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.

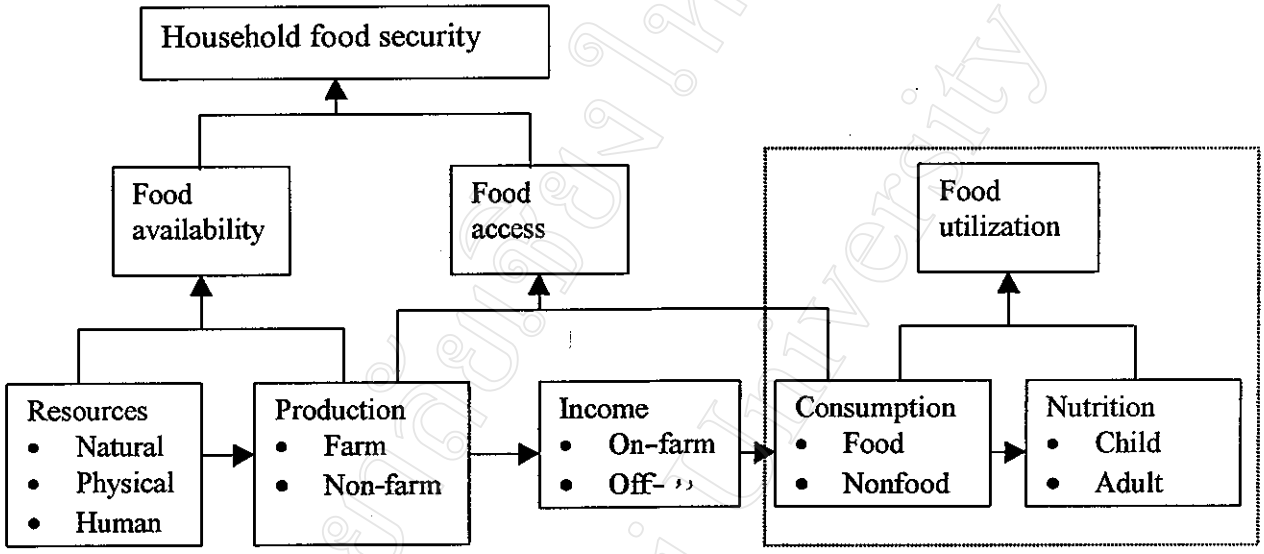

Figure 3.1. A conceptual framework for household food security analysis

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

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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:

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

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:

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

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 i^{th} 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:

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

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.