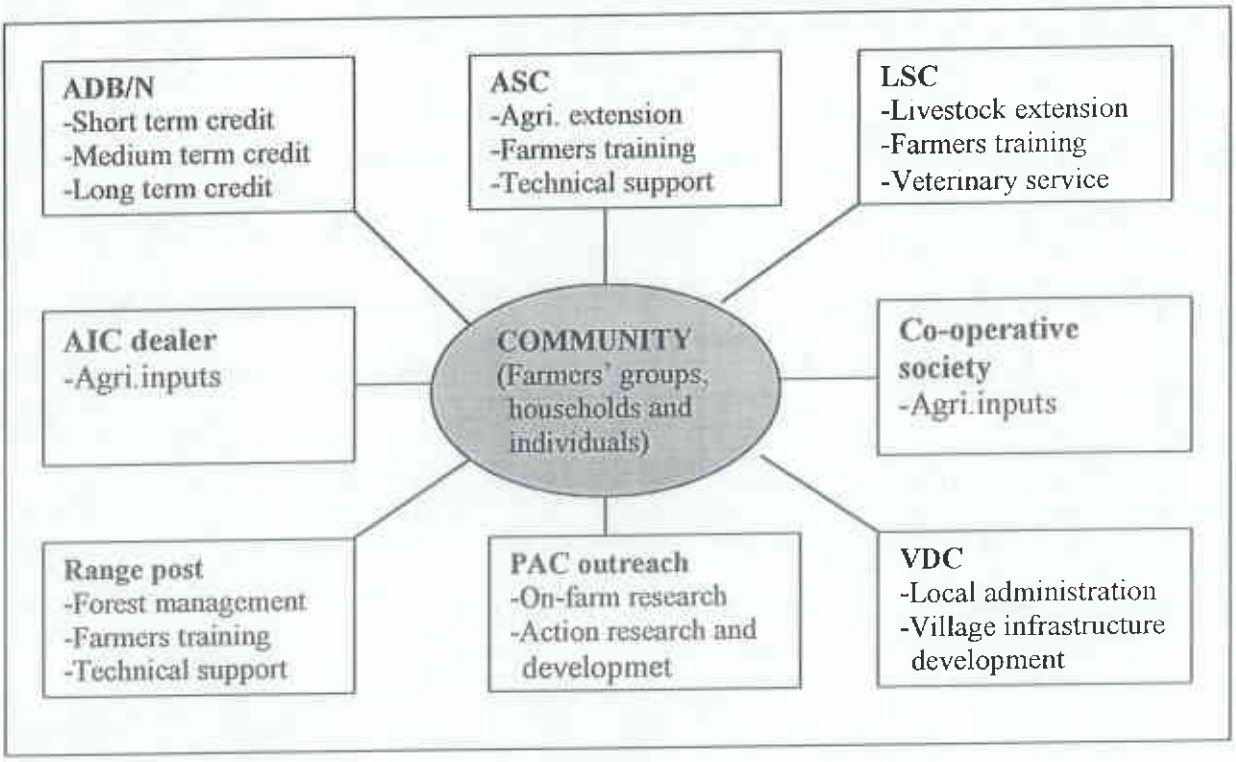

Figure 4.8 Different institutions working in the study area

4.3.8 Market

Since the study area is in isolated rural hills, there is virtually no organized market except a few numbers of tea stalls and some small groceries within and adjoining villages. The nearest market place is Sidhuwa on the way to Hile-Basnatpur road, which is at about five-hour walking distance from the center of the study site. Having no transportation facilities, farmers have to rely on human labor to carry necessary agriculture inputs and consumer goods from the nearest market place.

The *haat*, as it is known locally, is a periodic marketing place where farmers sell their agricultural produces. Minor forest produce, seasonal vegetables, fruits, tubers, *Jaand* (local beer made from millet fermentation), and some grain particularly millet and maize are sold in the *haat*. Local *haats* are therefore considered as the center of

economic activities in study area. In addition to economic exchange, the importance of *haat* bazaar is closely linked with the social systems providing an opportunity to meet their friends and relatives, which can be considered as an opportunity of exchanging information. Therefore, the periodic *haat* has not only economic importance but also social significance. To attend the one-day weekly *haats*, people come even from day-walking distance. Cottage industry products like bamboo trays and bamboo baskets (locally call *Nanglo* and *Doko*), and herbal yeast for brewing (locally called *Marcha*) are also important village products sold in the local *haat*. In addition to consumer goods, some agricultural input like seeds, agricultural tools (e.g. spades, sickle etc.) are also sold. There are three such periodic *haats* in and adjoining villages of the study area. Sanichare *haat* and Okhre *haat* within the study site are observed every Saturday and Thursday respectively. Fortnight *haat* (full moon and dark moon days) are observed at Sukrabare bazaar, adjacent to the study area.

CHAPTER V

FARMING SYSTEMS CHARACTERISTICS OF THE STUDY AREA

Permanent agriculture in the hills of Nepal was started perhaps before the eighteenth century. This might have led by the ever increasing population pressure and the then state policy of creating incentive to convert hill forest to agriculture in order to reap the taxes (Bajracharya, 1983.b). As a result, in the latter half of the eighteenth century, especially in the mid hills more forest and pasture that were not cultivated before and managed by the community for the benefit of the property holding group were brought into cultivation (Gibbon and Schultz, 1991).

The interaction of climate, topography, altitude, social and religious beliefs, access to land ownership, and the extent and access to markets has given rise to a wide varieties of farming systems in the hills of Nepal. The limited transport and communication infrastructures, unavailability of produce and inputs market, high variations in microclimates accompanied by large family size and small fragmented farms on hill terrace and precipitous slope have led the hill farmers to adopt subsistence farming (Shrestha and Yadav, 1990). As a result of adaptation of changing political, economic and social circumstances over the time, the hill farming systems of Nepal has therefore became a diverse and complex entity (Gibbon and Schultz, 1991). In this connection, this chapter will discuss different characteristic features of the existing farming systems of the study area with especial emphasis on systems components, their interrelationship, production and productivity, and their relations on household food security.

5.1 Farming systems components and their interrelationship

Traditionally, farmers in the hills have been integrating crops, livestock and forestry components in their farming systems in order to satisfy their demands for food and cash. A farmer or household maneuvers those farming components with his/her management skills in order to extract output that can be generated from each component. These components are intertwined in such a way that one can hardly think of a farming system in the absence of any one component. Undoubtedly farming being a single most sector of absorbing ever-increasing labor force in the rural hills, it is labor intensive and less productive per unit of labor employed (Shrestha and Yadav, 1990.). Although, the system provides food, fuel, timber, cash and employment to the households, all the subsistence-farming households in the study area are not able to produce sufficient food to meet their consumption requirement.

Even though, the farming systems of the study area possess the same components of representative farming systems of the hills, the degree and magnitude of interrelationship among and between the components may vary basically determined by the biophysical and socioeconomic specificity. Figure 5.1 shows interrelationships among different farming components in the study area. In this interactive relationship, the crop sector provides feeds and bedding materials to livestock and in return receives power and manure. Forests directly influence crop production providing compost materials and agricultural equipment (ploughs and poles); and indirectly by supporting livestock which provide manure and draught to the crop production systems. In addition, forests act as safeguard to cropland against soil loss through erosion and landslides. There is not much grazing area in the study site, therefore, interrelationship between livestock and grazing land is not prominent. Because of increasing population pressure and declining natural resources availability, the trend of decreasing livestock population has mentioned. Decreasing livestock number in the hills due to decreased grazing land

has also been reported in a number of literature in the context of hill farming systems of Nepal. (Yadav, 1990, Shrestha and Yadav, 1992, Bajrachaya, 1993).

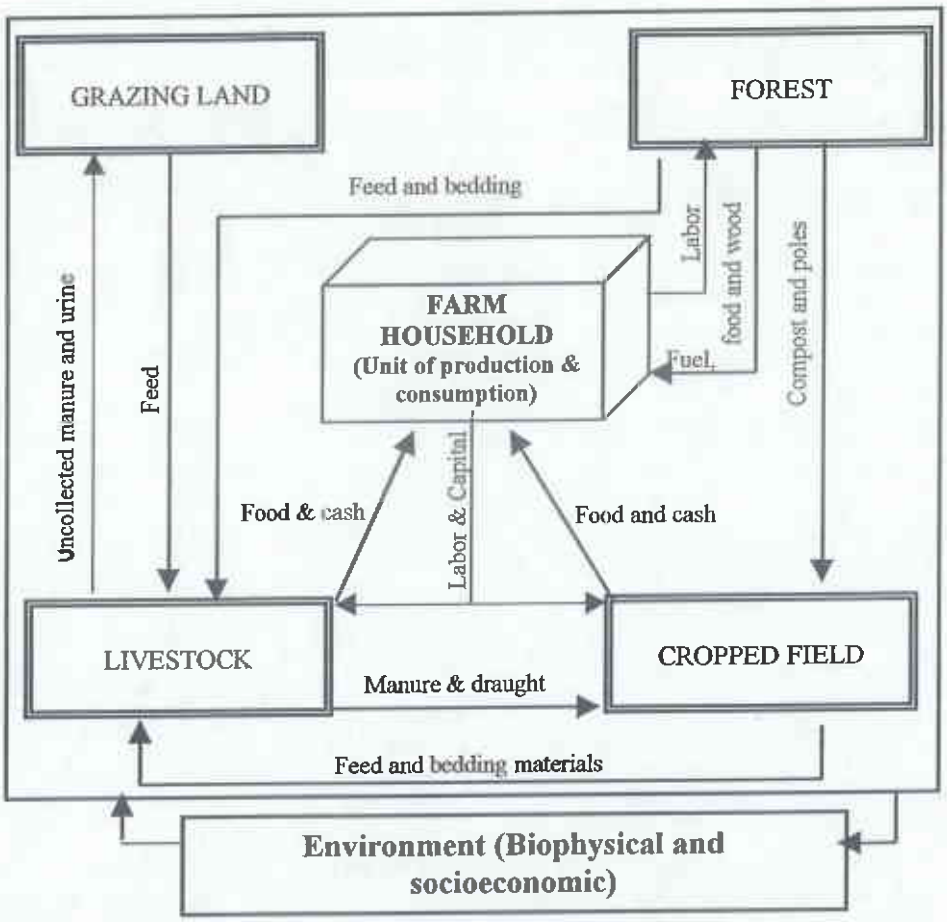

Figure 5.1 Interaction among the farming system components
(Source: Thapa (1989) and Pearce *et al.* (1994), and Poudyal (1997) with modification)

Household being the basic unit of production and consumption all those farming components directly or indirectly are influenced by the verdict of household's demands for goods and services. Farming household is virtually linked with all those components and plays key role in the overall operation of the systems as a system manager and decision-maker (Yadav, 1990). Since household's activities always revolve around the household welfare of providing food and nutrition to its members through rationale use of

available resources, it contributes to the system in number of ways providing labor and investment for the long-term sustainable use of the resources.

Socioeconomic and biophysical environment within and outside the systems are equally important for the smooth and viable existence of the farming systems. Government policy like subsidy in fertilizers and other agriculture inputs, bank interest rate and priority of landing, market, technologies etc. directly or indirectly influence agricultural activities. Inaccessibility to market could be the single most reason of adopting subsistence farming with low input and low output in the study area. Because of market inaccessibility, unlike other eastern mid hills with access to market and transportation network, this area has no cash oriented cropping. Therefore, the prominent high value cash crops of the eastern hills like cardamom, ginger, tea etc. were almost absent in this area. Other important social factors governing the characteristic feature of farming in the study area are weak social infrastructure like farmers groups, non-government organizations (NGOs), cooperatives, credit and saving schemes etc. Biophysical factors like climatic variations, erratic rainfall, recurrent draught and hailstone, incidence of diseases and pest, and many other vagaries have directly and indirectly influenced on the choice of farming activities in the study area.

5.2 Crops and cropping pattern

Farming systems of the study area is subsistence oriented and predominantly crop-based in nature. Although, the maximum households derive their livelihood primarily from agriculture, agricultural production is still traditional and takes place with the minimal cash flow. Cereal crops dominate the agricultural activities, which contribute the major part of the total agricultural production.

5.2.1 Cropping pattern

Wide range of crops and cropping patterns are adopted in the study area depending upon biophysical and socioeconomic settings of the farms and the households. Although, the sample households are confined within 1100 to 1700 masl, their farmlands start from the foot hill of 400 masl to the altitude of up to 1900 masl; locally call *Besi* and *Lek* respectively. Large combinations of cropping pattern are practiced by the farm households, which are basically determined by land type and the elevation. On *Bari* land it is common to grow maize followed by millet, while on *Khet* land rice is the predominant crop. The most dominant cropping pattern on *Bari* land is maize intercropped with bean relayed by millet. It accounts for about 60 per cent of the total *Bari* land. On less fertile upland, called *Pakho,* sole maize is grown, and after maize some other minor crops like sesame, black gram, buckwheat etc. are sown on some parts. But most of the *pakho* remains fallow after the maize harvest. Since various type of pulses like gram, bean cow pea etc., are often intercropped with maize, there are many variations on maize based cropping pattern (Figure 5.2). In the higher elevation potato interplanted with maize is the dominant cropping pattern on the *Bari* land. In the case of *Khet* land the main crop is monsoon rice. More than 70 per cent of farm households grow only monsoonal rice on the *Khet* land. Under the favorable irrigation facility at the lower elevations some farm households take two seasons rice crops: the early season rice (March transplanting) and the main season rice (June transplanting). Unlike other mid-hills, wheat cultivation in this area is almost negligible; only five households amongst the total sample households were found growing wheat. On the *Khet* land monocropping was found overwhelmingly practiced, which is basically due to lack of irrigation and strayed-animal problem during the winter.

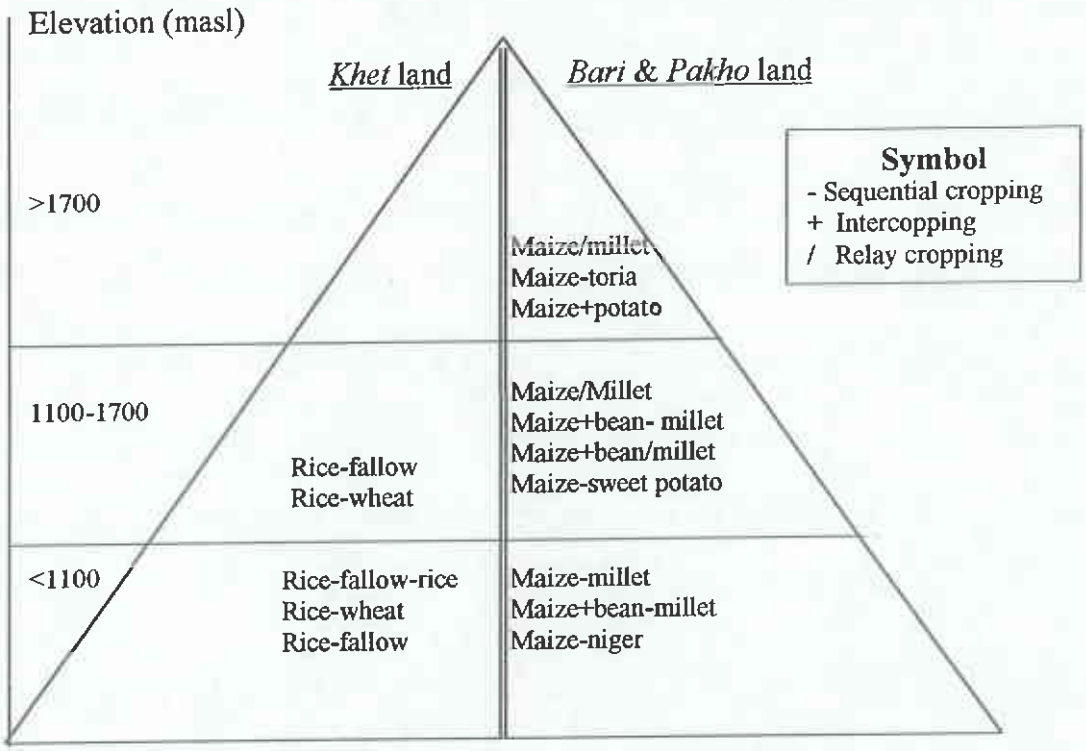

Figure 5.2 Dominant cropping patterns of the study area
(Source: Group discussion and PRA, 1998)

As mentioned earlier, because of lack of irrigation upland farming is the major attribute of farming systems in the study area. Maize is the most dominant crop cultivating from lower hills to higher hills during the summer. Winter cropping on the upland is almost negligible except near the homestead, which is usually fenced by the bamboo slits. Particularly in the dry area, where moisture retention is very low, even the homestead area remain fallow during the winter.

5.2.2 Cropping intensity

The aggregate cropping intensity of the study area showed decreasing land use intensity with increasing farm sizes (Table 5.1). Furthermore, land use intensity was found lower on *Khet* land than *Bari* land. Conlin and Falk (1979) had also reported lower

cropping intensity on the *Khet* land in the eastern hills of Nepal. The possible reason behind lower cropping intensity on *Khet* land could be that larger farmers own substantial proportion of *Khet* land, and having no market opportunity of agricultural produce they are reluctant to cultivate extra crops. On the other hand, *Khet* lands in the study area are mostly rainfed with no opportunity to grow winter season crop. Other possible reason responsible for lower cropping intensity might be the tenancy systems. Sharecropping system is the most common practice, which provides no incentive to the tenant for growing multiple crops as he/she has to share fifty per cent of the total produce with the landowner bearing the entire cost of required inputs by the tenant.

Table 5.1 Cropping intensity (CI) by farm size category and land type

Farm size (ha)	Land type		Sample average (CI%)
	Khet land (CI %)	*Bari* land (CI %)	
≤0.50	104	195	173.70
0.51-1.0	101	192	151.00
1.01-1.50	107	175	144.78
1.51-2.0	110	179	140.28
> 2.0	104	177	134.62
Overall	105	182	147.11

(Source: Survey data, 1998)

5.2.3 Crop production and productivity

Cereals are the main staple food crops in the study area. Rice, maize and millet are the major cereals contributing more than 80 per cent of the total food production and cover more than 95 per cent of the total cultivating land. Almost all farm households

cultivate maize but the area under maize accounts less than that of rice. Of the total cultivating land, rice covers 51 per cent, and the area under maize accounts about 47 per cent (Figure 5.3). This indicates that rice being the most preferred staple grain, even under the poor environmental condition farmers prefer to grow rice in order to meet their food requirement. Buckwheat, sesame, niger, sweet potato, black gram etc. are other minor crops grown on the *Pakho*, which is unfertile marginal land. Almost about 95 per cent of the sample households were found growing those minor crops but area coverage was barely about 10 per cent of the total cultivating land. Wheat cultivation in the study area is extremely low, and less than five per cent of the total sample households cultivate wheat, which covers less than one percentage of the total cultivating area. Millet on the other hand is the third important crop in terms of area and production. As millet is least desired food, only the poor farm household considered it as staple food. Therefore, a large share of millet is processed into alcoholic drinks such as *Jaand* (local beer) and *Raksi* (local sprite). Nevertheless, millet in the rural hills is considered as high value cash crop which fetches higher price than rice and maize, and is easy to sell. The poor households also consume millet flour as staple food, and millet straw is an important source of forage for animal during the winter.

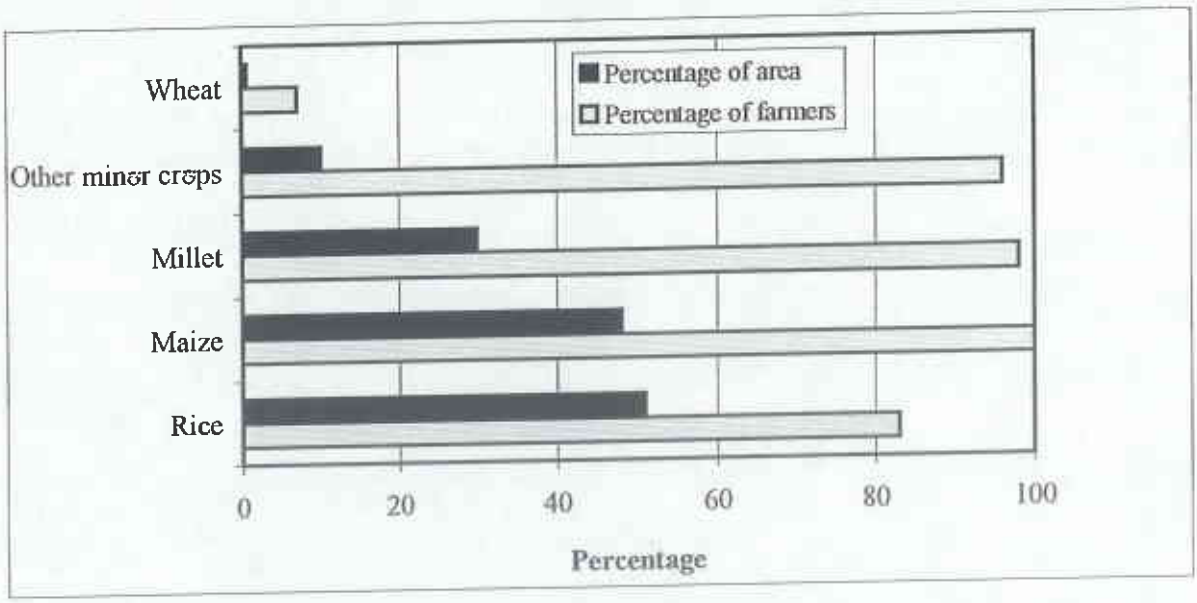

Figure 5.3 Percentage of area and farm households growing major crops (Source: Survey data, 1998)

Although, only a small proportion of rice cultivating land are fully irrigated, rice production is the prime concern of all farm households as it is considered the superior staple food grain. Being a traditional crop with cultural importance during festivals, farmers in the past, when there was no accessibility to buy rice in the market (before the construction of Dharan -Basantpusr road) had converted their possible *Bari* land into *Khet* land. Since, rice cultivation is done even under the poor environmental condition the average production per unit area seemed relatively low. Maize and millet are also traditional cereals in the hills. Maize has diversified uses: maize grits and flour as staple meals, roasted maize as snacks, maize flour as livestock feed etc., which reflects its immense importance from the household food security perceptive. In contrast to the significant role of those major cereals in achieving household food security, their production per unit area except that of millet, was found relatively lower than that of regional as well as national average (Table 5.2).

Table 5.2 Average area, production and productivity of major cereals

Crops	Study site			National and regional yield (Kg/ha)	
	Area (ha/Hh)	Production (Kg/Hh)	Yield (kg/ha)	National Average	Eastern hills Average
Rice	0.93	1,255.54	1,498.00	2,450	2,020
Maize	0.74	784.93	1,253.42	1,660	1,610
Millet	0.47	511.90	1,258.74	1,110	1,030

NB: Hh = household; ha = hectare

(Source: Survey data, 1998; Central Bureau of Statistic, 1996/97)

5.3 Livestock management and production

Livestock is an integral component of farming in the study area. A range of livestock species (buffalo, cattle, goat, sheep, pig and chicken) are kept by the farm households. Almost every household has a few heads of cattle and buffalo. As there is a little use of chemical fertilizers, because of its high cost and transportation difficulties, livestock keeping is considered essential for maintaining soil fertility. Livestock management is entirely dependent on the crop by-products, farm-forest and grazing. In this crop-livestock interaction, the crop sector provides residues and harvest stubble left on field after harvest for grazing to the livestock. Therefore, there is a complementary relationship existed between crop and livestock sectors. The crop residues and hay are kept to feed the animal in the fodder scarce period, particularly during pre-monsoon season. Integrating livestock into the crop production system has therefore enabled farmers to maintain their animals as well as crop production.

Livestock, particularly small stock like goat, pig and chicken are the main source of cash for most of the poor households. Therefore, livestock keeping particularly small animals was found objectively related with hedging against possible risk of cash deficit for the day-to-day household expenses. Almost all households irrespective of ethnic variations kept cattle and goat. Despite the lower productivity of aged cattle, farmers generally are reluctant to sell them (particularly cow) because of their religious taboo. This could be one of the main reasons responsible for larger livestock population per household.

Households with larger area of cultivating land prefer buffalo to cattle, since the local buffalo produces higher milk and manure than that of local cattle. It is mentioned that the average milk production of a local buffalo is almost double than that of a local cow. The average milk production of buffalo was mentioned about 780 litters per year, whereas in the case of cow it was only 390 liters. Due to lack of milk market in the study area, refined butter (ghee) is the final produce of milk and about 40-60 per cent of the total milk produced is converted into the ghee.

Since, the livestock production system is entirely based on fodder, forage and grazing, there is seasonal variation in milk yield. During the pre-monsoon season milk yield falls, and rises gradually towards the rainy season. Seasonality in milk production might be directly related with the availability of fodder and feed stuff. With the increasing farm size increasing milk yield was found in the case of both cow and buffalo, which might be due to larger farm size holders are able to dispose more feed and fodder than the small farm size holders. The present level of livestock density and productivity indicates that even though livestock being a vital component of farming, the farm households in the study area are not able to support their livestock properly in the absence of required feed and fodder.

Even it is not legally accepted, caste restriction on livestock keeping has direct implication on livestock production systems in the rural area. The *Brhamin/Chhetri* households, which are considered the highest in the Hindu caste hierarchy, do not rear pig and poultry in general. But in the case of poultry, the caste restriction has gradually been relaxed in the recent years. Therefore, almost all farm households irrespective of ethnic variations were found keeping poultry as an important source of nutrition and petty-cash needed for day to day household expenses. Exception in few households, who have improved poultry breed received as the test materials from PAC, almost entirely the poultry keeping in the sampled households was found with local breed, having lower egg and meat productivity. Egg production was mentioned erratic with the annual production of 60-120 eggs per hen with three laying periods. Table 5.3 shows annual livestock produces per household by farm size category

Table 5.3 Livestock products per household by farm size category

Livestock products	Farm size (ha.)					Overall
	≤0.50	0.51-1.0	1.01-1.50	1.51-2.0	>2.0	
Milk (Litre/year)	538.00	932.90	1,005.20	950.00	1,039.60	958.80
Chicken (No)	3.94	5.15	5.28	5.92	6.48	5.47
Egg (No./year)	236.40	309.00	316.80	355.20	388.80	328.20

(Source: Survey data, 1998)

5.4 Forestry and agroforestry management

Farming in the study area was found closely entangled with forest resources to a greater extent; nevertheless dependency on public forest for fodder, food and fuel wood has been reported extremely decreased for the last few years. From the forest, farm

households collect fallen leaves, fuel wood and even fodder. Even though forest under the community management has been increasing, very few households residing near forests have been reaping the products from the community forest, as for most of the farm households community forests are beyond their carrying distance even when they are the members of community forest users' group. Consequently, having no alternatives for energy and fodder, farm households have been keeping a patch of their farmland for tree plantation as a 'household forestry' particularly to meet the needs of firewood and fodder.

Fodder tree growing along the edge of *Bari* land is traditional practice in this area. Almost every farm households have at least 2-3 fodder tree species on their farmland, and up to 15 fodder tree species in some farm household have been recorded during the survey. Almost all tree fodder species were indigenous and naturally grown and or transplanted from the other places. The most common fodder tree species in the area are Nivaro (*Ficus roxburghii*), Dudhilo (*Ficus nemoralis*), Khanyu (*Ficus semicordata*), Gogan (*Saurauia nepaulensis*), Tanki (*Bauhnia purpurea*), and Kutmiro (*Litsea polyantha*) etc. Under the present livestock density per unit of cultivated land, fodder shortage during the pre-monsoon season was mentioned by majority of the farm households, however, severity of fodder shortage was reported amongst the small farm size holders. The average number of fodder in the study site was estimated 15 trees (excluding bamboo bush) per household, which came out to be 4.2 fodder tree per ruminant,

5.5 Homestead gardening

Homestead gardens comprising diverse species of vegetable, fruits and fodder tree were found in the study site. The area under home gardening varied from the minimum of about 100 m^2 to the maximum of about 1000 m^2 depending on available water supply, farm size and the household size. The structure and features of each homestead garden differed, nevertheless, the common goal of homestead gardening was to be self sufficient

in year round vegetable requirement. The functional diversity in homestead gardening in the study area found supplying food, fodder, firewood and mulching materials for agricultural production. As a component of traditional farming systems, homestead gardening were essentially combined with the livestock production systems. They were found located mostly on the down terrace of the dwelling near the livestock shed so that sewage from livestock shed and kitchen could be supplied directly to the garden. Since the gardens were subsistence oriented with the need-based production as a self-provisioning system, they were exclusively organic and labor intensive.

Traditional vegetables species were found commonly grown in the homestead garden. 'Traditional vegetables' mentioned here is defined as those vegetable species which have been growing in the areas over the many years and are adapted in the local environmental niche (Baral *et al.*, 1994). During the field survey it was found that farmers in the study area have been growing a maximum of 21 vegetable species. Among them the most common were pumpkin *(Cucurbita moschata)*, Chayote (*Sechium edule*), colacasia/taro (*Colocasia spp*), tree tomato (*Chphomandra betacea*), balsam apple (*Momordica balsamina*), broad-leafed mustard (*Brassica junci var. rugosa*), cucumber (*Cucumis sativus*), yam (*Dioscorea esculenta*) and Snake gourd (*Trichosanthes anguina*) etc.. Since vegetables are mostly used as relishes in the daily meal and are grown on a small plot of land and they are mainly grown for home consumption, importance is given to the household preference rather than market. Since most of the traditional vegetables are grown in the rainy season, the vegetable consumption pattern has been mentioned highly seasonal. Farm households with small farm size mentioned that they could not spare their land for separate homegarden for vegetable cultivation. Therefore, intercropping of pumpkin and broad bean in maize-millet cropping pattern is a common practice among the small farm households, which perhaps is their major source of fresh vegetable supply. Although, vegetable production was meant primarily for meeting the household requirements, some households sold a part of their total produce in the local *haat* to meet their daily household cash requirement.

Even though, the homestead gardening is an integral part of farming systems, only about 20 percentage of the sample households in the study area were found maintaining year-round fenced homestead gardening. Water scarcity for irrigation during winter and strayed-animal problem were mentioned as the major limiting factor for maintaining year-round homesteads gardening in this area. Because of those constraints it is common practice to keep rainy seasons' surplus vegetables for the dry season consumption. The most common vegetable species stored for future consumption are chayote, radish, rayo, and balsam apple. Chayote is stored in pits between the layers of dried plant materials (e.g. straw, millet husk etc.), radish and rayo are fermented and dried to prepare what is locally called *sinki* and *gundruk*, and the balsam apple are kept by sun drying.

Citrus are the major fruit species growing on the homestead garden. The most common citrus species growing in this area are madarin (*Citrus nobilis)*, sweet orange *(Citrus sinensis)* and lemon (*citrus spp.*). Except some traditional fruits species like guava, peach, plum, pear etc., fruit cultivation was found concentrated in the large farm size holders. Citrus plantation was found virtually nil in the farm households having less than 0.5 hectare of cultivating land (Table 5.4). This scenario implies that the small farm holders under the subsistence farming are not able to sacrifice their farmland for other crops except staple. Having no established market, the surplus fruits particularly non-citrus after the household consumption are either distributed to the neighbor or converted into animal feed. Whereas in the case of citrus, after the household's requirements are met, sold either in the local *haat* or to the fruit collectors who resell in the other external markets. There is a common practice of making *Amilo* (similar to vinegar) and selling them in the local *haat* and/or community or sending to their relatives living in the *terai*, where it is recognized as an important ingredient of pickle making amongst the hill-migrants.

Table 5.4 Households growing main fruit species by farm size category

Farm size (ha)	No. of Hh	% of households growing		
		Mandarin	Orange	Lemon
≤0.50	17	0	0	0
0.51-1.0	27	33	7	37
1.01-1.50	36	31	14	47
1.51-2.0	26	30	8	50
> 2.0	29	52	24	58
Overall	135	32	12	43

NB: Hh = households.

(Source: Survey data, 1998)

5.6 Seasonality and food situation

Seasonality in the agricultural production has direct implication on households' food situation and consumption behavior. Most of the crops grown in the study area are monsoonal implying a seasonal variation in household food supply. As consumption is primarily based on own farm production, it was found that about half of the total sample households in the study area face food deficit during June-July (Figure 5.4) from their own farm production, which is considered as the most food scarce period in the year. Therefore, food sufficiency situation was found decreasing towards the beginning of cropping season. Therefore, pre-monsoon season reflects the food deficit season and the post-monsoon season as food sufficient season in general. November-December, are the most prosperous months from the food availability point of view. However, level food of sufficiency above all depends upon the individual household resources endowment.

Lack of irrigation is one of the most important reasons responsible for the large-scale winter fallow in the study area. Because of no agricultural activities during the winter, poor households who are unable to sustain their living from their own on-farm production are heavily dependent on non-farm laboring during the winter. Therefore, the adult males from poor households move elsewhere out for the temporary labor works. Some of them do vending in different periodic markets (*haat* bazaar) during the whole winter in order to earn for their household sustenance. Similarly, some of them do portering within and outside the community. After storing the main season rice in December, households' main work in the village is to collect firewood for the coming rainy season, which provides some extent an opportunity of earning ways to the poor villagers, particularly women.

As agriculture is the main source of employment, most of the labor force during the agriculture off-season remains slacked. This is further intensified by the seasonal cropping calendar of the study area, which shows that winter season as a slack period for agricultural activities, implying that about 60-80 per cent of the working days during the winter season remain unused. Temporary migration of the adult male household member to *terai* and other cities or even India (Assam) for non-farm labor works during the winter was common in the past. But due to increasing population pressure and unemployment problem in the cities, the trend of temporary migration for labor works from the village, however, has been declining.

Food consumption pattern changes by the season. During the rainy season, there is abundance of green vegetable, but during the pre-monsoon season availability of green vegetable becomes extremely lower. Traditionally preserved dried vegetables: *Sinki* and *Gundruk* (fermented radish and radish/rayo leaves) are mostly used as vegetable relish during the dry season. Wild vegetables and fruit gathering from the open access public land and or forest, streams, gullies and fallow fields is done particularly during the winter and summer seasons. The gathered vegetables are used for household consumption but

the fruits are, however, mostly for individual consumption. A wide range of wild vegetable and fruit species gathered by the villagers in the study area (Appendix Table 5). Vegetable and fruit gathering is not a specified work as it is done at the time of firewood collection, fodder collection and livestock attending. Green vegetables are mainly picked during the pre-monsoon and monsoon when they flourish in the field and uncultivated land. But the wild fruits are available mostly in the winter. Because of its irregularities it is difficult to say how much fruits and vegetable each household gathers in a year. Nevertheless, there is significant role of gathered food particularly vegetables in meeting the households' food requirement and diet diversification especially during the food scarcity period. The accessibility of wild fruits and vegetables has been declining over the years due to over exploitation of available resources as a result of increasing population pressure and livestock gazing

A seasonal consumption pattern of staple food was mentioned among those households who have no sufficient rice for the whole year consumption. Households having no sufficient rice for the whole year manage consumption behavior over season. During the rainy season when there is abundance of milk and vegetables production households prefer to take maize as staple. Similarly when they have heavy workload the rice insufficient farm households take maize and rice mixed as it is considered that maize provides more energy and bulkiness (locally called *Adilo)* in the meal. Since, millet is considered as inferior cereal very few poor farm households consume it as staple food. However it is common to take millet flour occasionally in the form of porridge, irrespective of farm household's economic status.

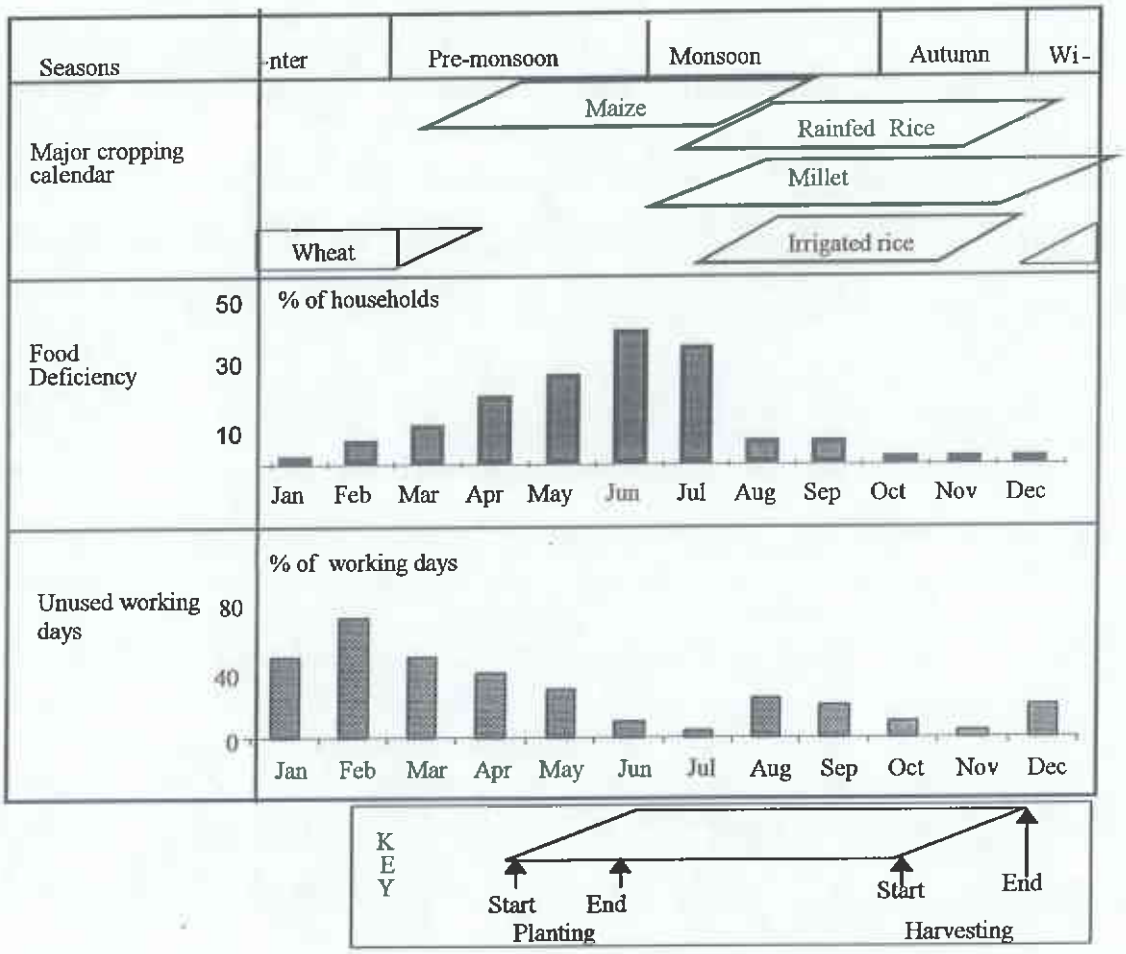

Figure 5.4 Seasonality and food situation
(Source: PRA and household survey, 1998)

5.7 Credit and extension

The network of formal credit and saving at the district level consists of Agricultural Development Bank (ADB/N), Nepal Bank Limited (NBL) and Small Farmer Development Project (SFDP) located at different parts of the district. Except for the few approachable households, ADB/N, sub branch office located at Sukrabare Bazaar, is only the source of formal sector credit for the study area. From the data source of agricultural

development bank, it came to understand that the loan for cereal production, which is smaller in amount and short-term in duration, was the major component of agricultural credit for this area. The outstanding amount of loan for the study are till January 1998 showed that the share of cereal production loan was 42 per cent followed by livestock and horticultural crop (Figure 5.5).

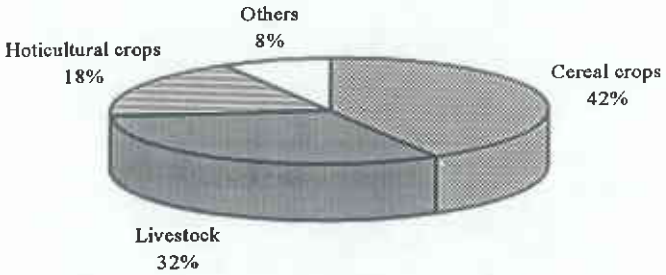

Figure 5.5 Agricultural credit in the study area by sector
(Source: ADB/N Sukrabare, 1998)

Other than agricultural credit, ADB/N also provides credit for rural enterprises, however, the amount and number of borrower of such loans were found negligible. Due to lack of targeted credit program majority of the small farmers who are unable to give collateral (land right certificate) to the bank are therefore deprived of institutional credit. Apparently lack of capital has made the poor difficult to undertake productive investment, which further decreased their labor productivity and consequently the total production extremely pushing them into the vicious cycle of poverty and food insecurity.

Participation in different extension activities plays important role in adoption and adaptation of agricultural technologies in the rural area where there are no opportunities of agricultural information other than conventional government extension services. Despite the important role of government extension services in the rural area, it has been

reported that there is extremely low intensity of agricultural extension services provided by the government extension agents. It is important to mention here that more than 50 per cent of the sample households even do not know about the existence of agricultural extension service center in their area. Furthermore, the survey results indicate that knowingly or unknowingly the extension and research activities in the study area found to be concentrated among the influencing large farm size holders (Table. 5.5). Among the sample households with less than 0.5 hectare of cultivated land, only one household has ever participated in agricultural extension activities viz. demonstration, training and visit. The possible interpretation of such disparity in participation could be either the technologies are not suitable for the small holders or there might have some influences from the large farmers on extension personnel. The similar result was reported by Khadka (1987) indicating inefficient performances of government extension services in the eastern hills of Nepal. The fundamental reason behind poor extension services might be due to the lack of sufficient trained manpower, and large area of their working. An Agricultural Service Center with two technical staff has to cover about 7-10 VDCs with approximately 2,000-3,000 farm households, which seems extremely difficult for them to provide efficient technical services to all farm households. Furthermore, agricultural technicians working in the hills have no sufficient technological background on hill farming systems as they are mostly trained in those institutes located in the tropical environment, where agricultural production systems are different than that of hill. This could be another important reason responsible for inefficient agricultural extension services in the rural hills.

Table 5.5 Participation in agricultural research and extension by farm size category

Response on	Farm size (ha.)				
	≤0.50	0.51-1.0	1.01-1.50	1.51-2.0	> 2.0
	Responses in %				
Participation in demonstration:					
• Yes	6	15	14	12	28
• No	94	85	86	88	62
Participation in farmers' visit:					
• Yes	0	11	14	10	10
• No	100	89	86	90	90
Participation in research:					
• Yes	6	11	33	31	34
• No	94	89	67	69	66
Participation in agricultural training:					
• Yes	6	7	8	15	21
• No	94	93	92	85	79

(Source: Survey data, 1998)

5.8 Adoption of modern varieties

Cereals being the primary source of food, adoption of improved varieties of cereal crops is often consider important to increase food production and productivity. The promising varieties of maize, wheat and rice recommended for the eastern hill condition was included in the study. In the case of millet none of the improved millet variety was found recommended in the eastern hills context. Therefore, adoption index for improved varieties (described in Chapter III, p.35), included only three major crops, namely rice, maize and wheat. The overall adoption index by farm size category is given in Table 5.6.

Table 5.6. Adoption index of modern varieties (MV) of major cereal crops

Farm size category	Percentage of households using MV	Average adoption index
≤0.50	28.5	13.55
0.51-1.0	33	26.90
1.01-1.50	51.8	32.10
1.51-2.0	69.3	38.09
> 2.0	68.7	44.94
Overall	60.2	32.64

(Source: Survey data, 1998)

As there are limited choice of varieties in each crop, the adoption index was found ranging from 4 per cent to the maximum of about 87 per cent. Based on the individual household's resource base, access to information, land type etc. the level of MV adoption was found varied. However, looking at the trend of MV adoption in relation with farm size, there was a significant correlation (r =0.42) between adoption index and farm size.

5.9 Characteristic features of farming systems of the study area

The choice of agricultural activities within the farm households particularly under the subsistence production systems heavily depends on the type of land the farm household owned. Therefore, the characteristic features of the individual farm were found basically determined by the land type. In the hills of Nepal, the agricultural lands are primarily divided mainly into two types: *Khet* and *Bari*. The distinction between the two rests on the production of rice. The *Khet* lands are carefully terraced in order to make them possible for water retention, so that rice could be planted. Moreover, *Khet* lands are more valuable than *Bari* land even though the total production from *Bari* might

be higher. Assuming that different proportions of two distinct land type determine the overall production level, resource utilization and finally the choice of farm activities, three different types of farm typologies have been defined for the purpose of this study, namely: mainly *Khet*, *Khet-Bari* and mainly *Bari*. The principle characteristic features of those farm types are summarized in Table 5.7

Table 5.7 Principal characteristic of farming systems of the study area by farm typology

Characteristic	Farm type		
	Mainly *Khet*[1]	*Khet-Bari*[2]	Mainly *Bari*[3]
Objectives	-Food and cash sufficiency	-Food and cash security	-Food security
Farm size	Relatively large	Medium	Relatively small
Cropping intensity	Low	medium	high
Market orientation	-Few	-Very few	-Almost none
Crop Production system	Mixed farming Rice dominant Diversified home garden with mixed fruits and vegetable species	-Mixed farming -Maize dominant -Home gardening with one or two fruit species and seasonal vegetable	-Mixed farming -Maize dominant -Home garden almost absent
Livestock production systems	-Mixed herd -Large animal dominant	-Mixed herd -Both large and small animal	-Mixed herd -Small animal dominant
Resource utilization	-Local resources -External inputs relatively higher -High level of resource recycling	-Local resources -External inputs -relatively lower -High level of resource recycling	-Local resources -Negligible external resources -Low level of resource recycling
Productivity	-Medium	-Relatively high	-Relatively low

[1] *Khet* land over 60 %
[2] *Khet* land 31-60 % and *Bari* land 40-69%
[3] *Khet* land less than 30 %
(Source: Conlin and Falk, 1979)

Biodiversity	-Moderate	-Relatively high	-Relatively low
Linkage among the system components	-Strong	- strong	-Relatively weak
Economic Risk	-Low	-Medium	-High
Cropping intensity	-Relatively low	-High	-High
Strategies	-Long-term investment -Land acquisition -Improved breed and varieties	cost minimization -Increase on-farm biodivesrity -Use of different agroecological niche	-Diversification of off-farm income sources -Risk minimization (use of local cultivars)

The supporting capacity of farm is improved if substantial proportion of *khet* land is held. As a result, the farm households' objectives and strategies of farming shifted from mere food security to food and cash security when farm productions sufficed their household food consumption requirement. The cropping intensity, on the other hand, decreased as the increased proportion of *Khet* land, since most of the *Khet* lands in the study area are rainfed with single of main season rice. With the low economic risk, the farm households with high proportion of *Khet* land are of risk taking nature and thus improved technology adoption increased with the increased proportion of *Khet* land. Household with smaller proportion *Khet* land, who are unable to support their food requirement from their own farm production diversified their off-farm income for their sheer survival.

CHAPTER VI

FOOD SECURITY SITUATION, INCOME, CONSUMPTION AND EXPENDITURE PATTERNS

This chapter discusses food security situation of the study area in general and household level food security in particular. After a general overview of the food security situation of study area, household's income, food consumption and expenditure pattern are discussed.

6.1 The aggregate food security index of the study area

Since, aggregate food security analysis gives an overview on food security situation of the study area, it is important for preliminary identification of food security problem of an area. The aggregate food security index combines per capita food availability for consumption (in terms of dietary energy supply) with the information on distribution pattern. FAO has developed an aggregate index for analyzing for analyzing overall food security situation of nation. The same method was applied in this study incorporating all three elements of food security, namely availability, stability and access to food (Thomson and Metz, 1997), explained in Chapter III, p.36)

The value of index ranges from 100, which represent complete risk free food security situation to 0, which represent total famine. The index less than 65 is accounted critical level of food security, between 65 to 75 categorized as low level of food security, between 75 to 85 medium, and over 85 represents high level of food security (ibid.).

So far as the average dietary energy requirement per capita per day for the hills of Nepal is concerned, no concrete recommendations are available so far. Gautam (1990) has mentioned 2,250 Kcal per capita (i.e. 2,744 Kcal per AE) per day on the basis of National Planning Commission, which he argued, might have based on Nutritional

Advisory Committee (NAC) of India (1958) or derived from FAO (1957). He further argued that the above mentioned subsistence calorie requirement is much more than requirement for an average Nepalese to do full economic activities. Therefore, for the purpose of this study the general recommendation of FAO, 2,500 Kcal per adult (cited in Trairatvorakul, 1984) was taken as basis for calculation. In order to identify food insecure households, household dietary energy adequacy ratio (HDEAR)[1] was used to setting a cutoff point of 0.8 HDEAR. A household was then defined as food-insecure if it provides less than 80 per cent of calorie requirement for its total members expressed in terms of adult equivalent scale (Armar-Klemesu *et al,* 1995, Maxwell, 1995). Employing the above equation (3.6) AHFSI was calculated, which came out to be 63, suggesting that at present, food security status of the study area is at critical level according to FAO classification, as discussed earlier.

6.2 Household food security status

Three levels of household food security status were defined based on the HDEAR, which was computed from the mean total household dietary supply and mean total household requirement in terms of adult equivalent scale. As mentioned earlier, a subsistence requirement of 2,500 calorie per AE per day was taken as a basis for calculation and households were classified as food-secure, marginally food-secure and food-insecure if HDEAR is ≥1.0, 0.80-0.99 and less than 0.80 respectively. Thirty-six percent of the total sample households were found food-secure satisfying more than subsistence energy requirement (i.e. HDEAR ≥1.0) with an average HDEAR of 1.37. Furthermore, 22 percent and 42 percent households were found marginally food-secure and food-insecure with an average HDEAR of 0.89 and 0.67 respectively. The average calorie available for consumption per AE/day among the three food security categories was 3,429, 2,223 and 1,660 Kcal per AE per day for food-secure, marginally food-secure and food-insecure households respectively. The 'marginally food-secure households' are

[1] Ratio between average calorie available for consumption per AE per day to calorie requirement per AE per day

defined as those households with transitional food security status in the sense that they could enjoy food security in the normal harvest year, and may face transitory food insecurity if the harvest is poor. In contrast, the food-insecure households are those who face food deficit every year and are in the situation of almost chronic food insecurity.

6.3 Indicators of households food security status

Various indicators are used to identify the household food insecurity status based on the specificity of concerned study area (Maxwell, 1995). Since the study site is located in the remote hills with subsistence production systems where the household economy is entirely agriculture based, indicators used in this study were access to land and livestock resources; demographic resources etc. Analysis of variance shows that household size, cultivating land holding, livestock holding, dependency ratio, income (both on-farm and off-farm), ratio of economically active female household member are significantly different between the household food security status groups (Table 6.1). The result implies that those indicators are by far more important to identify households' food security status in rural area with subsistence economy.

Table. 6.1 Indicators of household food security status

Indicators	Food security status		
	Food-secure (N=48)	Marginally Food-secure (N=30)	Food-insecure (N=57)
Households size (No.) **	5.27	5.66	6.68
Dependency ratio *	0.44	0.39	0.65
Proportion of economically active female household member *	0.41	0.42	0.34
Age of household head (years)NS	50.67	46.60	45.96
Cultivated land holding Per AE (ha)**	0.50	0.29	0.22
Land ownership (proportion of own land to total cultivated land)NS	0.97	0.96	0.96
Livestock holding Per AE (LSU)**	1.10	0.79	0.68
Livestock density (LSU/ha)NS	2.85	3.04	3.78
Total on-farm revenue (Rs per AE)*	3,741.48	2,873.99	1,892.84
Total off-farm revenue (Rs Per AE)*	7,364.08	4,204.63	3,909.07
Proportion of *Khet* land to the total land cultivated NS	0.43	0.41	0.40
Household dietary energy adequacy ratio **	1.37	0.89	0.67
Calorie availability for consumption (Kcal Per AE/day)**	3,429.00	2,223.00	1,660.00

Significant group differences * $p<0.05$; ** $p<0.01$

NS = Non-significant

(Sources: Survey data, 1998)

6.4 Food consumption pattern

Food consumption in the study area was found basically derived from own on-farm production and heavily cereal-based. Cereal consumption comprising rice maize and millet contributes more than 90 percent of the total calorie consumption irrespective of the household food security status (Table 6.2.). Importance of livestock and horticultural produce appeared after the cereals, however, their contribution to the total calorie consumption was found obviously lower. The share of grain legume in the total dietary intake is of immense importance to enhance dietary quality particularly when aggregate food consumption is mostly cereal based. But the survey results revealed that contribution of grain legume to the total calorie consumption in the study area was at miniscule contributing less than 0.5 per cent to total dietary energy supply. Nevertheless, almost every sample households produced grain legume more or less for their household requirement.

Table. 6.2 Calorie available for consumption by sources and household food security status

Sources	Food security status			
	Food-secure (N=48)	Marginally food-secure (N=30)	Food-insecure (N=57)	Sample mean (N=135)
	----------(Kcal/AE/day)----------			
Cereals*	3,197(93.2)	2,075(93.3)	1,525(91.8)	2,242(92.8)
Vegetables	91(2.9)	52(2.3)	45(27.1)	63(2.6)
Fruits	40(1.2)	33(1.5)	23(1.4)	32(1.3)
Dairy milk	56(1.6)	49(2.2)	49(2.9)	51(2.1)
Meat	42((1.2)	32(1.4)	33(1.9)	36(1.5)
Legumes	8(0.3)	5(0.3)	5(0.3)	6(0.3)
Other minor crops (tuber, oilseeds etc)	36(1.1)	27(1.2)	41(2.4)	36(1.5)
Total	3,429	2,223	1,660	2,414

* Rice, maize, millet and wheat

NB: Figures in the parenthesis are the percentage of total calorie supply

(Source: Survey data, 1998)

6.5 Sources of food supply

The study identified three major sources of food supplies in the study area; they are own farm production, wage received in kind, and purchase (either within the community or from nearby market). Own on-farm production was found by far the most important source of food for consumption contributing more than 80 percent of the total food supply (Figure 6.1). Contribution of wages received in the kind was also found important amongst the food insecure households. Although, contribution of grain received as the wage payment was found less than 10 per cent to the total food available, it has time specific importance, as it is generally received during the food shortage season starting from March to June when there is high demand of agricultural labor for maize and rice plantation.

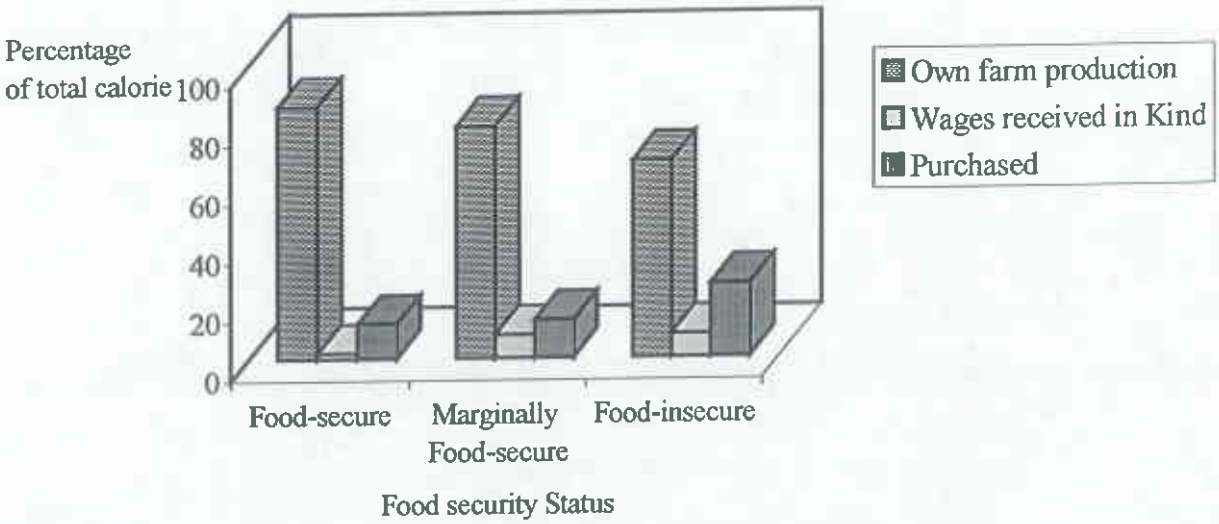

Figure 6.1 Sources of food supply by household food security status
(Source: Survey data, 1998)

The overall contribution of purchased grain to the total dietary energy supply was found very small. Especially food shortage households purchase rice from the nearest

market (Sidhuwa) and or from the surplus-producing households within the community. The overall food supply from purchased grain among the food insecure households was found about 15 per cent.

Gathered food from forest, streams and other areas has also important contribution to the overall household food security as they enrich the variety in the food consumption. Gathered food particularly wild vegetables are significantly important during the dry season when there will be no green vegetables available in the farmyard. Unfortunately, in the recent years, with the declining forest area and animal grazing, availability of those forest foods has been reported sharply declined. The wild leafy vegetables are collected particularly during the pre-monsoon and monsoon period starting from May to August. The important collection areas of wild vegetables are mentioned around agricultural fields, grazing land, stream bank, forest etc. About 80 % of the households respond that they use at least one or two species of wild vegetables as their vegetable relishes, but none of them could quantify the gathered vegetables as they have no any regularities of its collection. Nonetheless, remarkable importance of such gathered vegetables was mentioned particularly during the dry season when there will be no more vegetable supply from their farmyard.

6.6 Cash income and sources

Even though, the production and consumption systems in the study area are basically subsistence in nature, cash earnings is almost indispensable both for production investment and consumption. Despite the fewer opportunities of off-farm works within and outside the community, households in the study area have diversified their sources of cash earnings through different ways. Cash sent by the household member working in foreign countries and the seasonal migrant, pension (collectively defined as remittances), cash earned from wages labor within and outside the communities, and salaries are found the major sources of off-farm cash revenue. Rural cottage industries like bamboo craft,

carpentry, tailoring, black smith, brewing local alcohol etc. were found other importance sources of cash income in the village, even though the amount of earning was reported at minuscule. Cottage industries were found limited within the specific ethnic group as defined by the social systems. Off-farm income aggregates more than 50 per cent to the total cash earnings on an average among the sample households, but the sources are, however, found different among different household's status and ethnicity. Wages labor is the major source of cash earnings among the small farm households, as they mostly involved in agricultural laboring and portering (carrying load manually from one place to another). Since, the small farm size cannot sustain their livelihood, they are mostly involved in selling out their labor to the large farm size holders. In some cases, there is almost patron-client type relationship, where the poor regularly provide labor to the patron households and get food and cash instead. Remittance contributes notable amount to the total cash earnings among the sample households, though the number of households receiving the amounts is only about twelve percent. Since, there is some tradition within *Limbu* community to send sons to the British-Gurkha army, households getting remittances and pensions from the British-Gurkha regiments accrues comparatively higher amount of cash earnings among the *Limbu* ethnic group. However, the recruitment into the British-Gurkha regiment has now been declined sharply. Temporary migration for working in the foreign countries like Middle East, South Korea and Malaysia was also found increasing. But the remittance receiving from those migrants was mentioned uncertain, and sometimes barely enough to pay the debt borrowed to pay to the middleman and to manage other expenses before going to those countries. Moreover, it was mentioned that the amount received as remittances from the foreign countries are used mostly to buy land or pay mortgages. Conlin and Falk (1979) have also found similar result with regard to remittance and had further explained that many middle level households in the mid-hills of Nepal had improved their land holding situation by the investments financed by the remittances particularly from the British-Gurkha army. Although, there is no legal discrimination, the cash earnings from the civil services or so-called white-collar services within the country found mostly accrued to the

well-to-do households, particularly from *Brahmin/Chhetri* ethnic group. This might be particularly due to their higher academic status, as they spend heavily on education for their male children to acquire higher education, which largely determines the entry at various levels of government and non-government services.

Cash from on-farm produce is generated from the trading of on-farm products like cereals, livestock, dairy product (particularly ghee), fruits and vegetables. However, the contribution of on-farm earnings sources except cereals and live animal sales was found virtually smaller. Cereals trading within and outside the village is done based on level of production, type of cereals and cash requirements. Almost all households were found involved in cereal trading in one way or another. The most tradable cereals are millet and rice, as millet is considered inferior grain for staple food and particularly used for making alcoholic beverage, and the rice on the other hand is the most preferred cereal for staple food. Even the most food-insecure households occasionally sell their farm produce; a few eggs, small quantity of ghee, a few number of chicken, one or two goats and so on. Cash earning from the livestock accounts for the highest share to the total on-farm cash revenue. Moreover, relative contribution of livestock sector on the total cash earnings was found highest among the food-insecure households (Table 6.3). This indicates, even under the resource pressure, the poor food insecure households are giving more importance on livestock rearing, which might be their important strategy to cope against food and cash insecurity.

Table 6.3 Cash earnings and their sources by household food security status

sources	Food security status			Sample mean
	Food-secure	Marginally food-secure	Food-insecure	
	---------- Earnings in %----------			
On-farm				
• Grain sale	14.0	13.5	6.5	11.3
• Livestock	18.2	19.8	30.6	22.9
• Vegetable sale	2.5	1.6	2.0	2.1
• Fruits sale	2.8	1.2	2.4	2.2
Total on-farm	**37.5**	**36.1**	**41.5**	**38.5**
Off-farm				
• Remittances and pension	17.6	2.5	32.8	17.7
• Wage payment, services and other off-farm sources	45.2	61.2	25.5	44.1
Total off-farm	**62.8**	**63.4**	**58.3**	**61.8**
Total cash earnings per AE (NRs)	**9,720**	**6,179**	**4,988**	**6,935**

NB: NRs= Nepalese Rupees

(Source: Survey data, 1998)

6.7 Cash expenditure

The average cash expenditure was found increasing with the increase in household size. However, the purpose of expenses differed by the household status. With the increasing food security status there is decreasing proportion of household expenses on the stable food items but increases in quality food like meat, dairy products etc (Table 6.4). A large share of expenditure exceeding 50 per cent of the total cash expenditure goes for consumer item like kerosene, soap, oil, clothings etc, which are costly and should carry from the long distance. The average cash expenditure per AE was about 4,000 NRs (equivalent to US $ 61) per year on an average indicating a minimal cash transaction and higher dependency on own on-farm production for household requirement. When compared the cash expenditure in services like education

and health, there seems a big difference between food-secure and food-insecure households, which implies that the food-insecure households are not able to allocate their household-budget for health and education after the daily consumption expenditure. Since a large proportion of the cash earning has to spend for daily consumption, the food-insecure households are therefore unable to make long-term investment, which has further deteriorated their living creating a situation of low investment- low production-low consumption engulfing them into a vicious cycle of poverty and food insecurity.

Table 6.4 Cash expenditure by household food security status

	Food-security status			Sample mean
	Food-secure	Marginally food-secure	Food-insecure	
	----------Percentage----------			
Food	**25.4**	**31.0**	**36.2**	**31.0**
• Staple food	9.5	17.0	24.5	18.0
• Meat	13.4	12.5	10.2	11.0
• Vegetable	0.5	0.6	0.4	0.5
• Other food	2.0	0.9	1.6	1.5
Consumer goods	**55.4**	**51.0**	**53.9**	**53.2**
• Kerosene	4.2	3.5	3.1	3.6
• Clothing	43.3	39.2	40.2	40.9
• Tea, sugar and salt	3.5	3.8	2.5	3.2
• Alcoholic drinks and tobacco	2.0	1.5	4.1	2.5
• Other consumer goods	2.4	3.0	3.2	2.9
Service	**19.6**	**18.0**	**10.0**	**15.9**
• Health	3.5	3.6	2.9	3.3
• Education	13.2	10.5	4.6	9.4
• Transportation	2.9	3.9	2.5	3.1
Total expenditure per AE (NRs)	**4,109**	**2,715**	**3,567**	**4,148**

NB: NRs= Nepalese rupees

(Source: Survey data, 1998)

CHAPTER VII

FACTORS DETERMINING FOOD AVAI LABILITY

This chapter deals the household food availability for consumption, its distribution pattern and the factors determining the food availability. At the end of the chapter problems related to food insecurity and households' food strategies to mitigate the food insecurity problems are discussed. Growing body of literature referring to food concern mostly on calorie based on the assumption that other needs are usually satisfied if calorie consumption is satisfactory (Maxwell and Frankenderger, 1992). Grounded on the same underlining concept, the present study has focused on per capita calorie availability expressed in-terms of adult equivalent unit of consumption, in order to analyze households' food security. Since food availability is the necessity condition for food security, a household food availability model was designed using least square linear regression in order to identify relative significance of different socioeconomic variables on net food availability for consumption. Inasmuch as, the data generated for this study were derived from cross-sectional household survey, the model presented does not deal temporal variation in food availability.

7.1 The aggregate food supply

As the production systems in the study area are subsistence in nature, the production decisions were found objectively consumption oriented. The systems are self-reliant with a scant use of external inputs, and the total household production goes both for consumption as well as further production investment in the form of seed, labor payment and livestock feed. Other than consumption, the farm produces generate cash for household daily requirement from the sales of grain, vegetables, livestock, fruits etc. The cash is further spent to buy food (particularly rice), consumer goods, agricultural inputs, and services. Therefore, the physical flow of household food supply model (Figure 7.1) starts from own farm agricultural production: a large share (40%) of the total farm production goes for the household consumption. The remaining part of the

production goes for seeds, labor payment, animal feed, sale, exchange, social obligation etc. The cash generated from the sale of on-farm produces together with off-farm revenue and remittance constitute the household total cash revenue. In the same manner, consumption from the own on-farm production and consumption from trading (purchase, wages received in kind, and barter) aggregate the total household consumption. The overall scenario of farm food flow indicates that other than own on-farm production, the market purchase, wage received in kind, exchange etc. are also important sources of food for consumption. However, total food supply from those sources account for less than 20 per cent on an average. Furthermore, the degree of dependency on each source of food supply differs from household to household basically determined by the household's resources endowment and consumption behavior.

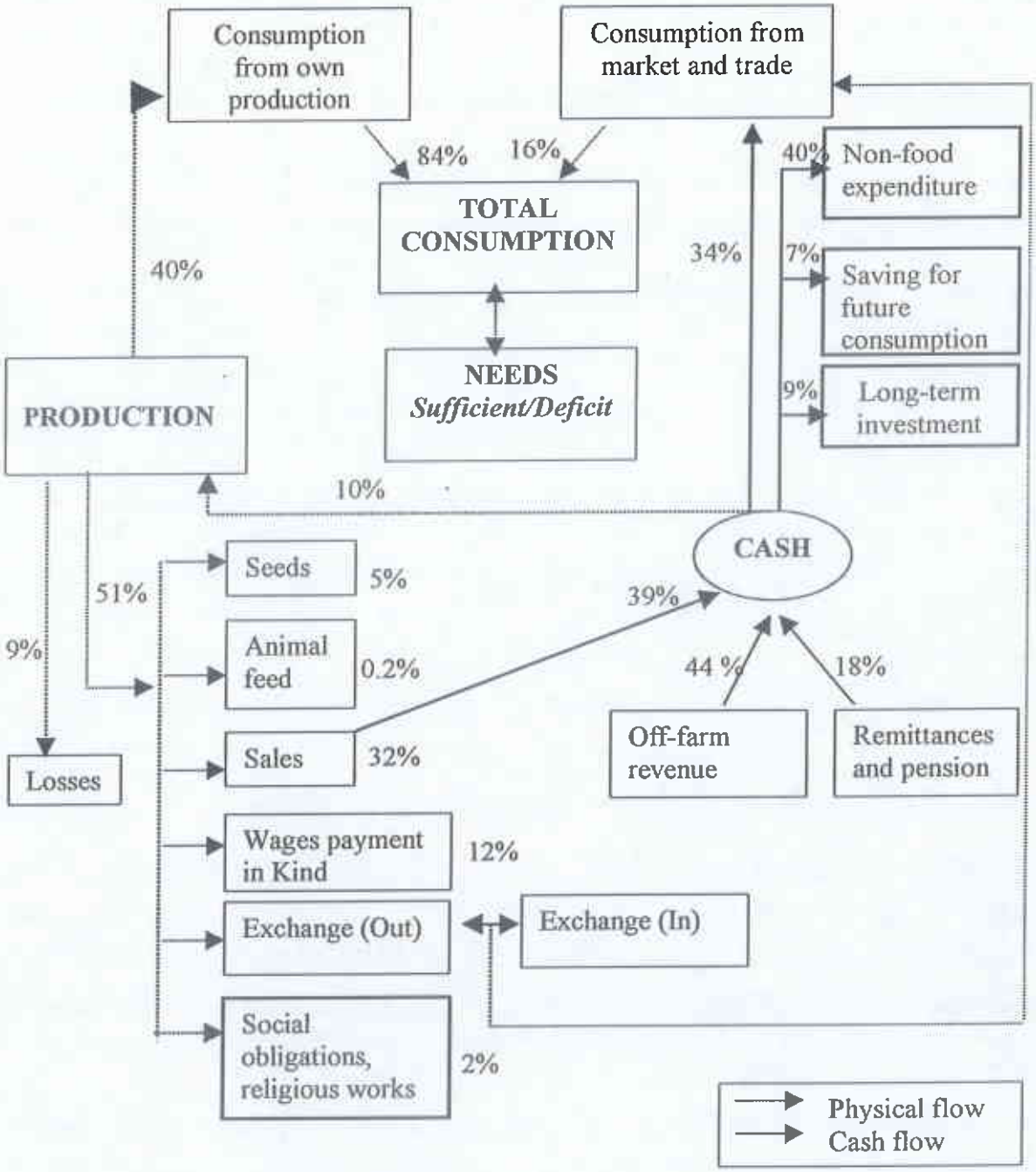

Figure 7.1 Physical and physical flow of household food supply
(Source: Survey data, 1998)

7.2 Households distribution by the level of food availability

Once the per capita food availability in terms of Kilocalorie per AE per day was calculated from the disappearance equation (described in Chapter III p 33), the distribution pattern of sample households by the level of food availability was examined by plotting them into histogram (Figure 7.2). Among 135 sample households 10 per cent were found to be getting less than 1,500 Kcal per AE per day. A majority of households (55 per cent) were able to get 1,500 to 2,500 Kcal and a negligible number of households were found obtaining more than 4,500 Kcal per AE per day. In aggregate, more than two-third of the sample households were found getting less than subsistence calorie requirement of 2,500 Kcal/AE/day.

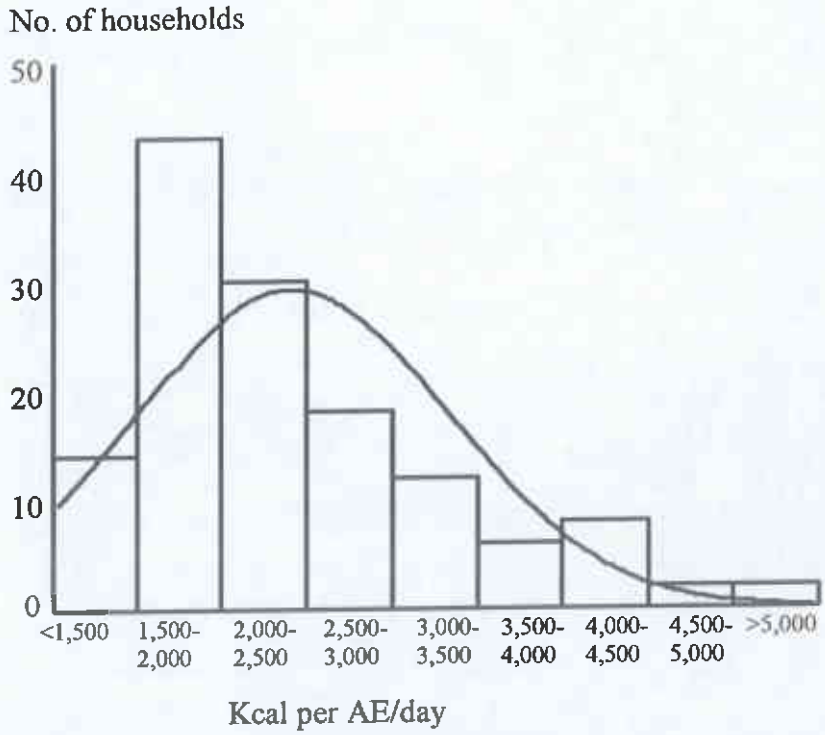

Figure 7.2 Distribution of sample households by calorie availability per AE per day (Source: Survey data, 1998)

7.3 Factors determining food availability for consumption

7.3.1 Specification of the model

This section presents an econometric model designed to analyze the relationship between the net calorie availability for consumption and some predetermined resource and demographic variables. The coefficient of each individual variable obtained from regression analysis was then used to interpret the relative contribution of each variable in the aggregate food availability expressed in terms of Kilocalories per AE per day. While designing the model, variables were defined with their expected results. The model was specified as:

$$KCAl\_AE = \alpha + \beta_1 LNDSZ\_AE + \beta_2 CASHREV\_AE + \beta_3 TADOPT + \beta_4 LSTUNIT\_AE + \beta_5 SHEAFM + \beta_6 ACTIVE + \beta_7 AGEHH + \delta_1 D_1 + \delta_2 D_2 + u \quad \text{----------} \ (7.1)$$

Where KCAL _AE is net household food availability (Kilocalorie per AE per day calculated by disappearance equation)

α is constant term

β_1- β_7 are regression coefficient for explanatory variables

LNDSZ_AE is cultivated land size (hectare per AE).

CASHREV_AE is total cash revenue both from on-farm and off-farm (Rupees per AE)

TADOPT is technology adoption index

LSTUNIT_AE is livestock holding (livestock unit per AE)

SHEAFM is the proportion of economically active female household member to the total household size

ACTIVE is total number of economically active household member

AGEHH is age of the household head (years)

D_1 is literacy status of the household head

1 if household head can read and write

0 Otherwise

D_2 is ethnicity dummy

1 if *Bhramin/Chhetri* household

0 otherwise

δ_1 and δ_2 are coefficients for dummy variables

u is stochastic error term

7.3.2 Test for multicollinearity

Multicollinearity problem arises when some or all the explanatory variables are highly correlated reducing the precision of estimation. A simple way of checking multicollinearity is to check simple correlation coefficient among the explanatory variables (Sriboonchitta, 1983). Since there is no specific rule, correlation coefficients greater than 0.80 among the explanatory variables was used to indicate existence of severe multicollinearity, as a thumb rule (Studenmund, 1992). Furthermore, coefficient of determination (R^2) from the OLS regression was compared with correlation coefficient matrix of explanatory variables to decide whether the model has presence of severe multicollinearity. Inasmuch as none of the correlation coefficients were found more than R^2, it was considered that explanatory variables included in the model are free from the severe multicollinearity problem. With the exception of few variables most of the variables have below 0.30 simple correlation coefficients and none of the variables has correlation coefficient more than R^2 in the absolute value (Table 7.1).

Table 7.1 Correlation coefficients matrix of variables included in the model

	KCAL -AE	AGE HH	SHE AFM	LNDS Z_AE	TAD OPT	LSTUNI T_AE	ACTI VE	CASHR EV_AE	D1	D2
KCAL_AE	1.00									
AGEHH	0.24	1.00								
SHEAFM	0.15	0.18	1.00							
LNDSZ_AE	0.67	0.33	0.03	1.00						
TADOPT	0.42	0.19	0.13	0.45	1.00					
LSTUNIT_AE	0.52	0.21	0.07	0.48	0.35	1.00				
ACTIVE	-0.11	0.24	0.25	-0.00	0.12	0.02	1.00			
CASHREV_AE	0.33	0.07	0.11	0.30	0.48	0.26	-0.06	1.00		
D1	0.13	-0.29	-0.01	0.11	0.39	0.14	-0.02	0.39	1.00	
D2	-0.07	-0.03	0-.05	-0.24	-0.48	-0.32	-0.06	-0.31	-.036	1.00

(Source: Survey data, 1998)

7.3.3 Test for heteroscedasticity

Since all estimation technique assume that error term is homoscedastic within the equation. Therefore, existence of homoscedasticity has important implications for all the estimation techniques (Shriboonchitta, 1983). For the linear statistical model, where data are collected from different social stratum, there is likely to have existence of heteroscedasticity (ibid.). Under such condition the variance of disturbance term sometimes happens to be systematically related with one or some explanatory variables as value of error term is more likely to be small for smaller value of explanatory variable and vice versa (Judge *et al.*, 1982, Harvey, 1976).

Having no *a priori* evidence about the nature of heteroscedaticity, a postmortem examination of residual squared ($\hat{u}_i^2$) was done plotting them against the one explanatory variable to see if there is any systematic pattern. Although, $\hat{u}_i^2$ and u_i^2 are not the same, u_i^2 can be used as proxies for $\hat{u}_i^2$ (Gujarati, 1995). Ordinary Least Square (OLS) regression was first run and then $\hat{u}_i^2$ were plotted against land size variable (LNDSZ_AE). The results from scattered plot exhibited almost linear relationship between u_i^2 and LNDSZ_AE, suggesting the presence of heteroscedasticity in the data.

Further empirical test of heteroscedasticity was conformed by using Glesjer test. Therefore in order to correct the heteroscedasticity problem in the data and increase the efficiency of estimation Generalized Least Square (GLS) technique was employed by using LIMDEP software packages.

7.3.4 Selection of functional form

Inappropriate functional form of included variables in the model causes serious consequences leading to the misinterpretation of results. Therefore, it is of crucial importance to identify suitable functional form of the variables included in the model before designing the final model. Since food availability for consumption based on the overall household resource endowment and household demographic structure, it is assumed that food availability for consumption increases with increasing household resources. Therefore, there might have some proportionate relationship between food availability for consumption (dependent variable in the model) and resources variables (explanatory variable). In order to examine the relative change in food availability in response to unit change in the resource variables, both linear and semi-logarithmic (*log-lin* model) functional forms were examined, and the coefficient of determination (R^2) was taken as the criteria for selecting appropriate functional form of the model. As the dependent variable is transformed into natural log, R^2 of the semi-log functional form equation is not directly comparable, therefore, quasi-R^2 was calculated taking anti-log of the transformed variable ($\widehat{\ln KCAl\_AE}$) as suggested by Studenmund (1992).

$$Quasi\ \ R^2 = 1 - \frac{\sum[KCAL\_AE - anti - \log(\widehat{\ln KCAL\_AE})^2]}{\sum[KCAL\_AE - mean\ \ of\ \ KCAL\_AE]^2} \text{--------}(7.2)$$

$$= 1 - \frac{[4.6E+07]}{[1.1E+08]}$$

$$= 0.59$$

The quasi-R^2 obtained from the above equation (7.2) is higher than the adjusted R^2 (0.56) obtained from the linear equation implying that the semi-log equation provides a better overall fit than the linear one. Therefore, based on the overall fit of the equation, semi-log functional form was tentatively chosen. The final selection was, however, made using Box-Cox test. To use the Box-Cox test both transformed and non-transformed form of the dependent variables were deflated by their respective geometric means and then regressed with explanatory variables (Studenmund, 1992), and the functional form with lower residual sum of square (RSS) was then chosen. Since, the semi-log functional form resulted lower RSS i.e. 0.10 than that of linear functional form (RSS value of 9.22) the semi-log functional form was then finally selected. This semi-log model gives neither a constant slope nor a constant elasticity. If an explanatory variable changes by one unit, then change on dependent variable takes place by $\beta i.100$ per cent, holding other variables constant. The slope and elasticity are calculated by $\beta i.Yi$ and $\beta i.X_i$ respectively (ibid)

7.3.5 Descriptive statistics

The descriptive statistics viz. mean, standard deviation, coefficient of variation (CV), minimum and maximum value of each variables included in the model are presented in Table 7.2. The coefficient of variation, which reflects dispersion in the data set appeared to be greater than 25 per cent in all variables included in the model. Among the variables included in the model, the total cash revenue per AE found to be with higher variation.

Table 7.2 Descriptive statistics of the variables included in the model

Variables	Unit	Mean	Std. Dev.	CV %	Mini-mum	Maxi-mum
KCAl_AE	Kilocalorie	2,413.8	918.6	38	1,173.00	5,242.00
AGEHH	Years	47.77	11.82	25	20.00	77.00
SHEAFM	Ratio	0.38	0.16	42	0.10	0.83
LNDSZ_AE	Hectare	0.34	0.21	61	0.06	0.97
TADOPT	Percentage	32.64	22.29	68	4.5	87.50
LSTUNIT_AE	LSU per AE	0.86	0.44	51	0.04	2.3
ACTIVE	No./household	3.08	1.26	40	1.00	6.00
CASHREV_AE	NRs per AE	6,935.00	8,424.50	121	133.70	52,300.00

(Source: Survey, 1998)

7.4 Empirical results and discussions

From the test of heteroscedasticity as described earlier, it was understood that the assumption of homoscedastic variance in the model is no more valid. Therefore, the LIMDEP software package, which provides White's heteroscedasticity-corrected variance and standard error along with the Generalized Least Square (GLS) estimation (Green, 1985) was employed to estimate the regression coefficients. The outcomes of the regression analysis are presented in the Tables 7.3

Table 7.3. Results of Generalized Least Square (GLS) estimation

Dependent variable: ln(Kcal/AE/day)

Variables	Unstandardized coefficients		Standardized Coefficients		
	B	Std. Error	Beta	T-ratio	Sig. level
Constant	6.956	0.110		63.017	0.000
AGEHH	0.003	0.002	0.089	1.284	0.202
SHEAFM	0.319	0.131	0.146	2.432	0.016
LNDSZ_AE	0.742	0.116	0.455	6.409	0.000
TADOPT	0.003	0.001	0.206	2.590	0.010
LSTUNIT_AE	0.209	0.55	0.259	3.791	0.000
ACTIVE	-0.045	0.018	-0.162	-2.550	0.012
CASHREV_AE	1.17E-06	0.000	0.028	0.402	0.68
D1	0.095	0.061	0.113	1.559	0.122
D2	0.188	0.048	0.266	3.887	0.000

F-statistics (9,125) = 20.11, Significance level of F-test = 0.000

Results from regression analysis presented in the above (Table 7.3) show that with the exception of number of economically active household member, the sign of variables included in the model are in consistent with the underlined expectations of the model. The key results form regression analysis suggest that access to land is by far the most important determinant of food availability in the study area. The central role of land holding in determining consumption availability of food might have largely resulted from the household economic structure, where a major share of food comes from own on-farm production. The standardized beta coefficients obtained by subtracting mean by observed value of each independent variables and dividing by its own standard deviation revealed that land holding with beta coefficient of 0.45, explains relatively higher variation in the food availability per AE per day. Tschirley and Weber (1994) in their study in rural Mozambique have also reported land holding as a principal determinant of income and food consumption. Empirically the present result suggests that keeping other variables constant, an increase in one unit (hectare per AE) of cultivated land holding increases the food consumption per AE per day by 74 per cent. In other way, one unit (hectare per AE) changed in cultivated land holding increases calorie availability (Kcal/AE/day) by 1,678

unit. Moreover, if we express the figure in more practical way using the local unit of land i.e. *ropani* (one *ropani* equivalent to 0.05 hectare), there will be 84 unit increase in calorie available for consumption per AE per day by increasing one *ropani* of cultivation land per AE.

The result empirically revealed that lack of cultivating land as the major constraint of household food security in the study area where farm production is almost entirely consumption oriented. Obviously, land fragmentation as a result of increased population size could be the major reason responsible for decreasing land availability in the study area. The key role of access to cultivating land on household food security might also be largely related to the poor infrastructure development resulting lack of alternative sources to household sustenance other than agriculture. This result, therefore, may differ under the condition of developed market accessibility with off-farm employment opportunities where dependency on land for sustenance is lower.

Livestock being a productive asset plays crucial role in determining agricultural production and productivity especially under the subsistence agricultural production systems. Importance of livestock as the major source of wealth and investment in the rural areas has been widely recognized. Livestock, therefore, has important contribution to household food security directly by providing animal food and indirectly through income generation and supporting crop production systems. Considering its overwhelming importance in agricultural production and consumption, livestock holding in term of LSU per AE was included in the model. The empirical evidence from regression analysis shows a positive and significant ($p<0.01$) effect of livestock holding on calorie availability per AE per day suggesting that with the increase of one unit livestock (LSU) per AE the food availability increases by 20 per cent, *ceteris paribus*. Moreover, the estimated beta coefficient (0.259) for this variable also revealed significant role of livestock to explain variability in the household food availability. This result corroborates with the findings of Castro *et al.* (1981) indicating livestock as a major

determinant of household food production and consumption. Food availability response to livestock holding is presented in Figure 7.3, which shows other variable remaining constant, if the present level of livestock holding is increased to the level of about 1.3 LSU per AE, the subsistence calorie requirement could be met.

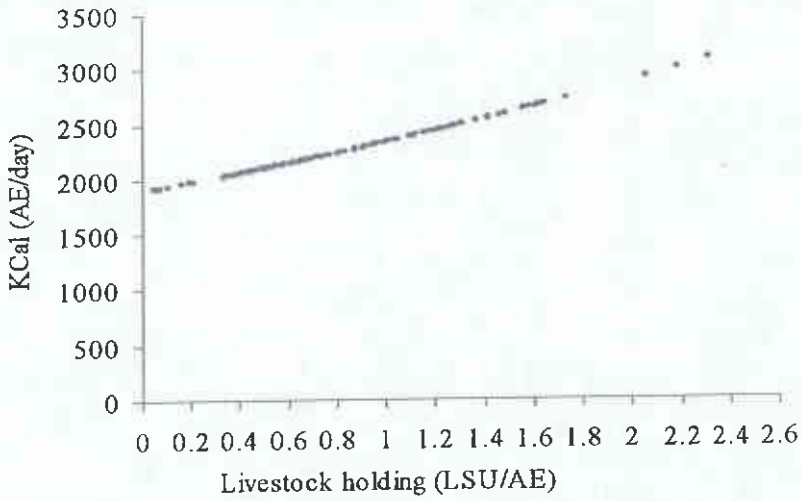

Figure 7.3 Food availability response to livestock holding

The number of economically active household member was presumably considered as one of the important household resources determining the level of on-farm food production and food acquisition from different sources and finally household food security. The number of economically active member, therefore, was included in the model to examine its effect on overall food availability, and was expected to have positive effect on household food security. Contrary to the expectation, the coefficient of economically active household member was found negatively significant ($p<0.012$). The result suggests that other things remaining the same, an addition of an adult member in the household reduces average energy availability for consumption (Kcal per AE per day) by 4.5 per cent. In other words, withdrawal of an economically adult member of the households adds 4.5 per cent up daily calorie availability for consumption to the rest, which suggests existence of surplus labor and increasing population pressure on limited

available resources and lack of off-farm employment opportunities. The problem has further manifested by the overwhelming percentage of unused available man-days during the winter, when there are no agricultural activities. Looking at the present population growth trend and the population structure, the above mentioned result indicates a serious threat on household food security, if population growth is not checked. Tschirley and Weber (1994) in their study have also reported declining calorie availability with the increasing adult household member in the rural Mozambique.

Women's role in household food security is considered crucial, and it is widely accepted that despite the daily household's chores, women activities are mostly revolved around the household welfare through production, processing and acquisition of food. Bajrachayra (1993) in her case study in the eastern mid hills of Nepal has also reported substantial involvement of women in agricultural production activities in spite of daily household chores. Due to complexities and time constraint, data on women's share in different economic and non-economic activities was not collected in this survey. Therefore, proportion of adult women to the total household size was used as a proxy variable and regressed against food availability in order to understand the relative contribution of women on overall household food security. The empirical result obtained from regression analysis showed a significant ($p<0.01$) and positive effect of economically active female household member on calorie availability per AE per day. This result implies that a unit increase in the proportion of economically active women member to the total household size increases the calorie availability per AE per day by 32 per cent, *ceteris paribus*. The above result suggests that despite the negative effect of number of economically active household member irrespective, there is positive role of women labor on overall household food availability (Kcal/AE/day), which could be due to higher involvement of women in household food production and acquisition. Kumar and Hotchkiss (1988) [as cited in Quisumbing (1996)] revealed that even under the resource pressure women's labor productivity in the hills of Nepal was positive in many crops. Additionally, during the course of the survey it was revealed that as compared

with their male counterparts, women agricultural labor from food insecure households in general prefer grain payment to cash payment for their wage payment which further support the above empirical results.

Even under the subsistence rural economy, it is customarily considered that access to cash as one of the most influencing factors of household food security since it determines the level of production and consumption investment. Considering the above underlying assumption, the total cash revenue per AE irrespective of sources was included in the model and was expected to have major contribution on overall food availability on consumption. Contrary to assumption, the regression results showed no statistically discernible effect of cash revenue on food availability although there is positive correlation. As the maximum share of food is acquired from own on-farm production, and larger section of cash revenue accrued among the food secure household from their own farm production, the effect of cash revenue on household food consumption availability was found to be non-significant. This result again corresponds to the results of Tschirley and Weber (1994) in rural Mozambique. However, as a means of acquiring productive resources, cash entitlement in the long run may play a crucial important role in household food security by increasing household access to productive resources like land and livestock. The weak influence of cash on food acquisition can further be interpreted as a result of lack of market for both agricultural products to sell and buy food products in the study area. Additionally, lack of off-farm employment opportunities has further impeded their purchasing capacity among the food insecure households. Lack of cash earning opportunity has, therefore, pushed the farm households towards self-reliance on their own on-farm production to ensure household food security.

Prominent variations in the choices of farm enterprises and consumption behavior were found among the different ethnic groups determined traditionally by the Hindu caste hierarchy. Therefore, ethnicity effect was presumably hypothesized to have positive influence on household food availability. An ethnicity dummy used in the model was,

therefore, found to be positively significant suggesting that *Brahmin/Chhetri* households are in better off situation in term of food acquisition than other ethnic groups in the study area. Conlin and Falk (1979), and Khare (1984) have also reported analogous results from their study in eastern hills of Nepal and northern India respectively.

It is obvious that adoption of modern varieties of cereal crops is important to enhance production, productivity, and finally overall household food supply, where a major share of household energy consumption is derived from cereals. Realizing the importance of improved cereals' varieties adoption on overall food supply, an adoption index was developed (Chapter III, p. 35.) considering the number of improved cereal crop varieties adopted/adapted by the individual sample household. The regression results showed significant effect of adoption index on food consumption availability. However, there was strong correlation (r=0.42) between land holding size and adoption index. This result can be further inferred that the most of crop varieties recommended by the research center are either in favor of large farm size holders or they are not in line with the needs of smaller farm households. As majority of households in the study area are small farm size holders, response of modern variety adoption on household food supply was found to be very small. Keeping other variables at their mean, food availability response to land holding and modern variety adoption is depicted in Figure 7.4.

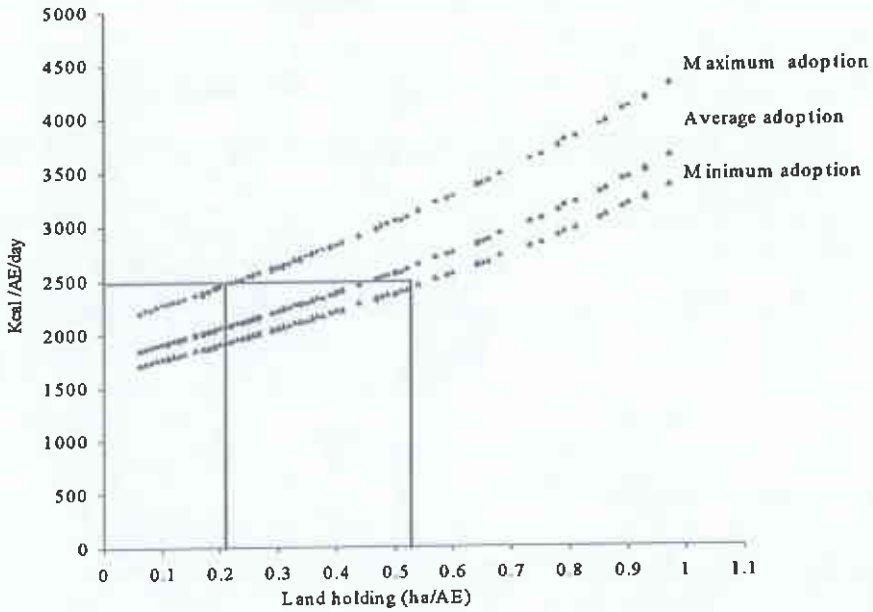

Figure 7.4 Food availability response to land and modern varieties adoption

Examining the response of food availability on land size and modern varieties adoption index, two scenarios emerges. First, even under the poor adoption scenario, if the present average land holding size (0.34 hectare per AE) is doubled, the subsistence calorie requirement i.e. 2,500 Kcal/AE/day could be met. The second scenario shows that under the present level of land holding, even if the modern variety adoption reached up to the full scale, the subsistence calorie requirement could hardly be met. Therefore, under the present situation, food security intervention through modern variety adoption may work well only under the large farm size condition. However, looking at the limited scope of increasing land availability, even if there is small response of modern variety adoption on aggregate food availability amongst the a small land size holder, increased modern variety adoption may be one way out to improve the food security situation at least for the short-run.

Educational status of household's head plays important role in the household resource management, technology adoption and even in the household food consumption behavior. Because of pervasive illiteracy in the rural hills of Nepal, educational status of household head measured in terms of years of schooling does not carry any pertinent meaning so far. Therefore, for the purpose of this study a dummy variable was used as whether or not a particular household's head can read and write. The empirical result from the regression analysis showed a positive effect of literacy on food availability, albeit, the extent of the effect was statistically non-significant, which might be due to the overwhelming prevalence of traditional production systems with low level of technological intervention.

Since this study was carried out in an interior rural area without road and market access, subsistence farming with the objective of ensuring household food requirement is the characteristic features of farming systems in the study area. The key results from statistical analysis indicate that calorie availability for consumption is highly correlated with access to cultivating land, and many farm households with smaller land holding was found to be unable to meet even the 80 per cent of calorie requirement. Livestock keeping, which could be one of the eminent strategies of ensuring food and cash security, found a major component of farming systems. The role of livestock on overall food supply has, therefore, found to be of great significance. Due to negligible market orientation both for selling and buying of agricultural produces cash transaction in the study area was found minimal which might have led self-reliance on food production and consumption. Having no alternative employment opportunities and pervasive underemployment with high dependency on agriculture have led pressure on available limited land resource for sheer survival. As regard to the ethnic variation in the household food availability that might have practically backed up by the cultural and rituals values determining the household consumption behavior and the choice of farming practices.

Since own on-farm production is the most quantitative component of food security among all the sample households, it forms the basis for food entitlement in terms of direct consumption of production. As the physical level of food supply determined by the total area of cultivation and per unit production, increasing productivity through technological intervention is important to enhance on-farm food security. Therefore, increased adoption of modern varieties together with inputs would be one way to boost up existing level of production and productivity thereby improving the food security situation at least amongst the large farm size holders.

7.5 Constraints to household food security

Understanding of the problems associated with food insecurity is important to design and implement food security interventions. This study has attempted to identify perceived problem, which are directly or indirectly responsible for hindering the household food security situation in the study area.

Problems identified through farmers' group and ranked by individual discussions were incorporated in the survey questionnaire and were assigned to rank by the individual interviewee. A simple three point scale: 1-3 was used to prioritize severity of the problem: 1 for least severe, 2 for moderately severe, and 3 for the most severe problem. The frequency of responses on each problem was then multiplied by the severity scale and aggregated to find out cumulative score. Based on the cumulative score the individual problem was ranked accordingly (Table 7.4)

Table 7.4 Household's perceptions on constraints to food security

Constraints	Severity level			Total score	Rank
	3 (Most)	2 (Medium)	1 (Least)		
	--------Number of responses----				
• Lack of irrigation	48	3	0	150	I
• Lack of employment opportunities	35	14	12	145	II
• Lack of suitable land	24	27	10	136	III
• Lack of market	17	24	12	116	IV
• Lack of inputs	20	25	5	115	V
• Diseases and pest	21	23	4	113	VI
• Lack of technical know-how	18	23	7	107	VII
• Land fragmentation	18	19	7	99	VIII
• Increased household size	16	5	19	77	IX
• Low wage rate	10	8	14	60	X
• Indebtedness	7	4	5	37	XI

(Source: Survey data, 1998)

From the results of problem ranking as mentioned earlier, lack of irrigation, lack of employment opportunity and lack of suitable land for cultivation came out to be the major problems associated with household food insecurity in the study area. Lack of irrigation, the most serious problem identified has resulted in declining agricultural production and productivity. As mentioned earlier, winter fallow was the prominent characteristic of the study area largely due to the problem of irrigation, which eventually rendered the cultivating land as an open access for grazing during the winter season. Lack of employment opportunity within and even outside the village, indeed, reduced their purchasing capacity to obtain required food and further investment for production.

This has further induced the situation of low production, low consumption and low investment, which has eventually intensified the problem of poverty and food insecurity.

Moreover, declining agricultural production and productivity is magnified by the lack of technological intervention and insufficient extension services. With the increasing demand for food due to increasing population to feed, the present level of production is not sufficient to meet the household food requirement. Therefore, many farm households are loosing their food self-sufficiency status. Obviously, lack of employment opportunities other than seasonal agricultural laboring with a minimum wage has further aggravated the situation among the poor households who are unable to sustain their living from their own farm production. Due to increasing hardship, during the late eighties, there was almost an established trend of permanent migration to *terai* from the study area. But the situation now has been changed due to increasing population pressure and heightened land price in *terai,* which compelled the poor households to eke out their living from the limited resources.

Since rural infrastructure is of central importance in enhancing production, consumption, distribution and trade, lack of transportation has been realized as one of the critical constraints impeding the agricultural production and productivity in the study area. Having no transportation and rural marketing structure, farm households are not able to sell their surplus agricultural produces, which further declines their access to cash and eventually leads to low investment and low production. Furthermore, lack of transportation and communication has put the farm households disadvantaged with poor access to inputs and information.

Because of property inheritance tradition from fathers to sons, household's productive resources particularly the lands are divided into the small-scattered parcels loosing its economy of scale. Therefore, the poor households with small pieces of land generally are not interested to invest for small piece of land, which is insufficient to earn

their living. That could be one of the major reasons for majority of households responding lack of suitable cultivating land as one of the major constraints associated with food insecurity in the study area.

The changing relationship between agricultural producers and members of occupational groups of people: tailor, blacksmith and leather workers i.e. *Damai*, *Kami* and *Sharki* giving them the traditional caste level (Blaikie *et al.*, 1980) has intensified the food insecurity problem among those occupational groups of people. Traditionally there was client-patron type of relationship between those occupational caste of people and the agricultural producers in the rural hills, which involved kind payment fixed according to some discernible idea of likely annual demand for the services from each of the occupational groups (locally called *Bista* system). During the recent decade the demand for such services has declined sharply because of increasing availability of readymade goods like readymade clothes, agricultural tools, shoes etc. in the cheaper prices. Due to less demand of traditional skill of those occupational groups of people, the *Bista* system in the rural area has been observed fading away. Because of decreased demand for their occupational works, they are now obliged to change their traditional occupations to physical laboring and portering for which they are not accustomed with. This situation has virtually led them into the verge of poverty and food insecurity.

7.6 Households' food strategies

Households facing food deficit problem adopt self-insurance strategies to minimize the risk of food insecurity and reduce likelihood of stress on their household economy. Households' strategies to cope with food deficit problem vary based on the available opportunities and their resource base. Maxwell and Frankkenberger (1991) citing Chang Cham and Thomas *et al.* (1989) explained that households' strategies against food insecurity vary by region, community, social class, ethnic group, gender, age, and the season. Even the poor households with declining food entitlements do not

respond arbitrarily against the problem but try to develop systematic food security strategies according to their available resources and opportunities in order to minimize the risk of immediate food insecurity without compromising the long-term livelihood security. The understanding of household food strategies has therefore been recognized in order to develop food security monitoring systems (Davies, 1993). Furthermore, understanding of household's food strategies provides a basis for development intervention addressing the food insecurity problem.

As food security is inter-linked with the notion of livelihood security, there might have some degree of trade-off between the short-term coping strategies to acquire immediate food need and the long-term livelihood security. The poor food-insecure households are sometimes obliged to meet immediate food requirement at the expense of productive resources like land and livestock, which eventually erodes the long-term livelihood security. Davies (1993) has, therefore, clearly distinguished the short-term and long-term food strategies as the former responds to an immediate decline in access to food, and the latter in contrast, involves a permanent change in the ways in which food is acquired.

Considering the above notion of short-term (coping) and long-term (adaptation) strategies, a group exercise was done with the key informants in order to investigate the household's food strategies of the study area. The household's food strategies adopted in response to food deficit situation were found to be influenced by the severity of the problem, household resource endowment and the available opportunities. Household that faces one or two months food deficiency makes up the gap by selling agricultural produces and borrowing cereals or cash, it rarely faces acute shortage of resources. But the household members should always be prepared to face stress that could result from poor harvest or unforeseen demand for expenditures. Therefore, this type of household faces transitory type of food insecurity. In order to solve the problem in the long run, they try to increase the overall production by intensifying the production systems like

taking additional crops such as vegetables, rearing livestock, and renting-in land. They are, therefore, always looking for increasing production and income in order to secure their consumption. On the other hand, households facing substantial shortage in food each year are in much more precarious situations. This type of household faces acute food shortage every year and live in the situation of hand-to-mouth existence. The only way of living for them is to diversify their source of income. All adult members of those households do off-farm laboring just to sustain their living.

A range of short-term food strategies have been identified from the group discussion, which includes changes in consumption behavior (e.g. eating less preferred food, altering intra-household food distribution, reducing food intake and frequency), food and cash borrowing, livestock sale, sale of household assets, mortgaging or pledging of land, seasonal laboring etc. However, individual farm household adopts varieties of strategies based on its resource endowment and opportunities available. Initially farm household uses adaptative strategies (e.g. adjustment on crop and livestock, change in food habit, borrowing etc.), and as the problem intense there will be more commitment of selling domestic and productive resources. Changes in consumption behavior were found particularly related with the choice of food and frequency of meal. When there is less food available, the poor households reduce their frequency of meal from three to two or sometimes just one meal a day or consume inferior quality food. It was also mentioned that for some households during the most food deficit period the daily meal sometimes depend entirely on the mercy of neighbors. Moreover, many of the poor households with poor resource base are accustomed to living in a state of extreme food deficit situation throughout the year.

Farm household responds to the food shortage by using various distinguishing types of risk management strategies and the short-term coping behavior (Maxwell and Frankenberger, 1992). Initially they attempt to solve the problem by adjusting available resources like crop and livestock. As the problem intensifies over the time there will be

more commitment of domestic and productive resources in order to solve the immediate food problems, which eventually erodes the long-term production potentiality involving a trade-off between immediate problem solving strategies and long-term livelihood security. Maxwell (1995) has, therefore, used coping strategies as a food insecurity indicator as an alternative measure of food insecurity. As commitment to productive and domestic assets increases to solve the immediate food problem, there will be less chance of reversibility to the normal situation. Various strategies are often used together; they have been presented in the sequence of severity and in relation to the chance of reversibility and commitment to domestic resources.(Figure 7.5). Starting with adaptation strategies (e.g. resource adjustment) farm household try to meet the household food demand by selling liquid assets (e.g. small animals), and subsequently productive assets sales (e.g. farmland) as the problem pronounced. At the extreme situation farm household will be obliged to leave the place (out-migration) just to eke out its living.

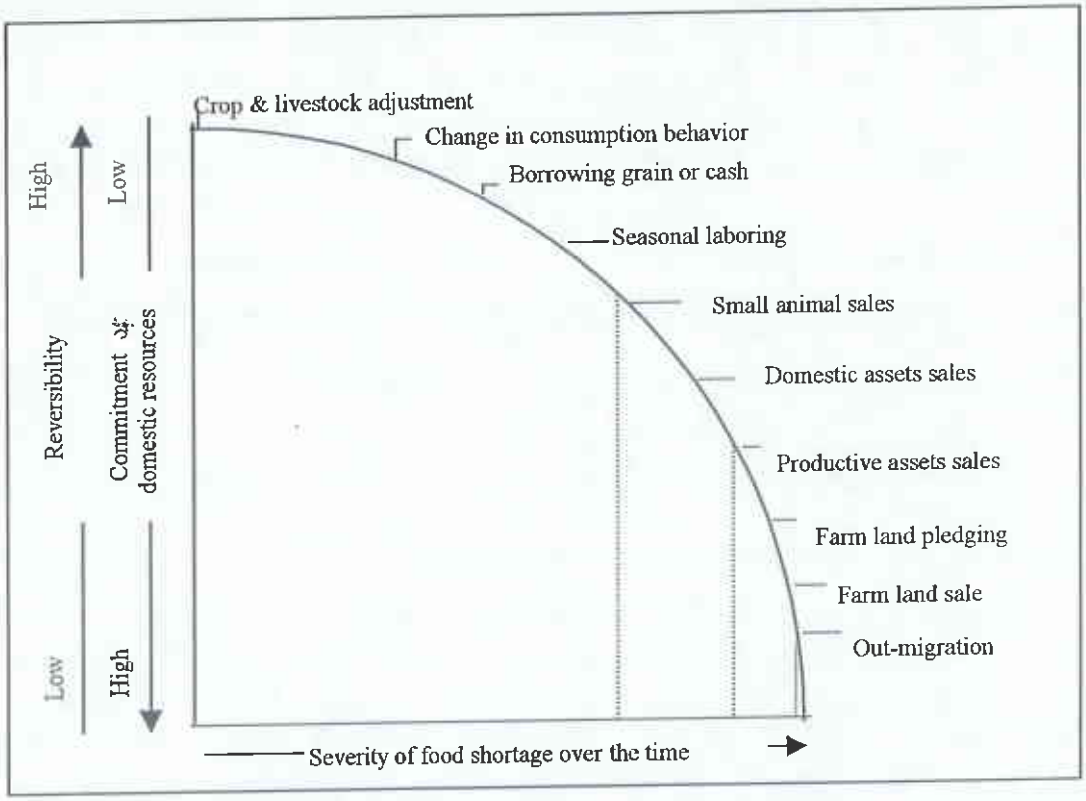

Figure 7.5 Households' responses to food shortage
(Adapted from Maxwell and Frankenberger, 1992)

Due to the unpredictable climatic condition and diverse topographic features, farm households in the study area have diversified their production systems exploiting different agroecological niche. Integration of crop, livestock, horticultural and agroforestry based integrated farming is an example that have been adapted by the farm households to minimize risk and uncertainty. Given the limited land resources, increased agricultural production through extensification is no more possible. Therefore, intensification of crop by intercropping different leguminous and non-leguminous crops particularly on the *Bari* land to increase aggregate production level per unit area of land is an obvious example of long-term strategies adopted by the farm households. In order to get sustainable growth in agriculture production through crop intensification emphasis has been given to the use of more local resources use with maximum resource recycling.

Terracing on sloppy land and compost making from forest bio-mass are important strategies to maintain soil fertility in order to enhance sustainable land use.

Renting-in land is found to be the one of the important strategies for increasing food production among the food deficit households. Farm households having no *Khet* land generally are found to be dependent on rented-in *Khet* land for rice production. Small farm animals such as goats, pigs and chickens are also managed as a safeguard against cash insecurity. Most of the food-insecure households earn cash form selling those animals to purchase food and other households necessities. Interestingly, these animals are widely viewed as a savings bank because they are considered life-saving assets during difficult times. Share rearing of livestock among the poor households was also mentioned as one of the important way out to cash deficit among the poor households. Various forms of animal share rearing are prevalent in the communities depending upon the relationship between rearers and owners. The different households' food strategies discussed above are summarized in Table 7.5.

Table 7.5 Household food strategies, objectives and responses

	Strategies	Objectives	Specific response
Short-term (Coping)	Purchase grain	-Protect consumption	-Use off-farm income -Sell assets -Borrow cash loan
	Receive grain		-Wages received in kind -Reciprocal obligation -Borrow grain -Exchange
	Modify consumption behavior	-Reduce consumption	-Reduced frequency of meal -Consume less preferred food -Reduced amount of food intake -Alternating intrahousehold food distribution
Long-term (adaptation)	-Crop diversification and intensification -Increase productive resources	- Increase production level - Minimize risk	-Use of different agroecological niche (vertical risk adjustment) -Multiple cropping - Choice of different crop with different maturing period (spatial risk adjustment) -Cultivate improved varieties -Renting-in land -Share rearing livestock
	Land improvement	-Increase soil fertility -Minimize risk -Increase production	-Irrigation -Terracing -Composting and manuring
	Diversify sources of off-farm cash income	-Increase purchasing power -Increase investment -Minimize risk	-Diversify off-farm works -Foreign employment

(Source: Group exercise, 1998)

Beyond household level, community level resource management strategies are another important aspect of food security strategies adapted in the study area. Increasing participation in community forest and community irrigation scheme can be recognized as the strong form of community solidarity. There are many forms of social relationship existed in the community, which can be regarded as established strategy to cope against food and cash insecurity. Labor and bullock exchange systems, which contribute significant labor requirement for agriculture has further magnified the strong social coexistence.

CHAPTER VIII

CONCLUSIONS AND RECOMMENDATIONS

8.1. Conclusions

8.1.1 The study settings

Dismal performance of agriculture combined with high rate of population growth has intensified food deficit situation in Nepal. Moreover, unfavorable climatic condition and weak infrastructure development have practically accelerated the food insecurity in hills. Additionally, smaller land holding size and lack of alternative non-farm employment opportunities add to the precarious conditions among the poor farmers.

Realizing the prevailing food insecurity situation the long-term Agricultural Perspective Plan (APP) of Nepal has given its major thrust on improving food security in the country. In order to bring about desirable changes in food security, it is important to identify the food insecure section of population, their resource base, problems, and associated determining factors. This research was designed to identify factors determining household level food security under the subsistence agricultural production systems in the eastern mid hills of Nepal.

A survey study combined with interviews with key informants and farmers' group discussions was carried out at Fakchamara outreach site of Pakhribas Agricultural Center (PAC). With the coverage of 12 wards from four village development committees of Terhathum district, this site represents low production potential area without access to road and market. Inhabited by multi-ethnic societies, the study area encompasses subtropical to mild temperate climatic zone.

8.1.2 The resource pressure

With the total area of 2,164 ha, only 54 per cent is under cultivation. The average size of cultivated land per farm household is about 1.50 ha. However, the land size distribution pattern is moderately skewed favoring towards the larger farm size holders. Considering present household members, the average size of household was found to be six with maximum of 12 and the minimum of a single-family household without children. The population pressure, taking into account the person (adult equivalent) per unit of cultivated land, found to be increasing with decreasing farm size illustrating a high population pressure on per unit cultivating land amongst the smaller land size holders.

Livestock is another important productive resource in the study area. As a major component of farming system, almost exclusively farm households were found keeping at least one or two livestock species, with the multiple objectives of getting food, cash, power and manure for farming. The average livestock holding size was 3.84 LSU with the maximum of 10.43 LSU. Moreover, the livestock density per hectare of cultivating land was found 3.82 on an average. Considering the livestock carrying capacity of a hectare of land, the present level of livestock density seemed to be quite high. The livestock density per unit of cultivating land was found higher among the smaller land size holder implying that even under the limiting resource pressure, the small farm size holder are giving high priority on livestock keeping.

In spite of indispensable interaction between forestry and farm production systems, forest resources in the study area are found scanty with a negligible economic return. Centrally controlled management of forest in the past seriously undermined the traditional responsibility of community, thereby resulting in pervasive forest degradation. Additionally, increasing demand of forest products due to increased population had further intensified the heavy deforestation in the study area. As a result, area under forest had been severely scrutinized. 'Household forest', which is essentially started by the farm

households to meet the growing demand for fodder and firewood, sounds impressive approach to reduce further encroachment in the forest.

8.1.3 The production systems

Farming systems of the study area comprise all components of typical hill farms with close integration of crop, livestock and forestry. Inaccessibility to market and employment opportunity other than agriculture has obliged the farm households to adopt subsistence farming to meet their daily food requirement.

Although a range of crops and cropping patterns are being adopted by the farm households; cereal crops like rice, maize and millet are the major crops of the study area. Rice being the most preferred cereal covers the largest area of cultivation followed by maize and millet. Even under the unfavorable condition farmers practice rice cultivation primarily to meet the households' consumption requirement. Rice-fallow is the most dominant cropping pattern in *Khet* land and maize-millet on the *Bari* land. Wheat cultivation is almost negligible confining at the lower altitude covering less than one per cent of the total cultivating land. It is very common to plant pulses into the maize based cropping patterns on the *Bari* land. Most common pulse crops are soya bean, broad bean, black gram etc. Since crop production system is traditional in nature with low level of technological intervention, per unit average productivity was found to be lower than that of national as well as regional (eastern hill) averages.

Livestock production system is entirely based on crop by-products, farm forest and grazing. Therefore, integrating livestock in the farming systems has enabled farm households to support their crop production systems and the livestock itself. As livestock management is entirely based on crop by-products, fodder and forage, there seemed a seasonal variation in livestock productivity particularly determined by the availability of fodder and feed stuff. Because of high livestock density per unit area of cultivating land,

and dominance of local breed, the average productivity of livestock was found to be extremely low.

Growing diverse species of fruits and vegetables adjacent to the homestead as 'home-garden' was found a traditional practice among the farm households. Traditional vegetables and citrus fruits species are the most predominant species grown in the home garden. Despite the realized significance of home gardening for household food and nutritional security, very few number of households were found able to maintain year-round homestead gardening. Lack of irrigation and strayed-animals problem during the winter were reported to be the serious constraints to maintain year-round homestead gardening in the study area.

Forests play a crucial role in providing food security. As an integral component of farming systems, forest not only provides forest fruits and vegetables for the village dweller but also support livestock and crop production systems. Leafy wild vegetables enhance variety in the human diet and are found particularly important during the dry season when there are no more green vegetables produced in the farm yard. Despite the significant role of forests in household food security and maintaining ecological balance, the fast depletion of forest resources in the past has degraded economic importance of forest. Therefore, forest plantation with selected plant species including forest fruits, nuts, fodder, perennial woody tree not only enhances economic importance of forest but also provides positive impact on environment and forest ecology.

8.1.4 The food situation

Based on production, requirement and distribution data, the Aggregate Household Food Security Index (AHFSI) for study area showed a critical level of food insecurity situation. Although, the average calorie available for consumption was 2,414 Kcal per AE per day, which is about four per cent less than subsistence requirement, about 42 per

cent of households were found getting lass than 80 per cent of their subsistence calorie requirement.

Rice is the principal staple followed by maize and millet. Millet consumption as staple was found only among poor households, otherwise it is used for brewing local alcoholic beverages. Cereal grain alone contribute more than 90 per cent of the total calorific supply, while remainder portion is derived from vegetables, fruits, meat, milk and other minor crops. Own on-farm production was found by far the most important source of food supply contributing more than 80 per cent of total calorific value. Instead, contribution of wage payment received in kind has also a significant importance amongst the poor households who are unable to produce sufficient grain from their own farm.

Seasonality in agricultural production system has direct implication on food availability and households' consumption behavior. June-July are the most precarious period of food deficiency, and food availability situation improves after maize harvest in the August. In general post harvest season are mentioned as food prosper season and pre-harvest as the food deficit one. Consumption behavior, therefore, changes according to the seasonal availability of food.

Because of limited cash earning opportunities and the consumption oriented production systems, cash transaction to acquire food was found at the minimum. The scanty amount of cash earnings among the food insecure households have further declined their long-term investment and saving for future consumption trapping them into the vicious cycle of low income - low investment- low production.

Having the inherent characteristic features of low input - low output system, and lack of market integration, farming in the study area has evolved as means of sheer survival. Lack of irrigation and low level of technological intervention has hindered agricultural production and productivity thereby heightening the problem of food

insecurity in the study area. As a result, a large section of households in the study area are unable to meet their daily calorie requirement

8.1.5 Factors influencing food security

Access to productive resources like land and livestock holding were found important to improve food security status of households. From the regression results, land holding was found to be the key factor determining food security status in the study area. Other parameters with significant coefficients in the model were: proportion of economically active female household member to the total household size; livestock holding (LSU) per AE, technology adoption index defined in terms adoption of modern varieties of cereals crops; and the ethnicity dummy differentiating *Brahmin/Chheti* and other ethnic groups. Contrary to the expectation, the coefficient of number of economically active household member irrespective of sex was significantly negative suggesting excess labor availability and lack of productive employment opportunities in the study area. Cash income on the other hand, has positive but non-significant effect indicating a minimal transaction of cash economy to acquire the food

Livestock, not only provide food for households' consumption but also an important source of cash. Small livestock, like goat and chicken, which can be raised with small investment by feeding with household scraps, were found important source of cash among the small farm holders.

Women play a decisive role in household food security. In the rural area, where production system is entirely consumption oriented, women are more responsible for food production, processing, preparation, storage etc. The significant contribution of women in overall household food security has been empirically justified in this study implying that with the increased women's access to productive resources, information and technology, the household food security could be improved substantially.

Cash income is one of the influential economic factors affecting production and consumption, however, increased income is not sufficient to enhance food security unless it is combined with increasing productivity and further income generation. The non-significant effect of cash revenue on overall food availability might be due to the poor market integration and lack of alternative employment and investment opportunities.

Adoption and adaptation of agricultural technologies are important to improve agricultural production, which ultimately improve households' food entitlement. Even with limited choice of modern varieties in the study area, the effect of adoption of modern varieties was found positive and significant on food availability. Adoption of modern varieties was found basically related with land holding sizes implying that the small marginal farm households are either devoid of technological information or the varieties developed are not suitable to poor farm households' condition. Since, majority of farm households in the study area are small farmers it is necessary to incorporate their need and priorities in the agricultural research and development agendas in order to ensure that the developed technology would be adaptable to poor farm households' conditions.

Ethnicity directly or indirectly influences the households' production and consumption behavior. Therefore, the agricultural systems and choice of technologies in the study area are influenced by the ethnic value and culture. The positive and significant effect of ethnicity on food availability indicates that *Brahmin/Chhetri* are in relatively better food security condition than other ethnic groups. With the declining demand for their traditional services, occupational caste groups of people, particularly leatherworkers and tailors, whose critical amount of food grain used to come from the obligatory payment (locally called *Bali*) are now in the verge of serious threat of poverty and food insecurity.

8.1.6 Constraints to and strategies for food security

Several constraints to households' food security in the study area were identified during the course of study. Lack of irrigation and technologies were found the most important constraints responsible for declining agricultural productivity. Land fragmentation has further heightened the problem, as the fragmented small parcels of land are insufficient to produce required food for farm households. Additionally, lack of alternative off-farm employment opportunities due to poor infrastructure has further aggravated the purchasing capacity of the poor households

Households' strategies to cope with food deficit problem were found varied based on the available opportunities and their resource base. The poor food-insecure households sometimes obliged to meet immediate food requirement at the expense of productive resources like land and livestock eventually eroding their long-term livelihood security. A range of short-term food strategies adapted by the farm household were identified, which includes changes in consumption behavior (eating less preferred food, altering intra-household food distribution, reducing food intake and frequency); food and cash borrowing; livestock sale; sale of household assets; mortgaging or pledging of land; seasonal laboring etc. The choice of individual strategy, however, found to be decided by severity of the problem and household's resource endowment.

To minimize the risks and uncertainties farm households have diversified their production systems exploiting different agroecological niche. Crop intensification by intercropping different leguminous and non-leguminous crops on the *Bari* land was found an important long-term strategy adopted by the farm households in order to increase aggregate food production level. Renting-in land, among the land scarce households, was found another important strategy for increasing food production. Small farm animals such as goats, pigs and chickens are also managed as a safeguard against cash insecurity.

Share rearing of livestock among the poor households was also found common as one of the important way out to increase access to cash deficit.

8.2 Recommendations and further research needs

8.2.1 Policy recommendations:

Based on the information generated from the present research, the following areas of research and development interventions have been recommended:

1) As more than 40 per cent of households in the study area are under the serious food security threat, immediate government intervention deemed imperative. For the short run 'Food-For Work (FFW) would be an alternative to increase access to food among the poor households.

2) Land fragmentation due to increasing number of family and property inheritance systems has converted the lands into small parcels, which are economically unsustainable. Therefore, the government should take initiative to implement well-envisioned agrarian reform enhancing better use of land resources. Furthermore, government should enhance tenants' land right and incentive to encourage landowners to rent-out their land to the needy tenants.

3) As the majority of farm households in the study area are small farmers with less than 0.5 hectare of cultivating land, subsistence food requirement of those small farm households will not be possible without increasing their access to cash. Therefore, alternative measures to improve cash earning opportunity among the small holder should be sought. Agro-based rural cottage industries would be an alternative.

4) Due to lack of transportation and marketing network in the study area, the government and non-government organizations aiming to ameliorate food security situation should develop on-farm food security strategies through productivity

improvement. At least for the short-run, the increased productivity through increasing the adoption of modern varieties and crop intensification would help improve food situation.

5) As a larger section of small farm size holders in the study area are substantially dependent on *Bari* land, improvement of *Bari* land farming should be the prime concern of research and development agencies to improve food security situation among the small farm size holders.

6) Due to lack of transportation, extension and promotion of high value low volume agricultural production like cash crops, dairy and fruit processed products is essential for market orientation.

7) Livestock improvement program aiming to replace unproductive animals with more productive breeds is an important area of livestock improvement. This program not only improve the livestock productivity itself but also reduce the size of livestock unit. The government and non-government organizations working for the livestock research and development should take initiative on improvement of local breeds.

8) Open livestock grazing system during the winter has exerted serious threat on crop intensification and forest regeneration in the study area, therefore, program encouraging stall-feeding practice is of immediate important. The village Development Committee (VDC) and the farmers' groups should take initiatives on convincing and/or enforcing the practice of stall-feeding in the community.

9) As minor crops like root crops, tuber, pulses, oil seed (e.g. ground nut, sesame) etc., which are grown in less fertile marginal land, play significant contribution on households' food supplies amongst the poor farm households. Therefore, research activities on those minor crops need to be encouraged. The National Agricultural Research Center, which is responsible agricultural research in the country in its research program.

10) Transportation network to link villages into the main transportation system is of immediate need to be addressed in order to transform low productive subsistence farming into demand -driven intensive market oriented agriculture.

11) Women empowerment through enhancing their participation in education, employment, research and extension is an important area to be addressed. The concerned research, extension and development organizations should incorporate gender empowerment program.

12) As the underlying problem of poverty and food insecurity is ever increasing population, which simultaneously demand more food, any coordinated approach to develop sustainable food security must concern on better control of the growing population.

8.2.2 Further research needs

While answering number of questions related to farming and food security issues, the present research has raised few important research topics, which require further research:

1. Study on farm household resources use efficiency, resource conservation decision and their impact on environment and food security.

2. Sustainability of existing livestock production systems and its interaction with other system components in the context of subsistence hill farming

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APPENDICES

Appendix Table 1. Approximate conversion table from local unit

Area

1 Mato muri	=	0.0127 hectare
1 Ropani	=	0.0509 "
1 Hal khet	=	0.0509 "
1 Hal bari (Banjho)	=	0.1018 "
1 Hal bari (Dhulo)	=	0.2036 "

Volume

1 Muri	=	20 pathi
1 Pathi	=	8 mana
1 Mana	=	1 Pint = 0.57 litre
1 Pau	=	0.25 mana

Weight:

1 Mound	=	37.3 kg
1 Dharni	=	2.4 kg
1 Seer	=	0.8 kg
1 Pau	=	0.25 kg

Crop volumes by weight

Volume		Weight (Kg)
Rice 1 pathi	=	2.4
Maize "	=	3.4
Millet "	=	3.3
Wheat "	=	3.4
Black gram "	=	3.5
Soya bean "	=	3.4
Pea "	=	3.6
Mustard seed "	=	2.9
Rape seed "	=	3.1
Seasame "	=	2.8
Bean	=	3.2

(Source: Conlin and Falk, 1979; Department of Agriculture, 1996; Key informant survey)

Appendix Table 2. Adult equivalent conversion scale

Reference person	Adult equivalent scale
Reference man:	
20-39 years	1.00
40-49 "	0.95
50-59 "	0.90
60-69 "	0.80
70 and above "	0.70
Reference women:	
20-39 years	0.74
40-49 "	0.71
50-59 "	0.67
60-69 "	0.60
70 and above "	0.52
Infant:	
6-11 months	0.38
Child:	
1-3 years	0.51
4-6 "	0.64
7-9 "	0.72
Boy:	
10-12 years	0.88
13-15 "	0.97
16-19 "	1.05
Girl:	
10-12 years	0.84
13-15 "	0.85
16-19 "	0.80

(Source: De Vega, M. C., and B. S. Fisher, 1983)

Appendix Table 3. Conversion table for food items into calorific value (Kcal per Kg of edible portion)

Food stuff	Calorie
Bamboo shoot	430
Banana	1,160
Bitter gourd	250
Black gram	3,470
Bottle gourd	120
Brinjal	240
Broad bean	480
Buckwheat	3,230
Cabbage	270
Cauliflower	300
Chilli	240
Cow pea	3,230
Ginger	670
Guava	380
Lemon	570
Maize	3,420
Meat	710
Millet	3,090
Milk	1,010
Mustard leaves	340
Onion	500
Orange	480
Peaches	500
Pears	520
Peas	930

Plum	520
Pomegranate	650
Potato	970
Pumpkin	250
Pumpkin leaves	570
Radish	170
Rice	3,460
Ridge gourd	170
Snake gourd	180
Soya bean	4,320
Sweet potato	1,200
Tomato	230
Tree tomato	350
Turmeric	3,490
Wheat	3,410
Yam	1,110

NB: For other non-specified vegetables and fruits 250 and 550 Kcal per Kg edible portion was used, respectively. The conversion coefficients for raw food into edible form are 0.6 for rice and 0.4 for other cereals (Asian Development Bank, 1982 cited in Shrestha and Yadav, 1992)

(Source: Excerpted from Department of agriculture HMG/N, 1996, and Shrestha and Yadav, 1992)

Appendix Table 4. Livestock unit coefficients

Livestock Species	LSU
Cattle	
• Cross-bred cow	1.00
• Cross-bred heifer	0.70
• cross bred calf	0.30
• Local cow	0.80
• local heifer	0.50
• Local calf	0.30
• Local male (adult bull)	1.00
Buffalo	
• Adult	1.23
• Heifer	0.93
• Calf	0.48
Sheep/goat	
• Adult	0.10
• Kids	0.05
Swine	
• Adult	0.12
• Piglets	0.05
Chicken	0.02

(Sources: Conlin and Falk,1979.,Guenat, 1991., Thapa, 1996., Poudyal. 1997)

Appendix Table 5. Common wild vegetable and fruit species in the study area.

SN	Local Name	Botanical name	Plant type	Edible parts	Season	Uses	Response*
1	Bamboo	*Bambusa spp*	Tree	Shoots	Summer	Vegetable	1
2	Ban tarul	*Dioscorea spp*	Climber	Modified root	Winter	Vegetable and snacks	4
3	Lunde ko sag	*Amaranthaus spp*	Herb	Leaves	Summer	Vegetables	3
4	Bhringi raj	*Eclipta prostrata*	Herb	Shoots	Rainy	Vegetable	4
5	Neuro	*Thelyopteris spp*	Herb	Leaves	Summer-rainy	Vegetables	1
6	Sim sag	*Nasturtium officinale*	Herb	Tender foliage	Winter-summer	Vegetable	2
7	Pudina	*Mentha spicate*	Herd	Tender foliage	Winter-summer	Pickle	3
8	Kabro	*Ficus lacor*	Tree	Buds	Summer	Picke and vegetable	3
9	Koiralo	*F. verigata*	Tree	Flower and buds	Summer	Pickle and vegetable	3

Continued.....

10	Sisnu	*Utrica dicica*	Herb	Young tips and leaves	Summer-rainy	Vegetable	2
11	Latte sag	*Amaranthus spp*	Herb	Tender foliage	Summer-rainy	Vegetable	2
12	Lunde ko sag	*Amaranthaus blitum*	Herb	Tender foliage	Summer-rainy	Vegetable	3
13	Sati bayar		Shrub	Fruits	Winter	Fruits	4
14	Aiseloo	*Rubus ellipticus*	Shrub	Fruits	Winter-summer	Fruits	3
15	Amala	*Phyllanthus emblica*	Tree	Fruits	Winter-summer	Fruits/pickle	3
16	Jamun	*Syzgium cummini*	Tree	Fruits	Summer	Fruits	4
17	Kattus	*Castanopsis spp*	Tree	Friuts	Summer	Fruits	4
18	Simta	*Pinus raxburghii*	Tree	Matured nut	Summer	Fruits	4

* 1 = More than 80 per cent of the respondents reported

2 = 51- 79 per cent respondents reported

3 = 26-50 per cent respondent reported

4 = less than 25 per cent respondents reported

CURRICULUM VITAE

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Academic Background

1999	M. S. Agricultural Systems (Agricultural Development and Management), Chiang Mai University, Thailand
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