DETERMINANTS OF FODDER TREE ADOPTION IN THE MID HILLS OF NEPAL

MILAN ADHIKARY

A THESIS SUBMITTED TO THE GRADUATE SCHOOL IN

PARTIAL FULFILLMENT OF REQUIREMENTS

FOR THE DEGREE OF

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AGRICULTURAL SYSTEMS

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ABSTRACT

Assessing the low acceptance of private plantation program launched by government and non government agencies to alleviate the shortage of fodder in the mid hills of Nepal is the major concern of the study. The main objectives of the research are: to describe adoption of fodder trees, to evaluate the performance of adoption and to analyze the factors influencing adoption.

Employing multistage sampling technique, 4 village development committees of Kavre district were selected on the basis of availability and non-availability of nurseries and markets. Survey data of the year 1993 was collected from 216 sampled households. Of the total sample size, 90 households were identified as adopters and 126 as non-adopters.

Adopters fodder trees could serve 78.5% of the demand of the farm households tree fodder. Increment in milk production ranges from 46% to 146%, saving time for fodder collection over 56% were the positive effects of adoption. Only less than

5% reduction in crop yield was reported in two village development committees.

A Logit model with Maximum Likelihood Technique was employed in investigation of determinants of fodder trees. Farmers' knowledge (purpose of fodder tree growing, skill in production, opinion about tree fodder in livestock feed, awareness in terms of scarcity problems, environment, market prices, sources of availability and agencies) is the most important factor. Social participation, distances to nursery and market and supply of fodder per livestock unit are the significant determinants in adoption of fodder trees on farm land. While total gross income, education, land per ruminants, family size and distance to forest are found insignificant.

Ranking and scoring techniques were used for understanding farmers' opinion and perception on fodder trees and distribution programs. Results indicate that high bio-mass fodder trees were preferred by majority of sampled households. Unknown about the importance of fodder trees followed by land constraints were investigated as the main reasons of non-adoption while mortality of seedlings was found as the barrier for the further adoption.

Hence, the study urges for the immediate improvement of a regular monitoring program through effective extension to improve the farmers' understanding of the importance of fodder trees growing and to create awareness regarding sources, agencies and market prices. While a comprehensive government program for distribution of resistant and desirable species and establishment of nurseries should be included in future plans for overcoming the encountered problems.

ชื่อวิทยานิพนธ์ ปัจจัยกำหนดการยอมรับไม้ยืนต้นเป็นอาหารสัตว์บนพื้นที่สูงปานกลางในประเทศเนปาล

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บทคัดย่อ

การศึกษานี้ต้องการวิเคราะห์เหตุที่เกษตรกรมีการยอมรับค่อนข้างต่ำเกี่ยวกับการปลูกไม้ยืนต้นเป็นอาหารสัตว์ ตามโครงการของหน่วยงานรัฐบาลและภาคเอกชนค่อนข้างต่ำ เพื่อประโยชน์ต่อการแก้ไขปัญหาการขาดแคลนอาหารสัตว์จากไม้ยืนต้นในพื้นที่สูงปานกลางของประเทศเนปาล โดยมีวัตถุประสงค์หลักคือ เพื่อบรรยายการยอมรับฯ ประเมินผล และวิเคราะห์ปัจจัยที่มีอิทธิพลต่อการยอมรับฯของเกษตรกร

การสำรวจข้อมูลปี 2536 ด้วยวิธีเก็บตัวอย่างแบบหลายขั้นตอน โดยเลือก 4 หมู่บ้านของอำเภอ Kavre ตามลักษณะที่มีและไม่มีหน่วยเพาะกล้าไม้และตลาด แล้วจึงเลือกครัวเรือนตัวอย่าง จำนวน 216 ครัวเรือน ปรากฏว่าเป็นครัวเรือนที่ยอมรับฯและไม่ยอมรับฯ จำนวน 90 ครัวเรือน และ 126 ครัวเรือน ตามลำดับ

จากการประเมินผลการยอมรับฯพบว่าปัจจัยที่มีผลในทางบวกได้แก่ ไม้ยืนต้นที่ปลูกสามารถตอบสนองความต้องการพืชอาหารสัตว์ได้ 78.5 % ของครัวเรือนที่ยอมรับฯ และผลผลิตนมเพิ่มขึ้นระหว่าง 46 % ถึง 146 % ประหยัดเวลาในการเก็บอาหารจากไม้ยืนต้นไม่ต่ำกว่า 56 % ส่วนผลในทางลบคือ เกษตรกรใน 2 หมู่บ้านมีผลผลิตจากพืชอื่น ๆ ลดลงประมาณ 5 % ของผลผลิตเดิม

จากการใช้แบบจำลอง Logit และวิเคราะห์ด้วยวิธี Maximum likelihood พบว่า ความรู้ (เกี่ยวกับวัตถุประสงค์ของการปลูก ความชำนาญในการปลูก ความตระหนักในเรื่องการขาดแคลน อาหาร สิ่งแวดล้อม ราคาตลาด และแหล่งกล้าไม้) เป็นปัจจัยที่สำคัญที่สุด ปัจจัยอื่น ๆ ที่สำคัญได้แก่ การร่วมกิจกรรมสังคม ระยะทางไปยังหน่วยเพาะกล้าไม้ ตลาดและปริมาณพืชอาหารสัตว์อื่น ๆ ที่มีอยู่ต่อหน่วยปศุสัตว์ ส่วนปัจจัยที่ไม่มีความสำคัญอย่างมีนัยทางสถิติคือ รายได้รวม ระดับการศึกษา ขนาดที่ดินต่อหน่วยปศุสัตว์ ขนาดของครอบครัว และระยะทางไปยังป่า

การวิเคราะห์ความเข้าใจและความคิดเห็นของเกษตรกรเกี่ยวกับพืชอาหารสัตว์และหน่วยงาน ทำโดยการจัดลำดับและการให้คะแนน ผลสรุปได้ว่า เกษตรกรส่วนใหญ่ชอบพันธุ์ที่ให้มวลชีวภาพสูง การไม่รู้ความสำคัญของพืชอาหารสัตว์และการมีที่ดินจำกัดเป็นเหตุผลของเกษตรกรที่ไม่ยอมรับฯ ส่วนการตายของต้นกล้าเป็นอุปสรรคต่อการขยายการยอมรับของกลุ่มผู้ยอมรับฯ

ข้อเสนอแนะในการแก้ไขปัญหาในระยะเฉพาะหน้าคือ ให้มีการติดตามโครงการอย่างสม่ำเสมอ โดยการส่งเสริมให้ได้ผลด้วยการพัฒนาความเข้าใจของเกษตรกรเกี่ยวกับความสำคัญของไม้ยืนต้นที่เป็นอาหารสัตว์ มีความรู้และตระหนักเกี่ยวกับแหล่งกล้าไม้และราคาตลาด ในขณะเดียวกันรัฐควรมีโครงการระยะยาวที่ครบถ้วนในการจัดหาพันธุ์ที่เกษตรกรต้องการและมีความต้านทานโรค และจัดตั้งหน่วยงานเพาะกล้าไม้เพื่อแก้ไขปัญหาการขาดแคลนอาหารสัตว์จากไม้ยืนต้น

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ABBREVIATIONS AND SYMBOLS

AAI	:Activity Adoption Index
Adp	:Adopters
Avg	:Average
CBS	:Central Beureo of Statistics
Cof	:Coefficient
DFAMS	:Department of Food and Agricultural Marketing Services
DLS	:Department of Livestock Services
FAI	:Farm Adoption Index
GOs	:Government Organizations
ha	:hactare
hh	:Household
ICIMOD	:International Center for Integrated Mountain Development
kg	:kilogram
km	:kilometer
lts	:liters
lu	:Livestock Unit
ml	:Man load (20-30 kg) for fodder (dry and green)
msl	:mean sea level
NGOs	:Non-Government Oraganizations
no.	:Number
Non-adp	:Non-Adopters
NPC	:National Planing Commission
NR	:Not Response
PLBP(GTZ)	:Promotion of Livestock Breeding Project
Res.	:Respondent
Rs.	:Rupees (Nepali Currency)
T	:Total
VDC	:Village Development Committee
VDC M	:Mahadevsthan Village Development Committee
VDC F	:Fulbari Village Development Committee
VDC K	:Khopasi Village Development Committee
VDC R	:Rabi-Opi Village Development Committee
/	:per
<	:Less than
>	:Greater than
%	:Percentage
-	:to

CHAPTER I

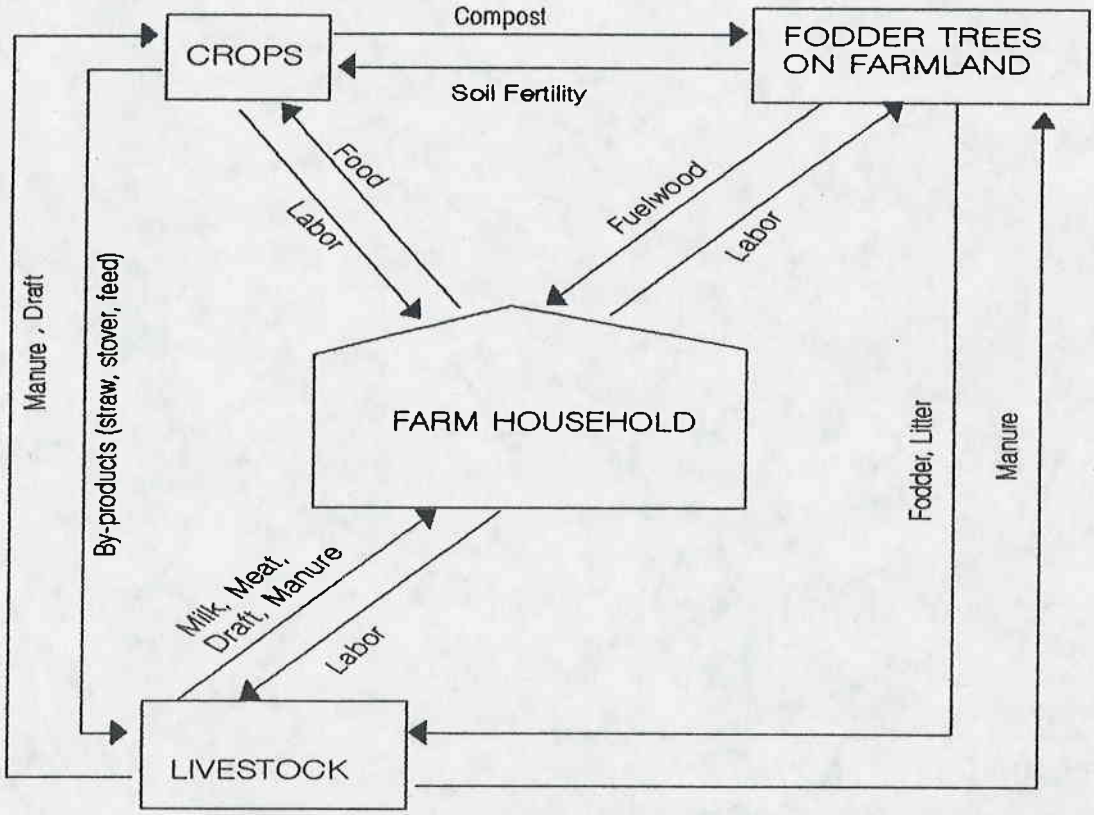
INTRODUCTION

1.1 Statement of Problems

The major efforts of most of the agricultural based countries is to increase agricultural productivity and to improve the economic condition of the farmers through the introduction of improved agricultural technology. Because the majority of the population of less developed countries (LDCs) derive their livelihood from the agricultural production and new technology offers opportunity to increase their production substantially. Planting of fodder trees on private land is one of the agricultural technology that has been received a considerable attention during the years for the sustenance of the farming system. Of course such practice has long been practiced traditionally, but recently *agroforestry* is widely used to this concept (Luetel, 1991).

The hill economy of Nepal, is characterized by mixed farming system in which, tree, crop and livestock form the cornerstone of the system (Robinson, 1989). The conceptual model of mid hill farming system is presented in Figure 1. Livestock farming is one of the fundamental and integral part of socio-economic life of majority of rural people of Nepal, accounting 17% of agricultural gross domestic product (GDP), representing about 26% of country's agricultural GDP (DFAMS, 1990).

Especially, the mid hill rural development largely depends on the livestock sector, generating 27% of the total income (Dreischulte, 1992). Among livestock, ruminants constitute a renewable resource providing a variety of benefits to the farmers such as meat, milk, hides, draft power, manures and fuel (Pande 1990; Mathema 1980; Devendra 1987).



.Figure 1 Conceptual Model of Farming System Components

Inspite of the great contribution from the livestock, the social-religious taboos of Nepalese culture has caused overstocking of unproductive livestock. Statistically (CBS, 1991) it is estimated that there are over 15.5 million heads of ruminants in Nepal, one of the highest per capita number in the world (Table 1).

Table 1 Livestock Population in Nepal (in 000 heads)

Livestock	Terai	Mid hills	High hills	Total
Cattle	2,242	3,242	800	6,284
Buffalo	920	1,772	303	3,003
Sheep	125	400	385	910
Goat	1,394	3,099	809	5,302
Swine	153	319	76	548
Poultry	2,510	6,431	1,217	10,158
Total	7,352	15,263	3,590	26,205

Source: CBS, 1991.
Note:Terai, Mid hills and High hills are the 3 ecological zones of Nepal covers, 17%, 68% and 25% of the total area of the country (CBS, 1991).

Hopkins (1983), revealed that in the hills the stocking rate is as high as 8 lu/hh[1], which is beyond the carrying capacity of land. The carrying capacity for grassland and forest is 0.54 and 0.31 lu/hh where as present stocking rate is 7 and 2.8 lu/ha or 13 and 9 times greater respectively (Rajbhandari and Shah, 1981).

Consequently, for the last two decades, in many areas, livestock numbers have been dropping without concurrent increase in productivity,

[1]lu/hh: Livestock unit per household; lu = standard unit for measuring livestock based on feed intake in relation to body weight.

where as the demand for livestock product is increasing with the increase in human population (Robinson, 1989). Rapid population growth, deforestation and depletion of communal (forest) resources by heavy lopping have led to environmental degradation and low productivity from the agriculture and forestry sectors. Pokherel (1992), reviewed that forest area in Nepal is disappearing at the rate of 84,000 ha/year, resulting in soil erosion and a consequent effect on environmental balance.

According to the survey of mid hills of Nepal, lack of fodder trees, inadequate pasture and grazing land are responsible for the low production performance of dairy animals apart from the other factors like disease and breed (Shrestha and Evans, 1984).

Pandey (1982), revealed that the shortage of fodder in Nepal is over 20% at the present assumption of 2 metric ton of dry matter per big lu per annum. Therefore in recent decades, difficulties being experienced by the hill farmers in meeting their daily requirements for food, fodder and fuel wood. Furthermore, non-accessibility communal resources have led to the inability of forest land to supply needs of people in sustainable basis.

Planting of fodder trees *(dale ghans)* on private land in this context holds potential benefits for slowing down the problem of fodder scarcity, soil erosion and providing energy inputs to ensure survival of

hill farming system. Hopkins (1983) stated that tree in the middle hills produce up to 70 kg of fodder per tree/year between 3-10 years. However, the crucial importance of fodder trees becomes apparent during the middle of dry seasons, when stored food supplies are dwindling (Arnold 1991; Robinson, 1989). According to Amatya (1991) about 40% of annual feed is supplied during the season. The importance of fodder tree not only lies in quantitative supplementation but also supply of high quality, nutritious greens throughout the year as some of these can withstand even in severe condition (Giri, 1990). Besides, fodder tree is only the component of significance as a source of leaf litter for compost, bedding materials for stall feed animals, potential use of hill waste land (terrace, riser)[2] and ensure efficient utilization of crop by-products. Additionally, tree fodder production is associated with a reduced cost of production (Singh, 1991).

Realizing the fact, Government and non-government (GO/NGOs) concerned with research and development have formulated a fodder improvement program under livestock development policy. To mobilize the plan, Gov/NGOs, have established nurseries in different areas, these have net work with district and village development committees. Fodder tree saplings (seedlings) of different species have been distributed either free of cost or very nominal price from these nurseries (Malla, 1987). The extension service has been provided to the farmers by JTs/JTAs[3] at the

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[2] According to LRMP (1980) and Malla (1987) the terrace and riser covers 18% and 20% respectively.

[3] Junior and assistant Junior technicians

farm level. But, still the problem of fodder scarcity has not been overcome. Various studies revealed that production and distribution of seedling did not match with the plantation on the farm land even though plantation has been increased. The plantation of seedlings from nurseries has been found little as compared to the indigenous natural originated and regenerated on the farm land, even the species they are promoting may not be good enough qualitatively as well as quantitatively (Carter and Gronow, 1992).

This evidence of farmers use of fodder seedlings from sources other than nurseries might be the problems of adoption of such saplings. Since just introduction of any kind of technology (farming practice) is not enough, it should be socially acceptable too in order to meet the shortfall (fodder shortage), to improve the farmers' income and consequently to strengthen the overall economy of the country. Therefore it is essential to identify and analyze the factors that may be responsible for adoption or non adoption of fodder trees on farm land in order to design and implement proper policy measures so as to overcome the current problems of the fodder shortage.

1.2 Rationale

In view of the urgent need of increasing farm productivity (crop-livestock), and to arrest the problem of feed shortage, research on

adoption of the fodder trees have been considered important. However, research and development thrust in agriculture, especially in technology adoption have been mainly directed towards major food crops in many parts of the world. A finger countable number of research have come out in focus in case of fodder tree and its adoption.

It is well recognized that the viability of a technology under farm condition and its acceptability to farmers is determined by technical as well as non-technical factors (socio-economic) of farm households. Yet, little is known about such factors that may affect the farmers' decision making, whether to adopt or not and why.

Government as well as private agencies programs are mainly concerned with the distribution of seedlings. However, so far no attention has been paid in monitoring of the established fodder trees (Thapa, 1989). Therefore, it is imperative to analyze the level of success in term of adoption performance and its impact to local farmers, which have not been so far examined at the farm level.

1.3 Objectives of the Study

Given the above background, this study seeks to understand fodder situation and the key determinants of fodder tree adoption in the mid hill of Nepal. Specifically, the objectives of the study are:

1.3.1 To describe the farming system and socio-economic conditions of the study area with reference to fodder tree and livestock situation.

1.3.2 To measure the adoption performance of fodder trees in farm families.

1.3.3 To investigate and analyze the relationship between socio-economic factors and farmers' adoption of fodder trees in order to identify the farmers' characteristics associated with fodder trees adoption.

1.3.4 To assess farmers' perception about fodder tree distribution program carried out by government and private agencies.

1.3.5 To identify constraints and possibilities to increase fodder production.

1.4 Literature Review

Since the study is concerned with adoption of fodder trees as an agricultural practice (technology), the meaning and concept of adoption, factors and previous studies on the related topics are essential to be highlighted.

1) Meaning and Concept of Adoption

There are several meanings of the term "Adoption". Rogers

stated that adoption, is a mental process that an individual passes from first hearing about an innovation to the final adoption (Rogers, 1962 and Mosher, 1978). However, according to Feder (1985), the meaning of individual adoption differs from aggregate adoption (diffusion). The former (individual) deals with the behavior of individuals where as later one (diffusion) concerns more with the spatial dimensions of the process. To be an adopter an individual has to pass the process of adoption, which may follow specific and sequential patterns (Feder 1985) viz; awareness, interest, evaluation, trial, and adoption. Where adoption is the last stage in the acceptance of an innovation and is the outcome of a sequence of events. However, for new technology adoption, it follows a S-shaped curve, as an uneven process (Lionberger, 1960).

2) Factors Influencing Adoption

Regarding the adoption of technology, there may be number of factors that influence the adoption practice. These factors may vary among individuals in a group, regions and do not occur singly but multi-dimensional in nature (Ashadi, 1992). Furthermore, the nature and magnitude of the association are not similar, rather vary from place to place, time to time and practice to practice (Wahhab, 1979). Because innovations have been introduced in environments with different economic, social and political institutions (Feder, 1985) and farmers' behavior of are found to have been correlated with them. Farmers' characteristics as a decision making unit has an important role in perceiving the knowledge.

Similarly, social norms, values, attitudes and relationship between social system and the decision to adopt innovation affect the rate of adoption.

3) Previous Studies Related to the Subject

Studies on factors associated with the adoption of recommended farming practices have been carried out in a number of countries from the past to present. However, very few works had been performed on fodder tree adoption specifically. Therefore, adoption of other innovation and practices were reviewed.

Ayob (1979) reported that large farms were more likely to adopt the machine compared with small farms on his study conducted in the Muda region of Malaysia. A maximum likelihood regression coefficient with the asymptotic standard errors and ranks were used to determine the relationship with the variables.

Buddhapitag (1980), in Chiang mai province, Northern Thailand found that factors like age, farm size and level of income are closely related to the process of adoption. Further, it is reported that most of the adopters were young farmers with large holdings and income. The change agents with least social distances were found effective in bringing the agrarian changes in the Thai rural areas.

Sharma (1980), in his study on the adoption of modern farming

technique conducted in the Kavre district of Nepal observed that younger,high caste, owner-operator and technically informed farmers were likely to be more optimistic and consequently to be the adopters of new technique. Step wise regression technique was employed to estimate the relationship of the beliefs (expected yield) with adoption and the later with socio-economic factors and level of information.

Rawal (1981), analyzed the factors affecting the adoption of modern varieties in eastern Nepal and identified that farmers' education, farm size, exposure to extension and experience as significant factors influencing the promotion of modern variety of rice and wheat by the use of correlation matrix.

Tantry (1981), in his study concluded that young, educated, high income, location of village and more members in a household were important factors for the adoption of package of innovations. Costly and risk bearing innovations were found popular with large farmers, while small farmers were found more adoptive of labor saving technology.

A research study, concerned with the adoption conducted in Northern states Nigeria reported that the variables like literacy and contact with extension are significantly associated with the adoption of farm practices. A simple correlation analysis with .05 level of significance was used for testing the relationships between related variables and adoption of recommended farm practices. Step wise

regression was also used to test the predicted factor (Voh, 1982).

Malla (1983), applied the maximum likelihood logit analysis in his studies about the technology adoption by rice farmers in Dhanusa district of Nepal. Farmers who were co-operative members and exposed to extension activities were found more likely to adopters than others. Farmers' Age, family size, non-farm income were turned out significant factors in decision making.

Boon-a-nan (1988), employed probit model and used maximum likelihood test for estimation of the factors influencing the adoption of high yielding rice varieties (HYVs) in central plain of Thailand. From the results, it was found that farmers' attitude toward risk, contact with agricultural officials, and the profit difference between HYVs and local varieties were the important factors for the adoption.

A descriptive analysis of the adoption of fodder tree in south east Nigeria revealed that the reason behind the little diffusion of browse tree cultivation was due to the complex mutually reinforcing factors. However, division of labor, decision making within the household and tenure system of land and tree are the most significant determinants (Francis, 1989).

Harper (1990), viewed that extension activities at field days can significantly affect the adoption of new technologies like insect sweep

nets and treatment thresholds. Logit models, with maximum likelihood as a estimation technique at 20% significance level was used to analyze adoption decision.

Evidence from Bangladesh (Shah, 1992) revealed that farm income emerged as the most important predictor of adoption of farm practices. Extension contact, age, education and farm size were other significantly related factors to adoption of farm practices. Spearman correlation analysis and step wise multiple regression was used to understand the relationship and to identify the significant independent variables respectively.

Caveness (1993) conducted research in Senegal to evaluate the factors influencing the adoption and farmers' perception of agroforestry. Stepwise discrimination analysis was used to identify the factors. Land ownership and labor availability were identified as the two most significant factors that contribute to agroforestry adoption as measured by Wilks' ratio.

CHAPTER II

RESEARCH METHODS

2.1 Scope of the Study

This study mainly deals with the trees, whose leaves and green tender branches are fed to ruminants. The general purpose of the study was to identify factors associated with adoption of fodder trees in the farming system, extent of adoption, and farmers' perception about the program implemented by GOs or NGOs.

Since this is the developmental policy, the introduction of such type of technology deals with the people in a region, country as a whole, concerned mostly with adoption, rather than the depth of technology itself. Additionally, this study confined on some internal socio-economic factors that farmers had some control like land holding size, livestock number. External factors were limited only to a few which include proximity to market, to nurseries and to forest.

The choice and adoption of fodder tree species vary from one ecological region to another in relation to their availability and feed value. Therefore, the outcomes of such studies, mainly in terms of species preference could not be disseminated to other areas. A separate study is required.

In the context of hill of Nepal, fodder tree are grown in terrace wall or bund raisers of land without proper spacing. Measuring of accurate area for each tree is not possible and tedious task.

2.2 Conceptual Framework

Several concepts had been used in the literature to describe the adoption of new technologies (Yaron, 1992). However, adoption here is defined as the plantation of fodder tree species that were brought either from nurseries and/or transplanted, regenerated by farmers either from outside or own farm land, which differed from the species that were grown naturally. The adoption mentioned above was considered as a dependent variable and was influenced by number of factors. As a more comprehensive way, the following concepts were sought.

1) Adoption Performance

In order to understand the performance (outcomes) from the adoption of farm practices (fodder trees), extent of adoption as well as effect of adoption were assessed. The former referred to the "degree of use" of farm practice as a quantitative measure and was assessed from number of adopters and fodder trees to the total number of farmers and ruminants respectively. The later part was examined through the impact in the farming system. Because adoption probably have some effect to the crop, livestock

and to the farmer as well in terms of milk production, crop yield, time of fodder collection, change in system of rearing etc. which could provide some opportunity to off farm income.

2) Adoption Factors

The adoption of fodder trees could be correlated to a number of independent variables. However, reviewing the literature on past research, scrutinizing the relevance of the findings in rural areas and also socio-cultural environment in Nepal, concentration was made mainly to some of the factors in socio-economic aspects, which were considered pertinent to explain the behavior of the fodder trees growing farmers of Kavre district. The following Figure 2, represents the conceptual frame work for adoption:

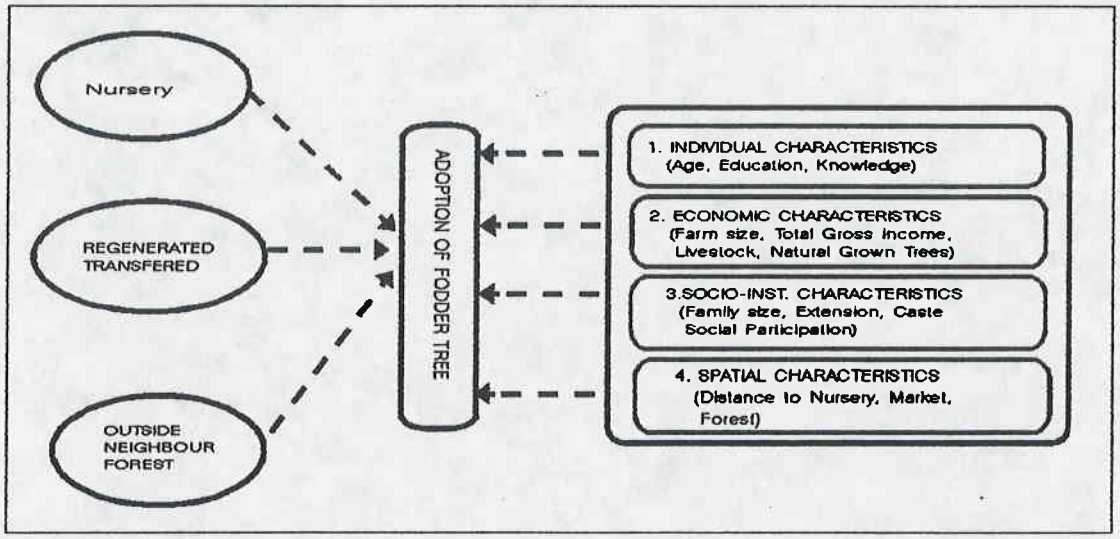

Figure 2 Conceptual Frame work of Fodder Tree Adoption

2.3 Data Collection

A combination of methods was applied, in order to gather necessary and relevant information, which is as follows:

1) Secondary Data

For initial understanding of the existing situation of fodder trees in Nepal, review of available information was carried out. This not only permitted to select specific area for the study vis a vis provided a guideline for designing and preparing a formal survey questionnaire. Secondary information like bio-physical, infrastructure, climate, topography, soil, altitude, cropping pattern, population, ethnic groups were collected from the concerned sectors such as; Department of Livestock; Forestry, PLBP (GTZ), CBS, DFAMS, Planning Division and NGOs like: Winrock International; ICIMOD; Australian Forestry. Specifically, the available village profile Mold (1993) supported more for describing the farming system of the study sites.

2) Participatory Method

Since the study is mainly about fodder tree adoption, a "matrix ranking and scoring" (Paliniswamy, 1992) was employed for understanding farmers' preference of fodder trees from their own choices, criteria and priorities.

3) Primary Data

Both informal and formal survey were conducted for different aspects. The former was used to select the area of study. Consultation was done with number of persons belong to the Kavre district who are acquainted with the problems in the field level. Special help was taken from extension staff (JT and or JTAS) of the district who has good rapport in the village. Other persons like village head men, village leaders and also respectful persons of village were selected as key informants.

While the later formal survey was carried out by preparing and pretesting questionnaire. Questions including mainly socio-economic related profile; adoption related and farm production and income on the concerned subject matter were asked to the sampled households. The questionnaires were prepared with the discussion of subject matter experts to overcome the unnecessary collection as well as to get only the required information. Preparation was done in English for ease to analyze and to save time. The local unit used for gathering the data, was transformed into standard unit in analyses. Skilled experienced persons of the relevant field were hired as enumerators for reliability.

2.4 Information Collected

The following data were gathered from the survey:

1) **Farming Systems**

-Land holding and land use

-Different crops, yield, cropping patterns

-Livestock population, feed information, income and expenses

-Existing tree species, production and management

2) **Socio-Economic**

-Farmers' identity (age, caste, education)

-Population and family size

-Income sources

-Knowledge and Social participation

-Infrastructure development

3) **Adoption Related**

-Farmers' knowledge and understanding

-Decision making

-Perception about the fodder tree distribution

-Farmers' preference and opinion of the fodder trees

2.5 Sampling Technique

Commensurate with the objectives, a sample size of 216 households with equal number (54) from each of the 4 village development committees (VDCs) were selected. A multistage purposive sampling procedure was used as follows:

STAGES	AREA	CRITERIA
First (Region)	Mid hill	* High density of livestock population * Potential for livestock development*
Second	Kavre (District)	* Accessible and familiar to researcher * Availability of secondary information * Can be generalized
Third	(VDC)	* Availability (non) of nursery and market
Fourth	(Household)	* Domestication of ruminants and land holder (Random selection) Fig.3.

Note* NPC (1984).

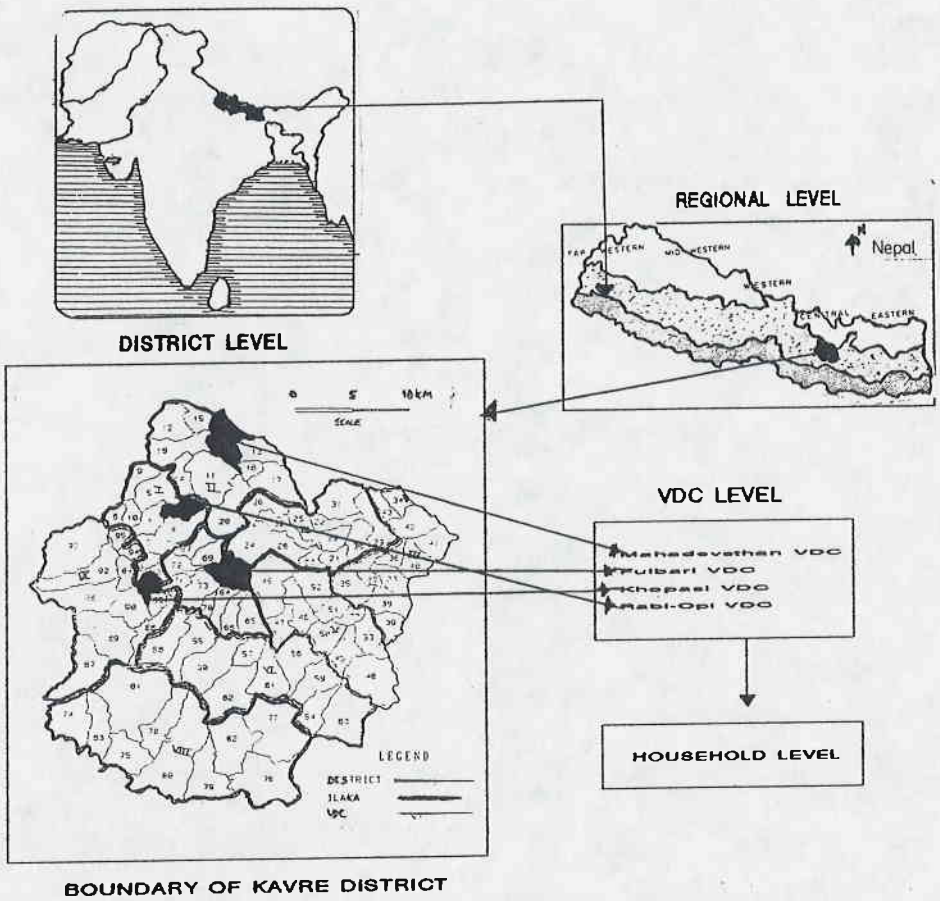

Figure 3 Multistage Sampling Technique

2.6 Analysis of Data

Both descriptive and empirical analyses were employed for different aspects in order to meet the objectives.

1) Describing the Farming Systems and Socio-Economic Condition

Percentage, rank, score, mean, range and standard deviation were applied for analysis of farming system components and socio-economic status. Contingency tables and diagrams were used to represent the inter relationship among the various components.

2) Adoption Measurement

It was based on the combination of two aspects.

i) The Degree (Extent) of Adoption Analogous with Casley and Lury formula (1984) and (Ashadi, 1992), it was assessed in index form and measured in percentage. The formula is presented as:

a) **Farm Adoption Index** = $\Sigma(100A/T)$.....(1)

b) **Activity Adoption Index** = $\Sigma(100N/R)$.....(2)

Where **T** is the total number the sampled household, **A** is the actual number of adopters, **N** is the actual number of **planted** fodder trees and **R** is the required number of fodder trees for the total number of

ruminants reared in the household.

ii) Effect of Adoption The performance of adoption in terms of effect was assessed through the changes that had brought in livestock subsystem (number/unit of holding), types (breed, ruminants/ non ruminants, milk production, fodder proportion in feed, rearing system), crop subsystem (production), human subsystem (fodder collection time). Percentage, mean and a simple statistical tool were employed to show the effect of fodder tree adoption on the whole system.

3) Factors Influencing Adoption

To identify the key variables and analyze the relationship between adoption of fodder trees and the selected variables, a logit or probit model is the appropriate form as recommended by various econometricians, for example, Maddala (1983), Pindyck and Rubinfeld (1981) and Wiboonpongse (1994). However, in terms of approximation, logit provides better result than the probit (Judge *et al.*, 1980). Therefore, logit is selected for this study, which was estimated using maximum-likelihood non linear technique. The equation of the model is given as:

$$P_i = 1/[1+e^{-\beta' X_i}]$$

where, P_i = Probability of farmers adopt fodder trees

$$\log \frac{P_i}{(1-P_i)} = \beta' X_i \quad \text{where,} \quad \log \frac{P_i}{(1-P_i)} = Y$$

Hence, $Y = \beta' X_i = \beta_0 + \beta_1.Knds + \beta_2.Age + \beta_3.Edu + \beta_4.Hedu + \beta_5.Tpland + \beta_6.Tgrinc + \beta_7.Lru + \beta_8.Ngft + \beta_9.Famsize + 10.Caste + \beta_{11}.Socpat + \beta_{12}.Ext + \beta_{13}.Nur + \beta_{14}.Mark + \beta_{15}.Fore$

Here, P_i is unobservable but for each observations we have information on whether farmer adopt or not. Thus, the measured dependent variable $Y = f(X_i)$, where $Y_i = 1$ if number of farmers (n1) adopt, otherwise $1-Y_i = 0$ if they (n2) do not. The n1+n2 = N, is the total number of sampled population. $\beta_0 + \ldots\ldots\ldots + \beta_{15}$ = Parameters and X_i = Variables ($X_1 \ldots\ldots X_{15}$) respectively. The maximum likelihood estimation used the second derivatives of log likelihood and iterates until the function converges.

The log likelihood formula is $\beta 1 = \beta_0 + [I(\beta_0)]'S(\beta_0)$ where β_0 is the initial value of β's i.e. initial stage of iteration. While I(β) and S(β) are first and second choice respectively which are divided by N, the total observation to obtain $\beta\hat{}$ or optimum estimation. The $\beta\hat{}$ is used to find estimated $P_i\hat{}$, which is given by Maddala (1983: 25) as:

$$P_i\hat{} = \frac{e^{\beta\hat{}'Xi}}{1+e^{(\beta\hat{}'Xi)}}$$

The computation was done by software computer program LIMDEP (Limited Dependent Variable in Econometrics)[1]. Employing this estimation

[1]Greene, W.H (1986): LIMDEP® Users' Manual, New York.

procedure, all parameters estimators give consistent and efficient asymptotically especially for large samples. Further, significance of entire model or subset of the coefficients can test by using the chi-square that replaces the "F" test . To test the goodness of fit Mc. Fadden R^2 was used, which is given as:

$$R^2 = 1-\log L_{max}/\log L_0$$

where, L_0 is the initial value when all parameters (except constant) are set equal to zero and L_{max} is the value of likelihood at maximum (Pindyck and Rubinfeld, 1981).

Based on research findings, all the variables included were hypothesized to have a great influence on the farmers' rational decision making in fodder trees adoption.

Knowledge (Knds) is one of the important factor in any technology (farm practice) adoption, deals about awareness of the problems and understanding of the technique. The awareness of fodder shortage, understanding on its cause and consequences, the techniques and purpose of the systems would create farmers' perception, valuation and attitude to adopt or not. In this case, proxy variables (rating or scoring) based on farmers' knowledge was applied.

Thus, the knowledge mentioned here consists of 4 major parts with

list of statements in each part. Purpose regarding the importance of the use of fodder trees. Skills includes identification, spacing, harvesting time and management, third part deals with farmers' opinion towards tree fodder in terms of feed and finally farmers' awareness about price of input and output of livestock, sources, agencies involved in fodder sapling distribution program.

For the measurement of this variable, the total score was standardized into 100 units, which was equally divided into 4 major parts (25 units). Further, each part total score (25 score) was divided by the number of statements listed in it. Finally, all the score obtained was summed up to individual knowledge score. The Table with list of statements of knowledge and score is given in Appendix 1.

Age of a farmer was measured in years. Young farmer was supposed to be more radical, progressive, and interested in new technology of farming than the older one.

Education (Edu) attainment of the farmer was considered as one of the factor for adoption. Because low rate of literacy is one of the major hurdles in the diffusion of recommended farm technologies in countries like Nepal. The education level is measured by the number of years of schooling attained. Here, **Highest education** attainment (Hedu) from the family members was also considered as a proxy of accelerator for adoption, and educated individual might have great role in decision making

in the house hold activities.

Farm Size (Tpland) is one of the most important factor that needs to be considered while identifying the factors of adoption. Many empirical studies also suggested that use of new technology (HYVs and inputs) tends to lag behind on smaller farms, because smallness of farm is often believed to be a reason that refrains farmers from trying a new practice. The farm size referred here "own" farm indicated, the cultivated land area owned by the respondent which differs from "total" farm size refers total area of land under the cultivation of a respondent irrespective of its sources of occupancy (Private+Lease). The farm size is measured as hectare of operational holdings.

Gross Income (Tgrinc) was the other economic variables chosen for the study of the farm household. This was defined as the total earnings of a respondent and the members of his family from any farm (crop+livestock) including consumption and non farm activities during the year prior to interview. The farm income was calculated by adding up the market value of harvested-time crop and income from livestock, where as non-farm income was income of farmers in terms of Rupees.

Livestock (Ruminants) Number (Lru) is the one that is essential to consider while determining the factors for adoption of fodder trees. Because in general fodder trees are mainly grown for the fodder, which is used as feed supplement to ruminant livestock. It could be measured in

heads or livestock unit[2] (lu) on the farm.

Natural Grown Fodder Trees (Ngft) also contribute fodder for feeding of ruminants. Therefore, it was assumed that if farmers had such types of existing fodder trees, they might be reluctant to plant the fodder trees on their land.

Family Size (Famsize) was defined as the total number of people in the household. Family serves as one of the social institutes which perform several function. The household size was measured by adding up the number of dependents actually living with the respondent in his household at the time of investigation.

Caste (Caste) is the categorization of farmers' in different groups on the basis of traditional socio-cultural factors. This also affects in adoption as believe or attitude towards the social norms is predominant in rural Nepal. This was grouped in 4 classes on the basis of prevalent occupational group and the analysis was carried out by running dummy variables for these groups.

Social Participation (Socpat) was defined as the degree to which an individual participates voluntarily in different organizations in the community and also involved in both formal and informal activities.

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[2]Livestock Unit (lu): Adopted from Devendra, C. (1989): where, 1Cattle=0.8 lu, 1Buffalo=1 lu, 1Goat=0.1 lu
Adopted from Rajbhandari and Shah (1981): 1Swine=0.12 lu
Adopted from PLBP (GTZ), 1991: 1Chicken = 0.00237 lu

Adoption rates were supposed to vary with the extent of social and institutional exposure of farmers. The extent of participation was measured by summing up involvement of respondent in each activity with scoring 1.

Extension Agent Contact (Ext) was regarded as the single most important factor for influencing day to day behavior of other farmers in the community. It psychologically influences farmers to adopt the system. This was calculated by the frequency of contact, regularly, occasionally, rarely, only calling and never by using scores 12 to 0.

Farmers' Access to Nursery (Nur) was the one that might have effect in adoption of fodder trees. Since, nursery serves as one of the source for the availability of seedlings, a farmer who had easy access to nursery might tend to adopt than the farmer who did not.

Market Availability (Mark) was the other factor consider as determinant of decision to adopt. Rearing of livestock is determined by the availability of market. Because market is essential for the flow of inputs (feeds, medicines) and outputs especially milk, which is perishable in nature.

Access to Forest Resource (Fore) might refrain adoption behavior since forest is also one of the resource for fodder and fuel wood, even though it is legally prohibited. It was measured in distance from the

respondent house.

2.7 Farmers' Perception about Distribution Program

To understand the farmers' opinion about the fodder tree distribution program that has been carried out by number of agencies both government and private, 3 questions were asked. Such as; preferred agencies and usefulness of the program and reasons, consequence of increase of fodder trees in future. The first two were evaluated through the mean and percentage form, where as latter one was measured in rank and performance score.

2.8 Assessment of Constraints and Improvement

Constraints might be different for different areas, therefore VDC wise problems encountered were examined. A farmer who adopted once might have stopped or slow down due to some reasons. It is essential to understand the problems of fodder scarcity to overcome and improvement in future implications. This was assessed through the preference of fodder tree species as well as farmers' readiness to adopt. Percentage, ranking, and scoring were employed to evaluate this objective.

CHAPTER III

STUDY AREAS AND THEIR RESOURCE BASE INFORMATION

An overview about the study sites regarding general features and their resource base information is described in this chapter.

3.1 General Characteristics of the Study Areas

This part elaborates about the bio-physical, socio-economic and demographic status and institutional development of research area.

3.1.1 Location and Agro-climatological Setting

The four Village Development Committees (VDCs) M, F, K and R selected for this study are located in the Kavre District, Central Region Mid hills of Nepal (Figure 3). The morphological diversity of the district has led to the differences in the socio-demographic and infrastructural development of the study areas. However, to a great extent, all these VDCs selected represent a fundamental features of the Mid hills of Nepal. The topography of the sites are similar to other hilly parts of Nepal with moderate to steep slope of mountain terrains and narrow tracts of plain land, converging into the valley between the hills. Despite the study sites covers a large and wide area, the major settlement are confined to the foot of the hills where water is available and soil condition are favorable for cultivation.

Agro-climatologically, all the study sites are located in the temperate zone mid-altitude (<1700 msl.). The VDCs are characterized by warm and temperate humid climate with annual mean temperature of about 20^0C and total annual rainfall of about 951 mm. The lowest temperature are in December and January while the highest are in June and July. The differences between monthly maximum and minimum temperature is greatest in May when the maximum is $31C^0$ and the minimum is $11C^0$. Rainfall is mainly concentrated in the monsoon season during May to September (Figure 4). Soils are comprised of Sandy loam to red fertile with good drainage. Frost is common during December to February, which is considered as constraint for winter crops. (Details in Appendix 2).

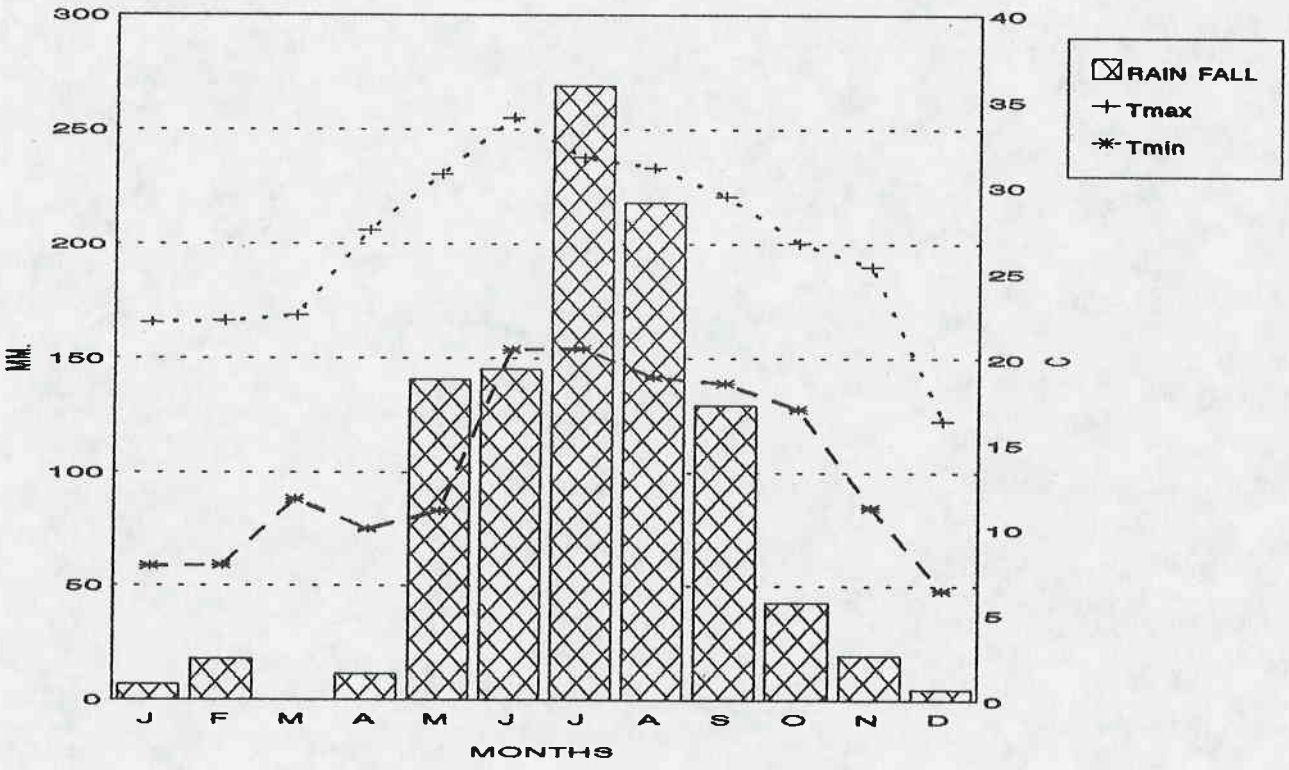

Figure 4 Monthly Temperature and Rainfall
Source: Meteorological Station, Kathmandu (1989-1991)

3.1.2 Demographic and Socio-Economic Status

Of the 54 households sampled from each VDC, more or less similar number of population was found with approximately equal proportion of male and female ratio (1:1). The households of all the sites constituted of a medium size (5-9) family members with an average size of 7 (Table 2). The finding is consistent with the village profile prepared by Mold (1993). There was no variation in family size of adopters and non-adopters (Appendix 10).

Table 2 Demographic Features of the Sampled Households

VDC	Res. no.	Population Number of the Study Sites				Family Size
	(no)	Total (no)	Male (no)	Female (ratio)	Male/Female (avg/hh)	
VDC F	54	405	202	203	0.99	7.4
VDC M	54	376	183	193	0.95	6.4
VDC K	54	344	179	165	1.09	6.7
VDC R	54	393	199	194	1.02	7.3
Total	216	1518	763	755	1.01	7.0

Source: Survey 1993.

Majority of the farm household (hh) was composed of economically active population or adult (16-60) group. The ratio of economically active to non-active (<16 or >60) group was estimated about 0.72 while children (<16) to adult (>16) was 0.66 (Table 3). The high estimated ratio reflects greater number of dependents on farm families. The later one represents a characteristic feature of developing countries, where flow of information is not spread well (Kaopong, 1992).

Table 3 Composition of Sampled Household Population by Sex and Age

VDC (N=54)*	<16		16-<60		>60		Avg age	
	Male	Female	Male	Female	Male	Female	Male	Female
VDC F	87	76	109	115	6	12	47.0	52.5
VDC K	65	54	101	100	13	11	54.4	53.7
VDC M	70	76	103	112	10	5	47.7	41.6
VDC R	86	89	101	97	12	8	54.8	48.2
Total (216)	308	295	414	424	41	36	50.9	49.0

Source: Survey, 1993.
* Respondent number of each VDC.
<16 = Children; 16-60 = Economically active adult; >60 = Inactive adult

Table 4. Literacy Percentage in the Sampled Household by Gender

VDC (N=54)	Total Pop. no.	Educational Status				Education Level		
		Literate %		Illiterate %		PM	Sec	High
		Male	Female	Male	Female	Both (Male+Female) %		
VDC F	405	33.1	14.8	19.0	33.1	91.2	4.7	4.2
VDC M	376	37.0	20.2	5.8	37.0	74.4	13.0	12.6
VDC K	344	37.8	27.6	3.2	31.4	86.2	6.2	7.6
VDC R	393	32.8	19.4	15.0	32.8	86.4	6.8	6.8
Total 216	1518	35.0	20.3	9.6	35.1	84.4	7.7	7.9

Source: Survey 1993.
Note: Pop= Population; Illet= Illiterate; PM= Primary; Sec= Secondary.

Looking at the educational background, on an average over 45% of the villagers were literate. The literacy percentage of male and female population of VDC K and M were figured out higher than the national level percentage i.e. 33% for male and 18% for female (DFAMS, 1991). However, in terms of distribution of educational level, majority of the sampled households population were limited up to the primary level schooling (1-5)

and only less than 8% got opportunity for higher education (>10 class). Table 4 depicts the educational background of the study sites.

Inspite of caste categorization, being Hindu Nation, majority of the communities have a strong faith in Hindu religion and culture. In VDCs' caste composition, domination was observed more or less of Brahmin caste except of VDC K where, majority of the households were Chettri caste 59.3%. However in overall Brahmin caste dominated to others by 12 or more percentage (Table 5).

Table 5. Caste Composition in Village Development Committees

VDC	Percentage of Sampled Household			
(N=54)	Brahmin	Chettri	Vaisya	Sudra
VDC F	42.6	9.3	42.6	5.6
VDC M	63.0	5.6	31.4	-
VDC K	14.8	59.3	24.1	1.9
VDC R	38.9	37.0	7.4	16.7
Total 216	39.8	27.8	26.4	6.05

Source:Survey, 1993.

3.1.3 Institutional Development

Based on the existing infrastructure of the district especially concerning to accessibility (nursery and market), Kavre district is regarded as one of the well furnished district of mid hills. Since, the district is located just 30 km far away from Kathmandu valley, all the

facilities like; schools, health centers, bank, irrigation canal, water turbines were provided. More advancement had been found in livestock developmental activities as GOs and NGOs had put more effort in this area for the promotion of quality of life of this district.

For instances, agricultural support institutes like service centers of agriculture and livestock, private and NGOs agencies (JOCV, UNICEF, BBP, FP) were established for water supply, health care, and education. Additionally a number of nurseries, milk collecting centers, chilling centers, feed and drugs dipo have been running in different areas for livestock development. However, all the VDCs are not equally well advanced in infrastructure development (Appendix 2).

Both "nursery" and "market" are confined in Mahadevsthan VDC (M), located 20 km distance from the district head quarter for flows of inputs and outputs of livestock products. VDCs F, K and R are located more or less 5 km distance from the head quarter but deprived of market, nursery and both nursery as well as market respectively. In this sense, VDC R is poorly developed as the sites especially VDC F and R are not linked with road. No such developmental activities and institutional support were confined in this village except one small farmer development program (SFDP) run by Agricultural Development Bank (ADB/N). Concerned to the access of the resources (market, nursery, forest), not so much markable differences can be figured out among the VDCs. Table 6 gives the clear picture about the situation.

Table 6 Distance of the Resources from the Household (in km.)

VDC	Nursery		Market		Forest	
(N=54)	mean	range	mean	range	mean	range
VDC F	2.8	0.5-5	2.9	0.05-6	2.6	0.05-9.0
VDC M	3.1	0.25-10	2.5	0.05-6	1.8	1-4.5
VDC K	5.1	2-9	4.4	2-7	3.3	0.05-9.0
VDC R	5.4	0.5-9	3.0	0.5-9	2.4	0.5-7.0

Source: Survey, 1993

Looking at the range differences and mean distances of the resources, VDC M and F households were found more access to the nursery because of the presence of nurseries. VDC M has access of natural forest resource followed by R, F and farthest for VDC K. However, these households were deprived to take benefit from these resources as these were located either far or under the control of government (eg. forest). Concerning to the market facilities, VDC M and K were well equipped with local market of feeds, veterinary drugs, milk collecting centers as compare to VDC F and R as these were not linked with roads.

3.2 Resource Base Information

Land, livestock, farm land trees and household labor are considered as major resources of the study sites and is discussed in details as follows:

3.2.1 Land Distribution and Use

The extent of land available for the selected VDCs varies considerably, ranging from 233 ha (VDC K) to 958 ha (VDC M). However the proportion of available land used for agricultural purpose was highest in K (87%) and lowest in F (25%). The area under the forest cover was 20% 8.4% 1.7% and 0% for VDC F, R and M respectively. However, all forest lands are under the Government property (Table 7).

Table 7. Distribution of Land Use of the Study Sites

Land Use	Village Development Committee							
	F		M		K		R	
	ha	(%)	ha	(%)	ha	(%)	ha	(%)
Agriculture	136.5	25.3	600.5	62.7	202.3	87.0	329.5	65.0
Forest	110.0	20.4	16.8	1.7	-	-	42.5	8.4
Pasture	61.0	11.3	141.2	14.7	7.5	3.2	44.1	8.7
Residential	10.8	2.0	36.9	3.9	22.7	9.8	41.2	8.1
Others*	221.7	41.0	162.5	17.0	-	-	49.8	9.8
Total	540.0	100.0	957.5	100.0	232.5	100.0	507.1	100.0

Source: MOLD, 1993
Note: * land used as fallow, communal, river, rocks and ways

Farm land which is comprising of different types of land, lowland (khet) and upland (bari) is the major production area of all the study sites. Upland forest and fallow were generally used for livestock grazing and fuelwood collection. The general cropping pattern was similar in all the areas with paddy based cropping system in lowland while maize based

cropping system was followed in upland. Wheat, mustard and millet were grown as secondary crops while tomatoes and potatoes are the main cash crop of the area. The predominant cropping pattern is shown in Figure 5.

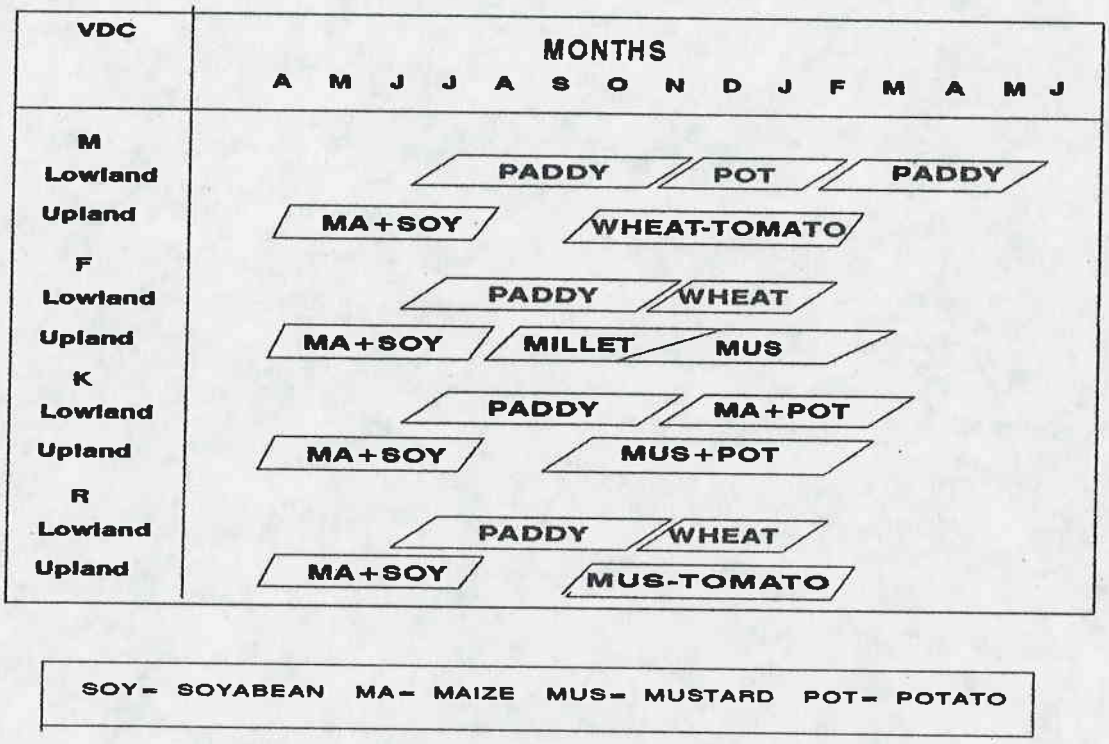

Figure 5 Dominant Cropping Pattern of the Study Sites
Source: Survey, 1993

3.2.2 Animal Raising

Livestock was one of the other important resource for income generation and livelihood of the Kavre community. All types of livestock ruminants and non ruminants were raised in the study sites. According to the Kavre study report carried out by PLBP (DLS/PLBP, 1992) around 50% of the ruminant herd was of goat population which was followed by Cattle (32.9%) and 17.8% of buffalo. While in non-ruminant sector pig constituent was quite low, less than 1% in all the VDCs (Table 8). Similar type of herd composition was prevalent in individual VDC. The reason behind such composition of holding was mainly due to the influence of social religious taboos rather than other things (Interview, 1993).

Table 8 Livestock Population in the Study Sites

VDC	Total Number		Percentage of Ruminants and Non-Ruminants				
	Ruminants	Non-Ruminants	Cattle	Buffalo	Goat	Pig	Poultry
VDC F	11,792	28,200	32.4	14.2	53.4	0.71	99.3
VDC K	1,291	1,068	33.4	11.0	55.6	-	100.0
VDC M	4,192	2,872	33.3	27.6	39.1	0.63	99.4
VDC R	11,987	4,543	33.2	18.7	48.1	0.50	99.5
Total	29,262	36,683	32.9	17.8	49.3	0.70	99.3

Source: PLBP, 1992.

3.2.3 Tree Species

Tree species especially, fodder trees of the farm land of the study sites had a significant contribution in supporting the lives of

human as well as livestock. Both indigenous (natural grown) as well as planted species were confined on the bunds, terrace wall and risers of the upland. In terms of species composition, density coverage and level of production, a wide diversification was observed in all the sites. In over all around 78% of the farmers own fodder trees on the farm land. However there was a wide range in owning number and production among the VDCs (Table 9).

Table 9 Density Cover and Production of Fodder Trees* per Household

VDC	Average no.		Production (kg)		Farmer with Fodder Trees	
	Mean	Range	Mean	Range	no.	%
VDC F	18.9	0-182	404	0-12300	44	81.5
VDC M	364.7	0-3760	3277	0-25950	52	96.3
VDC K	12.2	0-189	206	0-3480	26	48.1
VDC R	11.8	0-91	330	0-1200	45	83.3
Total 216	398.7	0-3760	1054	0-25950	169	78.3

Source: Survey, 1993.
Note*: Included natural grown and adopted fodder trees

VDC M has higher number of fodder trees (19699) with domination of improved (exotic) species like ipil and kimbu, followed by VDC F (1025) with *kutmiro, kimbu and koiralo* as dominating species. Conversely, the other two VDC K and R have greater domination of indigenous species like *gogan, panyu, bakina and panyu, kutmiro, bakina* respectively. However, in all the VDCs except K, *kutmiro* was popular and spread dominantly (Table 10,. Appendix 3).

Table 10 Dominant Fodder Tree Species on Farm Land in Terms of Total Number, Production and Households Number

VDC (N=54)	Percentage of Number			Dominant Species by Production			HH Response		
	1	2	3	1	2	3	1	2	3
VDC F	C (29)	A (10)	B (8)	C (57)	L (11)	F (9)	C (64)	F (20)	L (16)
VDC M	E (52)	A (29)	C (10)	C (32)	E (28)	A (15)	C (84)	B (80)	E (40)
VDC K	G (25)	L (22)	N (11)	G (35)	L (32)	I (8)	L (30)	C (15)	N (12)
VDC R	L (27)	C (25)	N (17)	C (42)	L (18)	F (7)	C (47)	L (36)	J (26)

Source: Survey, 1993. Note: 1, 2 and 3 are the rank of species.
C=*kutmiro*; A=*kimbu*; F=*khanayo*; L=*painyu*; E=*ipil*; N=*bakaino*; G=*gogan*; J=*timilo*; I=*tanki*
Note: (See Appendix 3 for the scientific names of the species)

The findings of Amatya (1989) and Robinson (1989) supports the dominance of such natural grown fodder trees. But different in VDC M and F, where plantation on bari land had increased so densely that adopter trees number were greater than natural grown by 77% and 40% respectively.

3.2.4 Family Member in Farm and Off-Farm Activities

Farm family members, both economically active as well as non active group with two distinct sex (male and female) constitute as one of the major labor resource for carrying out farming system activities in all the research sites. Table 11, given below shows that the children and adult contributes around 15% and 85% of the total labor force (922). Calculating the time devoted by male and female groups, an overall of 3 hours variation was found in each VDC.

Table 11 Family Farm Labor Supply by Gender and Age in the sites

VDC (N=54)	Total Farm Labor	Age %		Gender %		Working period hours/day	
		Child	Adult	Male	Female	Male	Female
VDC F	242	16.9	83.1	36.4	63.6	6.1	9.8
VDC M	198	10.6	89.4	44.9	55.1	8.2	11.0
VDC K	239	12.6	77.4	43.1	56.9	4.2	7.5
VDC R	243	20.2	79.8	44.0	55.1	8.2	11.2
Total 216	922	15.2	84.8	41.4	58.6	6.7	9.9

Source: Survey 1993.

While considering the gender in farming system activities, female contribution was envisioned higher in all the activities performed. A significant demarcation of male and female could be observed in the enrollment of household followed by livestock and crop (Table 12). Apart from the farm and non farm activities, some of the family members were also engaged in off-farm activities. Especially in VDC K, 67% of the respondent have got opportunity of off-farm employment with greater (63%) in job (service and teaching). This findings coincides with the higher literacy percentage in VDC K. Table 13. provides the details of findings.

Table 12 Division of Family Labor in Farming System Activities by Gender

VDC	Crop (%)			Livestock (%)			Household (%)		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
VDC F	12.6	18.4	31.0	13.3	21.5	34.8	10.5	23.7	34.2
VDC K	17.0	17.4	34.4	17.1	19.2	36.3	9.0	20.3	29.3
VDC M	15.9	16.9	32.8	16.8	18.2	35.0	12.2	20.0	32.2
VDC R	16.4	17.5	33.9	16.2	18.6	34.8	11.4	19.9	31.3
Total	15.5	17.5	33.0	15.8	19.4	35.2	10.8	21.0	31.8

Source: Survey, 1993

Table 13 Number and Percentage of Farmers in Occupational Activities

	VDC M		VDC F		VDC K		VDC R	
	no.	%	no.	%	no.	%	no.	%
1. Agriculture	44	81.4	33	61.0	18	33.3	35	64.8
2. Agri + Teaching	3	5.6	1	1.9	26	37.0	2	3.7
3. Agri + Service	3	5.6	6	11.1	1	26.0	5	9.3
4. Agri + Business	4	7.4	5	9.3	2	3.7	4	7.4
5. Agri + labor	0	0	9	16.7	0	0	8	14.8
Total	54	100.0	54	100.0	54	100.0	54	100.0

Source: Survey, 1993

3.3 Highlights

The general characteristics of the study site comprises temperate agro-climatic settings, reflecting the mid hills of Nepal. Revealing the socio-economic and demographic status, ratio of male to female coincides with national level estimation (1:1) but the literacy percentage in the study site is higher by 2% in both male and female than the national average. However, in terms of institutional development VDC M is well equipped with and accessible of nursery, market and forest. Similarly, in case of resource holdings especially, land and tree VDC M has got the highest holding of 938 hectare and 19699 trees respectively. Furthermore exotic species of fodder trees like ipil and mulberry are found in VDC M and F where, nursery is exist. Significantly less labor involvement in farm activities (approximately 2 hours) and consequently higher in off-farm activities (66.7%) in VDC K reflects the role of market. VDC R in all these aspects are deprived with and therefore poorly developed.

CHAPTER IV

FARMING SYSTEMS AND SITUATION OF ADOPTERS AND NON-ADOPTERS

This chapter discuss about the general farming systems of the mid hills of Nepal which is categorized into 4 major sub-systems, specifically, crop, livestock, farm fodder trees and household sub-systems. Each of them has been elaborated separately with number of sub-headings. Apart from this, comparison has also been made between adopters and non-adopters in each sub-system to understand the situation of them.

Therefore, the total sampled households have been categorized into two major parts, "adopters" and "non-adopters" in order to distinguish the characteristics features between the two . The classification has been done on the basis of plantation of fodder trees as explained in Figure 2 (Chapter II). The later one (non-adopters) further is further grouped into two classes. The first type (non-adopters1) are the one who have not planted but have natural grown fodder trees while, the second type (non-adopters2) are those who do not have even a single fodder tree on their farm land.

On the basis of this categorization, of the total sample of 216 households, there were total 90 (41.7%) adopters with highest number in VDC M (43) followed by VDC F (23) where there is availability of nurseries. While among the non-adopters 126 (58.3%), non-adopters1 were found higher 79 (36.6%) as compare to non-adopters2 (47 or 21.6%). Table 14 explains

the details on it.

Table 14. Number of Farmers in Different Groups of Household Sub-System on the Basis of Fodder Trees.

VDC	Adopters	Non-adopters1	Non-adopters2	Total Non-adopters
VDC F	23	21	10	31
VDC M	43	9	2	11
VDC K	14	14	14	40
VDC R	10	35	9	44
Total	90	79	47	126

Source: Survey, 1993.
Note: Non-adopters1=Having natural grown fodder trees
Non-adopters2=Do not have any trees

4.1 Crop Sub-System

The Crop sub-system has been explained in terms of land holdings, land use priority and crop and by-products production, sale and purchase.

4.1.1 Land Holdings and Land Use Priority

Different varieties of crops like cereals, legume, vegetables and forage were grown in the household farm land. The average land holding size of sampled household was same for all VDC except K VDC, which has quite low holdings i.e 0.6 ha only (Table 15). Irrespective of the VDC, however, the overall private holding was less than 1 ha while adopters holding was higher (1.16) than mean (0.98) and non-adopters (0.84) hectare.

Table 15 Total Holdings of Different Types of Land in Hectare

Land Types (N=54)	Village Development Committees							
	F		M		K		R	
	mean	range	mean	range	mean	range	mean	range
Khet1	0.2	0-0.8	0.4	0-2.5	0.24	0-0.7	0.3	0-2.2
Bari2	0.7	0.05-2.5	0.6	0.1-2.5	0.3	0-1.2	0.6	0.1-1.8
Forest	0.05	0-1.1	0.1	0-1.4	0.05	0-1.1	0.03	0-0.8
Fallow	0.2	0-1.5	0.1	0-1.5	0.02	0-0.5	0.13	0-1.3
Total	1.16		1.18		0.6		1.05	

Source: Survey, 1993
Note: 1 = Low land area; 2 = Up land area

Similarly, on an average 63% of the households own less than 1 ha of land. However, adopters were lesser by approximately 10% i.e (53.3) in this group but conversely non-adopters were higher by 7% (69.8%) from the average. Only around 10% of the households own greater than 2 ha. of land. Mostly, the priority of land use is determined by the land holding size, land types and needs.

Thus it was observed that majority of the farmers (>75%) of each VDC preferred to cultivate paddy on low land, as rice being a major staple food crops for daily life. In contrast diversified cropping pattern was followed in bari land (cultivated upland). But preference of maize for upland crop was the most (>79%) as used for dual purpose, food as well as feed purpose and also a substitutional diet to paddy for the low income group people (Table 16). The terrace and risers of bari land around the homesteads were fully utilized by growing of trees for fodder and fuel wood purpose. Apart from the cultivable land, the non-cultivable land

(forest and fallow) was also used by forest trees for fuel woods, timber and grasses for fodder and thatching purpose. Such type of pattern was consistent with the findings of different studies (Gajurel, 1987; Gatenby, 1990; and Robinson, 1989).

Table 16 Private Land Holding and Priority of Land Use

VDC	% of Farmer own Land (ha)			Farmers' Priority of Land Use (%) Low Land			UpLand		
	>1	1-2	<2	PA	PO	MA	PA	PO	MA
VDC F	44.4	44.4	11.1	75.9	-	-	-	-	85.2
VDC M	59.3	25.9	14.8	77.8	11.1	1.9	-	9.3	81.5
VDC K	83.3	14.8	1.9	92.6	1.9	-	-	1.9	85.2
VDC R	64.8	24.1	11.1	75.9	1.9	1.9	1.9	9.3	79.6
Total 216	63.0	27.3	9.7	80.5	3.7	0.95	0.47	5.1	82.8

Note: PA = Paddy; PO = Potato; MA = Maize

4.1.2 Crop Production

Since the holdings of upland was higher than the low land in all VDCs, the coverage area for maize was comparatively higher than the other crops in all the sites. Irrespective of the total area under production, the production performance largely depends on the types of land used. Looking at the production performance of paddy (7.3/ha) and potato (3.3/ha), low land quality of VDC M showed up best, followed by VDC K (Table 17).

Table 17 Crop Production, Consumption and Sales

Major Crops	F				M				K				R			
	A[1]	P/ha[2]	%S[3]	%C[4]	A[1]	P/ha[2]	%S[3]	%C[4]	A[1]	P/ha[2]	%S[3]	%C[4]	A[1]	P/ha[2]	%S[3]	%C[4]
Rice	12.6	3.1	22.4	77.6	17.5	7.3	35.7	64.3	13.0	4.9	22.4	77.6	18.2	4.3	29.2	70.8
Wheat	29.7	0.63	2.5	97.5	8.0	2.0	42.7	57.3	6.7	11.4	2.6	97.4	12.5	15.3	7.1	92.9
Corn	36.7	19.7	11.0	89.0	30.0	2.4	6.7	93.3	14.7	16.7	4.0	96.0	27.7	23.1	4.8	95.2
Millet	1.5	0.33	0	100.0	6.5	1.2	25.6	74.4	0.5	0.9	0	100.0	0.6	1.2	0	100.0
Potato	0.3	2.9	0	100.0	9.7	13.3	88.4	11.6	5.8	13.2	84.3	15.7	7.3	7.3	81.6	18.4
Soybean	9.0	0.2	25.8	74.2	2.8	0.5	28.3	71.7	1.0	0.3	0	100.0	3.1	0.1	25.9	74.9
Mustard	7.7	0.3	15.0	85.0	2.3	0.6	42.4	57.6	7.5	0.4	0	100.0	7.7	0.6	15.3	84.7
Tomato	-	-	-	-	0.2	5.2	79.5	20.5	-	-	-	-	0.9	6.9	90.8	9.2
Vegetables	0.1	0.6	0	100.0	0.2	2.2	39.2	60.8	1.6	2.4	63.5	36.5	0.1	1.0	0	100.0

Source : Survey, 1993
Note: Unit used
1. Area (A)[1] : hectare
2. Production/hectare (P/h)[2]: tons/hectare
3. Sold (S)[3] : Percentage of total production
4. Consumption (C)[4]: Percentage of total production

Conversely, maize production performance turned out low as compare to others, representing poor upland quality. In this sense, VDC R was found better off than other VDCs'.

The crops cultivated were mainly for consumption purpose and if surplus then sold for income generation. However, cash crops like potatoes (>80%) and tomatoes (79-90%) were grown for the selling purpose rather than consumption purpose as these were highly market oriented crops. The study conducted in Majhigoan and Dumerechour of Kavre district also brought out potato as the top in net benefit per hectare (New Era, 1990). Comparing to the percentage sold to the total production of staple food crops (rice), VDC M was better off (35.7%) followed by R, F and K

respectively. However, considering maize as substitute for paddy to low income group, it was found that percentage of maize consumption was higher in VDC R related with production level. On the basis of percentage sold of the crops to the market, the flow of commodity to the market was highest in VDC M, followed by K. The variation confined on percentage share of market among the VDCs reflects that the outlet is dependent upon the accessibility to the market.

4.1.3 Farm Feed Production

By-products of the crop constitute the major portion in the diet of livestock. Especially, crop residues (rice straw, maize stover, millet stalk, husks of crops) called dry fodder were stored and fed during the dry seasons. In addition, the grinned and processed product of crops (maize flour, mustard cake, rice polish) called concentrate were fed mainly to the productive and milching animals. Considering the percentage of the feed supplied Table 18 depicts that, livestock of VDC R were highly dependent on farm land (91%). Whereas VDC M and K due to the market facilities, greater percentage of feed i.e. concentrate, 44% and 37% were purchased as compare to 19% and 24% in VDC F and R respectively.

Table 18 Percentage of Farm Feed Production, Purchase and Expenses per Annum

Feeds	VDC F				VDC M				VDC K				VDC R			
(N=54)	mean (kg)	farm (%)	pur (%)	exp (%)	mean (kg)	farm (%)	pur (%)	exp (%)	mean (kg)	farm (%)	pur (%)	exp (%)	mean (kg)	farm (%)	pur (%)	exp (%)
Concentrate	892	81.5	18.5	25.7	1032	56.2	43.8	28.2	540	62.8	37.2	23.4	762	76.0	24.0	19.6
Straw	1206	78.0	22.0	53.2	3090	93.4	6.6	59.3	1668	96.6	3.4	65.2	2274	81.7	18.3	69.6
Maize Stover	2415	62.7	37.3	21.0	1515	100	-	5.9	819	100	-	6.4	1584	97.3	2.7	9.7
Millet Stover	18	100	-	0.06	294	99.4	0.6	1.1	4.5	100	-	0.03	184	100	-	1.1
Husks	-	-	-	-	-	-	-	-	-	-	-	-	117	100	-	-
Forage	-	-	-	-	24	100	-	5.5	10.6	100	-	4.97	-	-	-	-

Source: Survey, 1993
Note: mean (kg) = average feed supply per household in kilogram
farm (%) = percentage produced from farm per household
pur (%) = percentage purchased of the total feed supply
exp (%) = percentage of the total expenses of feed spent in Rupees (Rs.)

Looking at the household expenses in feed, VDC M had the highest expenses in concentrate (28%) but lowest in dry fodder (66.3) among the VDCs. Contradictory to this, the greater (79.3%) expenses was in dry fodder of VDC R where both nursery and market is lacking.

4.2 Livestock Sub-System

Holding of livestock, herd compositions, feeding pattern, demand and supply of fodder and value of tree fodder in feed ration have been discussed in livestock sub-system.

4.2.1 Livestock Holding Size

The average holding of livestock was found in F>M>R>K pattern with mean holding of 3.71, 3.4, 3.0 and 2.1 lu respectively (Table 19).

Table 19. Average Livestock Holding in Livestock Unit (lu)

Livestock Types	Village Development Committees (N=54)							
	F		M		K		R	
	mean	sd	mean	sd	mean	sd	mean	sd
Cattle	1.64	1.2	1.15	1.17	1.2	0.86	1.64	1.47
Buffalo	1.7	1.2	1.96	1.2	0.55	0.86	0.94	1.07
Goat	0.4	0.3	0.3	0.32	0.3	0.25	0.41	0.4
Swine	-	-	-	-	0.02	0.017	0.03	0.13
Poultry	0.01	0.02	0.01	0.03	0.008	0.014	0.005	0.01
Ruminant	3.7	1.9	3.4	2.0	2.1	0.97	3.0	2.0
Non-Rum.	0.01	0.02	0.01	0.03	0.01	0.025	0.04	0.14
Total lu	3.71	1.92	3.4	2.0	2.1	0.99	3.0	2.1
Adopter lu	4.2	1.91	3.7	2.1	2.2	0.97	3.2	2.9
Non-adp lu	3.4	1.88	2.4	1.3	2.1	0.96	3.0	1.9

Source: Survey, 1993.
Non-Rum. = Non Ruminants

Considering the species in the herd, the average buffalo holding was greater compare to cattle in VDC F and M, reflecting the preference of buffalo over cattle but vice versa for R and K. The lowest holding of VDC K (2.1 lu) explains that large ruminants holding was not much prevalent in village household. However, non-ruminants holding was similar for VDC F, M and K with average mean of 0.01 lu but highest in VDC R (0.04 lu).

From the assessed result the influence of nursery in the VDC M and F could be visible. Comparing the adopters and non-adopters, the greater livestock unit was found in adopters of all the research sites reveals the cause of adoption of fodder trees.

4.2.2 Herd Composition and Distribution Related to Socio-Economic Characteristics

For the multiple aspects, there was diversification in livestock herd composition. However, the composition was governed by strong socio-economic characteristics of the household. Table 20 presents very distinque characteristics in rearing of livestock that, Brahmin and Vaisya caste households did not rear swine at all. Only 12.5% of the Chettri household rear it. Whereas 87.5% of Sudra households kept swine with very few percentage (<10%) kept large ruminants (cattle, buffalo).

Looking at the family size and livestock composition it was observed that majority of medium family size (5-9) own all types of livestock than the small family size. Similarly majority of the households with high income group reared ruminants (42-56%), whereas medium income group (50%) reared swine. In the low income group, percentage of household rearing poultry (38.7%) was highest. It was interesting that all most all of the households whose land holding was less than 1 hectare had greater diversification in herd composition and holding size compare to large holdings.

The herd holdings (lu) shows negative relationship with the land size. The non-ruminants like swine and chickens were kept by majority of the small farm size 75% and 64% respectively. The results support the findings that small farmers over looked risk while large farmers perceive risks (Caveness *et al*, 1993).

Table 20 Herd Composition Classified by Socio-Economic Characteristics

Animal	Family size			Caste				Income			Land Holding		
Species	1	2	3	1	2	3	4	1	2	3	1	2	3*
Cattle	19.6	63.2	17.2	39.9	30.7	23.3	6.1	23.9	34.4	41.7	58.9	30.7	10.4
Buffalo	9.8	69.9	20.3	52.4	16.8	27.3	3.5	11.9	22.2	55.9	53.1	32.2	14.7
Goat	18.2	65.3	16.5	38.1	26.0	29.5	5.7	22.7	34.7	42.6	60.2	29.0	10.8
Swine	-	100	-	-	12.5	-	87.5	37.5	50.0	12.5	75.0	25.0	-
Poultry	16.0	65.3	18.7	5.3	22.7	58.7	13.3	38.7	26.7	34.7	64.0	24.0	12.0

Source: Survey,1993.
Note: *
Family size 1= <5 (small); 2= 5-9 (medium); 3= >9 (large) members in the household
Caste 1= Brahmin; 2= Chettri 3= Vaisya; 4= Sudra (Occupational class)
Income 1= <26,000 (low); 2= 26-50,000 (moderate) 3= >50,000 (high) income in Rs.
Land 1= <1 (small); 2= 1-2 (medium) 3= >2 (large) holding size in ha.

4.2.3 Feed and Prevalent Feeding Pattern to the Livestock

Farmers usually feed in the stall itself to their livestock all the year round. The ration of the livestock feed was composed of both feeds (concentrates or byproducts) and fodder (green or dry).

Looking at the total quantity of feed fed per lu, VDC K and M provided more or less the same quantity, over 4 thousand kg/lu/annum, followed by R (3.8) and F (2.7) thousand kg/lu/annum respectively. In which, the proportion of grass constituted highest approximately (>50%), followed by roughage in all the VDCs, except VDC M (31%). Figure 6 and Appendix 9 provides the details.

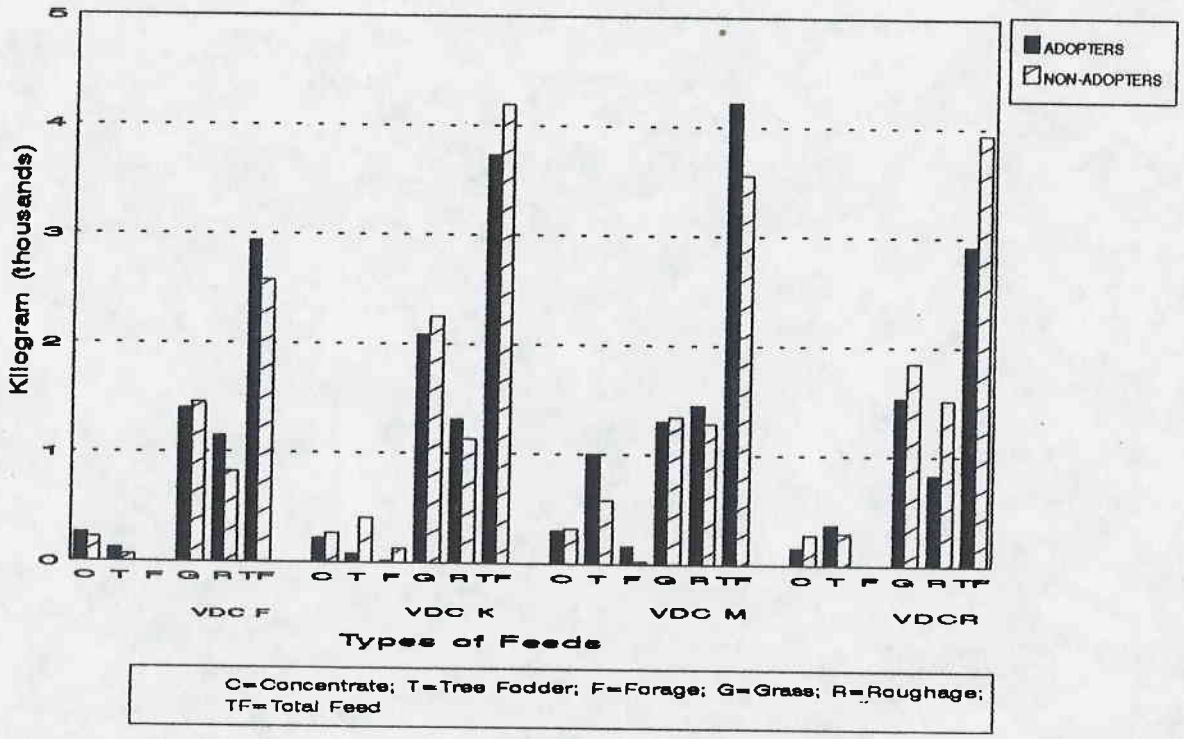

Figure 6 Quantity of Feed Fed per Livestock Unit per Annum
Source: Survey, 1993

However Dixit (1985) reported only 17% of grass contribution in feed. The percentage of tree fodder, concentrate and forage in the ration was found comparatively higher in VDC M around 22.8%, 7% and 3.4 % respectively. Furthermore the least proportion of forage was restricted to only VDC M and K where nursery and market exist. While comparing the quantity of feed fed to livestock, it was assessed that adopters of VDC F and M provided greater quantity of feed per lu than non-adopters, while vice versa in VDC K and VDC R.

Especially, the feeding of tree fodder was greater among adopters than non-adopters in all VDC except K where it was vice versa. For the later case, looking at the farthest distance to forest, moreover prohibition for use, explains that the supply of tree fodder was from the greater number of natural grown trees on the farm land, since the natural grown fodder trees were higher number than planted in this VDC (Appendix 4). The small holding of livestock unit accompanied with mostly small ruminants were other causes explains the more quantity of feed supply among non-adopters as compare to adopters.

On the basis of the availability of the by-products and seasonal fodder, the animals were nourished. Majority of the household (80%) fed concentrates (maize flour, rice-bran, mustard-cake etc.) on an average of 11 months through out the seasons. Nutritional forage cultivation, was still not much familiar in the study sites and hardly enough for half a month. Green grass were fed on the basis of cut and carry during rainy

season for more or less 4-5 months. Figure 7, provides an overview of the feeding pattern.

Items	SEASONS												Res. no.	Avg. Months of Feeding
	S	O	N	D	J	F	M	A	M	J	J	A		
	1			2			3			4				
Concentrate	*	*	*	*	*	*	*	*	*	*	*	*	192	10.9
Tree Fodder		*	*	*	*	*	*						85	2.4
Forage					*	*							17	0.3
Rice Straw		*	*	*	*	*	*	*	*				135	8.3
Maize Stover		*	*	*	*	*							90	5.2
Millet Stover											*	*	34	0.8
Grass									*	*	*	*	184	4.6
Husk									*	*			4	0.3

1 = Early Winter 2 = Late Winter 3 = Summer 4 = Rainy Season

Figure 7 Dominant Feeding Pattern in the Study Sites.
Source: Survey, 1993

In this context, tree fodder and by-products were the main source of fodder especially during dry season. Particularly, tree fodder constitute the essential part of the maintenance ration and fed around 2-3 months of dry season. March- May was reported as the peak scarcity period of fodder, similar to the others findings (Hawkins, 1983). Maize stover, millet stalk and husk were generally stored and fed when there is no availability of paddy straw. A similar type of feeding pattern was reported by Gatenby (1990) in his study.

4.2.4 Demand and Supply of Fodder for the Ruminants:

The short fall of demand of feed and fodder to the livestock of the Nepalese hill farming system has been reported by the numbers of researchers elsewhere (Hopkins, 1983; Leutel, 1991; Abell, 1979; Pandey, 1982 and others). Inspite of the availability of fodder from the various resources, fodder deficit in feed ration was obtained as a general norm in all the study sites. Table 21. presents, an overall average of 2.3 thousand kg/annum of green fodder (grass+ forage+ tree fodder) was deficit in the research sites that ranges from 0.5 to 5 thousand kg/annum.

Table 21 Average Quantity Availability, Production and Requirements of Fodder for Ruminants per Household

VDC		Green Fodder[1] (000 kg)			Energy[2] (000 Mega Joules)		
(N=54)		Demand[3]	Supplied[4]	Deficit	Required[5]	Supplied	Deficit
VDC F		10.6	5.65	-5.0	36.5	33.4	-3.1
VDC M		9.8	8.2	-1.6	33.7	46.4	+12.7
VDC K		6.0	5.5	-0.5	20.8	27.1	+6.3
VDC R		8.6	6.3	-2.3	29.6	21.4	-8.2
Total	216	8.7	6.4	-2.3	30.1	36.1	+6.0
Adp.	90	10.1	7.4	-2.7	34.8	42.6	+7.8
Non-Adp.	126	7.8	5.7	-2.1	26.8	31.5	+4.7

Sources: Survey, 1993
Demand[3] (Agricultural Diary 1993)
Supply[4] (Survey, 1993)
Required[5] (Hopkins, 1983)

Note: Green Fodder[1] = Tree fodder + forage + grass
Energy[2] = Calculated for both green and dry fodder
For Calculation (see Appendix 5)

However, considering the dry fodder (straw and stover) while computing in terms of energy (Metabolic energy), there was surplus energy in VDC M (12.7) and K (8.2) thousand mega joules energy for maintenance/lu. Where as in VDC F and R livestock were raised in considerably low nutrients supply i.e deficit of 3.1 and 6.2 thousand mega joules/lu respectively. Hence the demand and supply of green fodder as well as energy calculation depicts that VDC M as a whole kept livestock in better condition with adequacy in quality and quantity of feed.

Irrespective of VDCs, while considering the adopters and non-adopters, the green fodder was in deficit greater by 0.6 and 0.4 thousand kg in adopters than the non adopters and mean of the total sampled households. But in terms of energy supply both adopters and non-adopters had surplus with 3 thousand mega joules for the former. This implies there was huge supply of green grass in non-adopters as compared to adopters, which can also be proved from Figure 6 shown in earlier. While the adopters balanced it through by-products. This results urged the need of green fodder in the ration which is highly nutrient, since poor livestock nutrient is considered as the most important constraint to livestock production (Chand, 1990).

4.2.5 Fodder Trees in Feed Value

While concerning about the feed and fodder, the role of fodder trees become apparent. Most of the authors have mentioned about the

crucial role of the tree fodder in livestock feed, however to understand the most important role from the farmers' perspective point of view ranking and scoring test was carried out (Table 22). Variation was observed in the opinion of farmers while incorporating the tree fodder in feed value. Value of tree fodder in milk production aspect was the most frequently stated (93%) and scored 82.8 as the most significant impact to the household farming system. Feed supplement with 71.7 and animal nutrition 67.4 score were ranked into second and third respectively.

Table 22. Farmers' Opinion about Tree Fodder Value in Livestock Feed

Opinion of Farmers	Number of Farmers in Rank							NR	Farmers Response %	Score
	1	2	3	4	5	6	7			
1. Feed Supplement	43	6	8	9	7	9	-	8	91.1	71.7
2. Increase milk Yield	32	41	8	2	1	-	-	6	93.3	82.8
3. Maintain Animal Health	8	31	31	6	1	-	-	13	85.5	67.4
4. Supply in Lean Period	1	4	29	28	11	7	-	9	90.0	53.1
5. Makes Feed Palatable	1	1	3	19	8	5	1	51	43.3	22.1
6. Save Searching Time	2	3	6	13	30	4	-	28	68.9	33.8
7. Others	1	3	3	1	3	1	-	78	13.3	8.7

Source: Survey, 1993.
NR= Not Responded

4.2.6 Livestock Production

Livestock and livestock products have an indispensable role in household cash generation, nutrition and crop production. The performance of such farm animal can be attributed to a large degree from the fodder they are getting (Pandey, 1982). However, productivity of the livestock is also associated with a number of factors such as; nutrition

breed, spatial and temporal dimensions. For instance, the average milk production per lu was highest in VDC M (446 lts/annum), followed by (380 lts/lu) in VDC K despite the lowest holding of cattle and buffaloes.

Considering the production level and proportion flow to market level, the highest percentage was found in VDC M (69%) and lowest in VDC K (35%) with 0.3 and 0.65 as production-consumption ratio (P/C) respectively (Table 23).

Table 23. Livestock Products Production, Percentage Sold and Consumption per lu per Annum

Items	Unit	F			M			K			R		
		Prd.	Sold	Con.	Prd.	Sold	Con.	Prd.	Sold	Con.	Prd.	Sold	Con
Milk*	lt	300	40	60	446	69	31	380	35	65	238	55	45
Ghee*	lt	0.5	0	100	0.3	42	58	0.3	37	63	0.06	100	0
Manure	kg	66	0	100	67	0	100	62	0	100	61	0	100
Animal	Rs.	1060	87	13	1617	98	2	442	59	41	555	97	3
Egg	no.	3601	0	100	2516	41	59	2818	0	100	1485	0	100

Source: Survey, 1993
Note: * Milk and Ghee from Cow and Buffalo
Prd= production; Con= Consumption

It was found that greater than 60% of income was from the milk production with invariably greater percentage from the buffalo milk through out the research sites (Table 24). The reason behind this is the pricing system of milk on the basis of fat percentage, where buffalo milk contains comparatively 2-3% higher than cow (Chamberlain, 1989). Consistent findings i.e performance of buffaloes in terms of milk production is reported by Shrestha (1992) and Pradhan (1987).

Apart from milk, ghee, was also prepared certain amount from the milk kept for consumption and used mostly for cooking purpose. Despite the less ghee production compare to VDC F (0.3 lts per lu per annum) only VDC M (42%) and K (37%) sold the ghee for cash generation, implies the role of market for livestock products.

Table 24 Percentage of Income from the Livestock

Livestock	Source of Income	VDC F	VDC K	VDC M	VDC R
Cattle	Milk	11.5	37.5	9.9	25.2
	Ghee	1.1	1.9	0.6	0.3
	Manure	1.2	1.7	0.63	2.1
	Livestock Sales	0.9	-	0.9	0.2
Buffalo	Milk	59.0	46.4	61.6	51.2
	Ghee	0.5	-	0.08	-
	Manure	1.5	0.85	1.24	1.3
	Livestock Sales	15.3	1.2	19.7	9.0
Goat	Livestock Sales	6.4	8.0	3.7	8.0
	Manure	0.3	0.41	0.15	0.5
Pig	Livestock Sales	-	-	-	1.2
	Manure	-	-	-	0.07
Poultry	Eggs	0.43	0.6	0.25	0.15
	Poultry Sales	1.6	0.97	0.1	0.5
	Manure	0.2	0.15	0.13	0.07

Source: Survey, 1993
Note: Market Price of Livestock Products (from interview, 1993) are: cow milk = Rs.10.0/lt; Buffalo milk = 12.5/lt (Rs. 1.8/fat%); Ghee=140 Rs./lt; Livestock Manure = 2 Rs/ml; Poultry manure = 60 Rs/ml

Livestock were sold or slaughtered for consumption generally in the occasions and ceremony. The livestock sale to total income came out

in second position everywhere from buffaloes except VDC K, where goat income was greater by 10% especially from meat. In spite of presence of market the percentage sold to consumption, of VDC K was low than the other VDCs (>87%). The biggest contribution of the farm animal was their manure production, which was found more or less similar within the average range of 60-67 ml/annum/lu)[1] in each VDC. The non ruminants (pigs and chicken) contribution was negligible as these were kept only in few household in non-commercial way.

4.3 Tree Sub-System

Discussion of prevalent species, farmers' opinion in terms of preferences and purpose of fodder trees are done in Tree Sub-System.

4.3.1 Availability of Fodder Tree Species

Diversification was found in the species of fodder trees so as in the period and the length of harvesting. In terms of feed supplement consequently these support to the farmers in economic point of view. Diversified species have advantage over the monoculture. It can be said from the picture of lopping season (Figure 8) of the research sites that most of the fodder trees are harvested during winter and summer season and least in mid summer and rainy season.

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[1] ml= man load = 1 full bamboo basket i.e 1 doko = 20-25 kg (Tulachan, 1984)

Majority of the farmers (106) responded that kutmiro provides fodder during scarcity period. Similarly, 46 respondent out of 169 mentioned that ipil could be harvested through out the year. The results confirm the role of fodder trees which, supply fodder during the dry period (Pandey, 1982 and Amatya, 1992). Similarly, Gautam (1987) also reported these species as the most appropriate in his study at Matipanchayat of Dolakha district.

Species	SEASONS												Res. no. (N=170)
	S	O	N	D	J	F	M	A	M	J	J	A	
	1			2			3			4			
kimbu	*	*	*	*	*	*	*	*	*				20
koiralo			*	*	*	*	*	*					54
kutmiro	*	*	*	*	*	*				*	*		106
khanayo	*	*	*	*	*	*							31
khasreto		*	*	*	*								15
ipil	*	*	*	*	*	*	*	*	*	*		*	46
gogan				*	*								6
hatipile		*	*		*								11
tanki	*	*		*									9
timilo		*	*	*	*	*	*	*					16
dudhilo	*	*						*	*				8
painyu				*	*	*	*	*					37
chiple				*	*								5
bakaino							*	*					17
budhar								*	*				2
others							*	*					8

1 = Early Winter; 2 = Late Winter; 3 = Summer; 4 = Rainy

Figure 8 Lopping Season of Fodder Tree Species
Source: Survey, 1993

4.3.2 Existing Fodder Tree Species on Farm Land

The fodder trees that were planted on the farm land were not survived all, some of them died because of the number of reasons. A computation of survival rate and mortality rate of a particular species are presented in Figure 9 and Appendix 6. It was observed that VDC K had highest mortality rate (91%) succeed by VDC F (27.3%) then M (16%) and R (4%). The overall mortality rate was (32.7%) irrespective of the species. Among the species *kimbu* had lower survival rate (47.5%), followed by *budhar* (49.8%). *Ipil* survival rate was found considerably higher 76% than reported in LAC study i.e 53% (Balagun *et al.*, 1986).

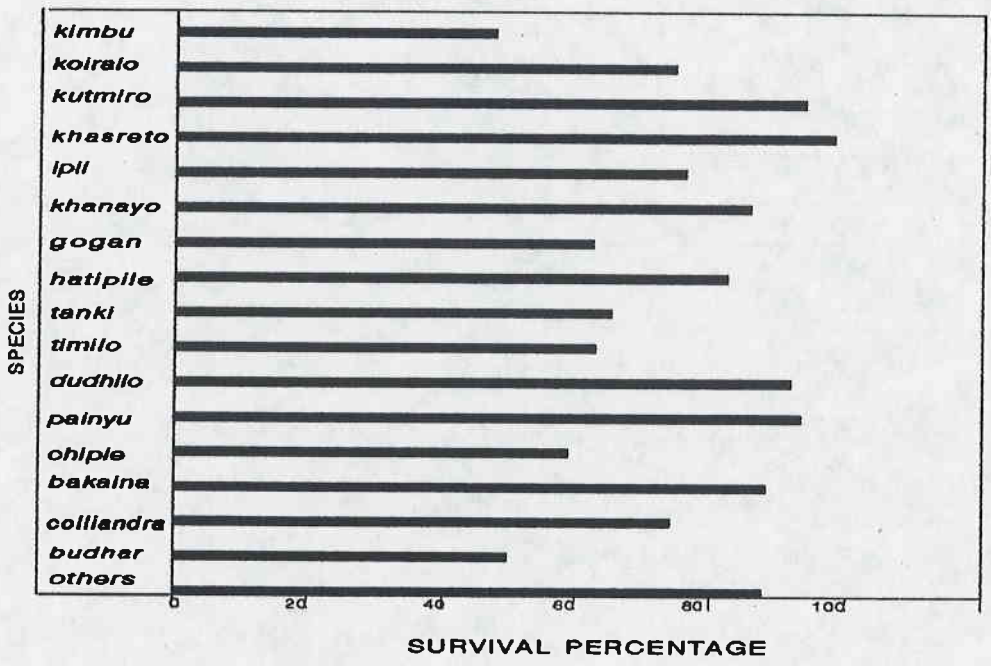

Figure 9 Survival Rate of Fodder Tree Species
Source: Survey, 1993

As mortality of the fodder trees were mentioned, the reason for the same is also necessary to raise which may be the probable constraints for the adoption. However, most of the non-adopters did not response so only adopters response is presented (Figure 10).

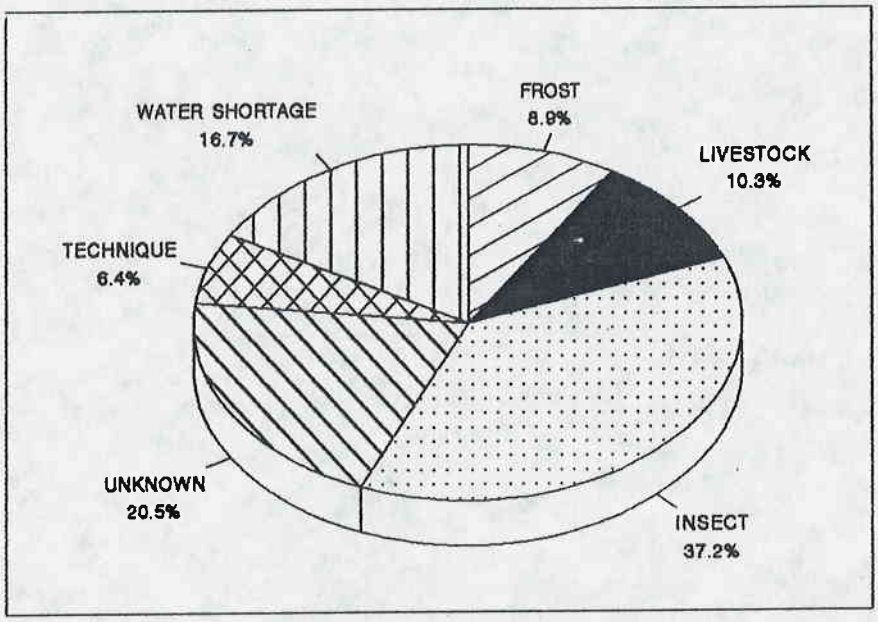

Figure 10 Reasons of Mortality of Fodder Trees Given by Adopters (N=78)
Source: Survey, 1993

From the Figure 10, insect damage was one of the main cause responded by 37.2% of the farmers, agreeable with Amatya (1992) study. The other five more reasons stated were unknown (20.5%), water shortage (10.7%), livestock damage (10.3%), frost (8.9%), un familiar with technique (6.4%) respectively. Similar type of reasons were mentioned in the survey conducted by Thapa *et al.*, (1990) but majority of the farmers responded frost as the major cause of mortality.

4.3.3 Purpose of Growing Fodder Trees on the Farm Land

Despite the fodder trees are mainly for fodder purpose to feed livestock (ruminants), a number of other multiple objectives were listed out from the farmers. The listed objectives were asked to rank and scored by preference score technique (Adopted by Bajracharya, 1993; Leutel, 1991). Fodder was ranked as first most important objective achieving 96.5 performance score, followed by fuel wood (Table 25).

Table 25. Farmers Purpose of Growing Fodder Trees on Farm Land (N=90)

Objectives	Number of Adopters in Rank							Farmers Response		
	1	2	3	4	5	6	7	NR	%	Score
1.Fodder	82	6	1	-	-	-	-	1	97.78	96.51
2.Fuel wood	2	67	19	1	-	-	-	1	98.89	81.73
3.Multipurpose	1	9	50	21	3	-	-	6	93.33	64.10
4.Soil Conservation	-	1	4	36	4	-	1	31	65.56	39.82
5.Utilize Waste land	1	-	1	3	11	2	-	72	20.00	9.67
6.Increase Crop Yield	-	1	-	2	2	2	-	83	7.78	3.81
7.Wind Breaks	-	-	-	3	3	1	-	83	7.78	3.65
8.Animal Protection	-	-	-	1	1	1	2	85	5.56	1.75
9.Staking	1	2	1	2	1	7	-	76	15.56	7.78
10.Free Available	-	1	1	-	1	-	1	86	4.44	2.38
11.Others	1	1	1	1	6	3	1	73	15.56	7.46

Source: Survey,1993.
Note: NR= Farmers not response in number

The result obtained supports the statement of Amatya et al. (1993 pp 117.) that "*single most important use of trees of Nepal is for fodder*". However, vice versa result was reported by Osemeobo (1989) while evaluating the small holder tree planting participation in Nigeria. The

various other aspects were also mentioned by the farmers that were considered as important for the household use (Table 25).

4.3.4 Preference of Fodder Tree Species

Because of similar agro-climatic condition most of the fodder tree species being distributed in all the 4 VDCs. However, as the term indicates "preference" farmer's choice among the number of fodder tree species may differ from others. There may be a considerable overlap in the preference for the same species. The preference of tree species may include a number of reasons, which are socially acceptable, economically viable, technically feasible and institutionally available in production and management. Considering this, the scope of the research was extended to this level, so that the findings could be generalized for the possibilities of improvement in future. Both informal (PRA) and formal (questionnaire) survey technique were applied for the accuracy and comparison. From the former technique a matrix ranking method was conducted in the VDC F and M. Whereas for the later, a ranking and scoring technique of preference was used and species were categorized into 1st, 2nd and 3rd degree of preference. The methodology applied is given as below:

Rank of Preference	Score	Calculation
1	100	No. of farmers in 1st rank*100/N
2	67	No. of farmers in 2nd rank*67/N
3	33	No. of farmers in 3rd rank*33/N

The cumulative score was calculated by adding all the three rank scores. Out of 16 different species except the others, *kutmiro* was ranked in 1st preference securing overall 60.1 score, *ipil* and *kimbu* were placed into 2nd and 3rd preferred species by securing 18.4 and 14.1 popularity score (Table 26).

Table 26 Farmers Preference of Fodder Trees (N=169)

Species	Respondent		Number of Farmers Ranking			Preference Score
	no.	%	1	2	3	
koiralo	18	10.6	4	5	9	6.2
badhar	12	7.1	5	6	1	5.6
kutmiro	1207	1.0	73	38	9	60.1
dudhilo	16	9.5	10	1	5	7.4
panyu	22	13.0	5	11	6	9.2
timilo	13	7.7	1	7	5	4.4
gogan	7	4.1	1	5	1	2.8
hatipile	15	8.9	9	3	3	7.1
ipil	38	22.5	20	12	6	18.4
kimbu	29	17.2	17	8	4	14.1
khanayo	22	13.0	4	10	8	8.0
laharepipal	2	1.2	1	1	-	1.0
bakaina	11	6.5	2	5	4	4.0
chiple	2	1.2	-	1	1	0.6
khasreto	15	8.9	5	5	5	6.0
tanki	16	9.5	6	5	5	6.6
others	4	2.4	-	-	4	0.8

Source: Survey, 1993.

Looking at the spread among the household and highest number among the species, *kutmiro* showed dominance in both aspects in all VDC except VDC K where *painyu* was grown by majority of people (30%). The most interesting point documented in this analysis is that exotic species (*ipil, kimbu*) existence and dominance could be observed where there is

nursery (VDC M and F). Appendix 7, depicts the scenario of the above mentioned feature.

When the results obtained from the preference score were compared with matrix scoring method, in VDC F, *budhar, kutmiro and khanayo* and in VDC M *kimbu, ipil* and *khasreto* were ranked in 1st, 2nd and 3rd degree of preference respectively (Appendix 8). Inspite of not matching in rank categories, the preferred species were found similar with the preference scoring technique. Similar type of result was obtained by Bajracharya (1993) conducted in Salle village, eastern hills of Nepal.

The reason behind the selection of the first three major species on the basis of score is presented in Table 26. According to the stated reasons, kutmiro was preferred the most because of the high biomass (69%), livestock preference (25%) and increase milk yield and fat % (20%) as first 3 major reasons. For the 2nd preferred species (*ipil*), nutritious quality, multiple use were the major reasons whereas availability throughout the season (37.9%) was the major reason of preference of kimbu. The species preferred and the causes were found similarity with Upadhaya (1991) in the Dhading district of Nepal.

Table 27 Preference Reasons for the Species

Reasons	Farmers Response no. and (%)		
	kutmiro (N=120)	*ipil* (N=38)	*kimbu* (N=29)
1. Increase milk and fat	20 (16.7)	7 (18.4)	2 (6.9)
2. High Biomass	69 (57.5)	-	4 (13.8)
3. Livestock Preferred	25 (20.8)	3 (7.9)	1 (3.4)
4. Multipurpose	1 (0.8)	10 (26.4)	6 (20.8)
5. Nutritious	2 (1.7)	11 (28.9)	5 (17.2)
6. Throughout fodder	3 (2.5)	7 (18.4)	11 (37.9)
Total	120 (100)	38 (100)	29 (100)

Source:Survey,1993.

4.4 Household Sub-System

Explanation of household sub-system has been done on the basis of holding size of different resources, income from farm and off-farm activities, perception about the activities, participation and decision making in fodder tree plantation and management.

4.4.1 Household Categorization by Holding Size

Table 28 gives a brief picture of size of holdings of different types of resources (land, livestock, income and human) by 3 major groups of farmers. The categorization was done on the basis of holding of total land i.e. small (<1 ha), middle (1-2 ha) and large (>2 ha). It was inspected that majority of the sampled households (63%) were small farmers owned less than 1 ha. of land. However the other resources were not in measurable condition.

Of the total small farmers a half of them kept 1 to 4 livestock unit and 29.2% kept over 4 lu. Whereas most of the medium and larger farmers hold large herd (>4 lu). The small farmers were more or less equally distributed in all the income groups. However majority of the medium (15.3 of 27.3%) and large (9.2 of 9.7) holdings farmers have earnings >50,000 Rs./annum. Majority of small and medium farmers have 5 to 9 family size but 50% of the larger farmers have more family members i.e more than 9.

Table 28 Households Distribution in Different Resources

Farm Size	Land Size (%)	Livestock Unit (%)			Income (%)			Family Size (%)		
		1	2	3	1	2	3	1	2	3
Small	63.0	2.8	31.0	29.2	22.7	22.7	17.6	15.7	49.0	4.2
Medium	27.3	0.9	19.4	6.9	1.8	10.2	15.3	0.93	19.4	6.9
Large	9.7	0.0	1.8	7.9	0.0	0.47	9.2	0.92	4.2	4.6

Source: Survey, 1993

Note:		1=Small	2= Medium	3=Large
Farm size	(ha) :	<1	1-2	>2
Livestock Unit	(lu) :	<1	1-4	>4
Income	(Rs.):	<26,000	26,000-50,000	>50,000
Family Size	(no.):	<5	5-9	>9

From the analysis a positive relationship could be drawn especially, land size with other resource holdings except family labor. Therefore large farmers were mostly higher caste with large holdings and higher income. While antagonistic relationship was observed in the small farmers where, diversification in herd composition is very common.

4.4.2 Household Income Source

Both on farm (crop+livestock) and off-farm were the immediate source of cash generation for farm households in all the study sites. However, the contribution to the household income from various activities of the farming system vary from one area to other. Table 29 shows that the estimated total annual gross income per household was highest (Rs. 751 thousand) in VDC M. This was mainly because of the high income generation from the crop sector (>50%). The livestock and off farm each contributed about 22.4 and 11.5 thousands Rupees respectively to the total income.

Table 29 Average Gross Margin & Total Gross Income of Household

VDC		Crop				Livestock				Off-farm	Total			
		IN	EX	GM	R/C	IN	EX	GM	R/C		IN	EX	GM	R/C
VDC F		17.7	3.9	13.8	4.5	16.3	7.9	8.3	2.1	5.7	39.6	11.8	27.8	3.4
VDC K		23.1	6.9	16.2	3.3	8.9	6.4	2.5	1.4	16.8	48.9	13.3	35.5	3.7
VDC M		41.1	13.3	27.8	3.1	22.4	12.4	10.0	1.8	11.5	75.1	25.7	49.4	2.9
VDC R		29.3	14.7	14.5	2.0	9.0	12.4	-3.4	0.7	10.2	48.6	27.1	21.4	1.8
Total	216	27.8	9.7	18.1	2.9	14.2	8.9	5.3	1.6	11.1	53.1	18.8	43.4	2.9
Adp	90	32.7	10.0	22.7	3.3	19.1	10.6	8.6	1.8	13.2	65.1	20.6	44.5	3.2
Non-adp	126	24.3	9.5	14.8	2.5	10.6	7.7	2.9	1.4	9.5	44.5	17.2	27.3	2.6

Source: Survey, 1993
Note: IN=income; EX=Expense; GM=Gross Margin; R/C=Return to cost of the respective column.

Despite the total gross income of VDC K and R was more or less similar i.e. 48.9 and 48.6 thousands, the share of crops and livestock to total cash income was different, estimating 23.1 and 8.9 in VDC K and in VDC R 29.3 and 9 respectively. Similarly, in VDC F, the crop, livestock

and off-farm sectors contributed 17.7, 16.3 and 5.7 thousand respectively to the total gross income 3.96 thousands.

While gross margin is computed with consideration of the expenses of each sector, the similar result was obtained for VDC M and K i.e. highest and 2nd highest gross margin income, 49.4 and 35.5 thousands respectively. However, for VDC F and R, VDC was better off than VDC R. It was noted that the VDC having nursery (M and F) have greater percentage of livestock share 22.4 and 16.3 with more return to cost ratio (1.8 and 2.1) respectively. Similarly, VDC having market (K and M) got greater percentage of income (49.4 and 35.5) respectively, with greater percentage of share from crop gross margin. VDC K received the highest off farm income 16.8 thousands compare to other VDC.

Irrespective of the VDCs, Table 29 also indicates that among the total sampled households, adopters gross income was greater by Rs. 10,000 and 20, 000 than average and non-adopters. It was found that the greater share was from crop, followed by livestock and off-farm with greater return to cost ratio. Similarly, adopters economic condition was realized better than non-adopters due to the high return to cost (3.2) from each sector.

4.4.3 Perception of Household about Activities Performed

Considering, the various farming system activities, the farmers were involved, they were asked to prioritize the activities performed.

Table 30 indicates that greater percentage of the farmers (63.5 %) gave 1st priority to crop. Livestock was preferred as 2nd choice (57.9%) and off-farm as third (75.8%). Similar result appeared in the all VDCs. However, in VDC K, the percentage of farmers preferred off-farm as first rank (31.5%) were comparatively higher than other VDCs. Matching this priority with the income from each sector as shown Table 29, it could be conveyed that the priority is associated with the total income earned by the farmers.

Table 30 Household Perception about the Activities Performed

VDC	Number of Households in Each Rank of the Activities Performed								
	Crop			Livestock			Off Farm		
	1	2	3	1	2	3	1	2	3
VDC F	30 (55.6)	22 (40.7)	2 (3.7)	17 (31.5)	26 (40.1)	11 (20.4)	7 (13.0)	6 (11.1)	41 (75.9)
VDC M	33 (61.1)	19 (35.2)	2 (3.7)	18 (33.3)	32 (59.3)	4 (7.4)	3 (5.6)	3 (5.6)	40 (88.9)
VDC K	35 (64.8)	15 (27.8)	4 (7.4)	2 (3.7)	29 (53.7)	23 (42.6)	17 (31.5)	10 (18.5)	27 (50.0)
VDC R	39 (72.2)	13 (24.1)	2 (3.7)	10 (18.5)	38 (70.4)	6 (11.1)	5 (9.3)	3 (5.6)	46 (85.2)
Total N=216	137 (63.4)	69 (31.9)	10 (4.6)	47 (21.8)	125 (57.9)	44 (20.4)	32 (14.8)	22 (10.2)	162 (75.8)

Source: Survey, 1993.
Note: 1,2 and 3 are the rank of the activities. Figures in () refer to %

4.4.4 Participation of Household in Livestock Related Activities

To achieve the greater productivity and corresponding income from

the livestock, farmers' involvement in special expertise and training and organization plays a significant role. With this, farmers could make right decision at right time. For instances, in livestock developmental activities, selection of species either tree or breed suited to the agro-climatic condition of the area and their management is essential to harvest the production for long period in sustainable basis. Because such activities broaden the arena of farmers' knowledge and keep attention in feeding and rearing system.

Regarding the percentage involvement in training and membership in group organization, it was observed that less than 36% of farmers had opportunity to participate in training and below 60% at farmers group organization. Of which, majority of them received nursery training and RAHS (rural animal health and milk production). It was also noticed that the percentage of adopters involvement in training especially, nursery was greater than non-adopters (Table 31).

The farmers of the VDC M were found members of buffalo and co-operative while K of buffalo, co-operatives and cattle group respectively. Majority of the farmers were involved in buffalo group, especially of VDC M, K and R (Table 32, Figure 11).

Table 31 Respondent Participation in Training

VDC	Types of hh	Res. no.	% Participation		% Obtained Types of Training				
			Yes	No	1	2	3	4	5
	Both*	54	20.3	79.7	13.0	5.5			1.9
VDC F	Adopter	23	14.9	27.7	13.0	1.9	-	-	
	Both	54	35.2	64.8	9.2	12.9	3.7	1.9	7.4
VDC M	Adopter	43	31.5	48.1	7.4	11.1	3.7	1.9	7.4
	Both	54	11.1	88.9	1.9	7.4	1.9	-	-
VDC K	Adopter	14	5.6	20.3	1.9	3.7	-	-	-
	Both	54	11.1	88.9	1.9	3.7	-	-	5.6
VDC R	Adopter	10	1.9	16.7	1.9	-	-	-	-

Source: Survey, 1993.
Note: Both* =Adopters+Non-adopters
1=Nursery
2= Animal Health and Milk Production
3=Farmers Group+Nursery
4=1+2
5=Other agricultural

Table 32 Sampled Households Member in Farmers' Groups

VDC	Types of hh	Res. no.	% Member		% of Member in Farmers' Groups Types			
			Yes	No	(1)	(2)	(3)	(4)
	Both *	54						
VDC F	Adopter	23						
	Both	54	59.3	40.7	51.9	3.7	3.7	-
VDC M	Adopter	43	55.6	24.1	48.2	3.7	3.7	-
	Both	54	16.6	83.4	5.6	-	3.7	7.4
VDC K	Adopter	14	11.1	14.8	3.7	-	-	7.4
	Both	54	11.1	88.9	-	-	11.1	-
VDC R	Adopter	10	1.9	16.7	-	-	1.9	-

Source: Survey, 1993.
Note: Both* = Adopter + Non Adopter
1=Buffalo group
2=Buffalo+Goat group
3=Cooperative group
4=Cattle group

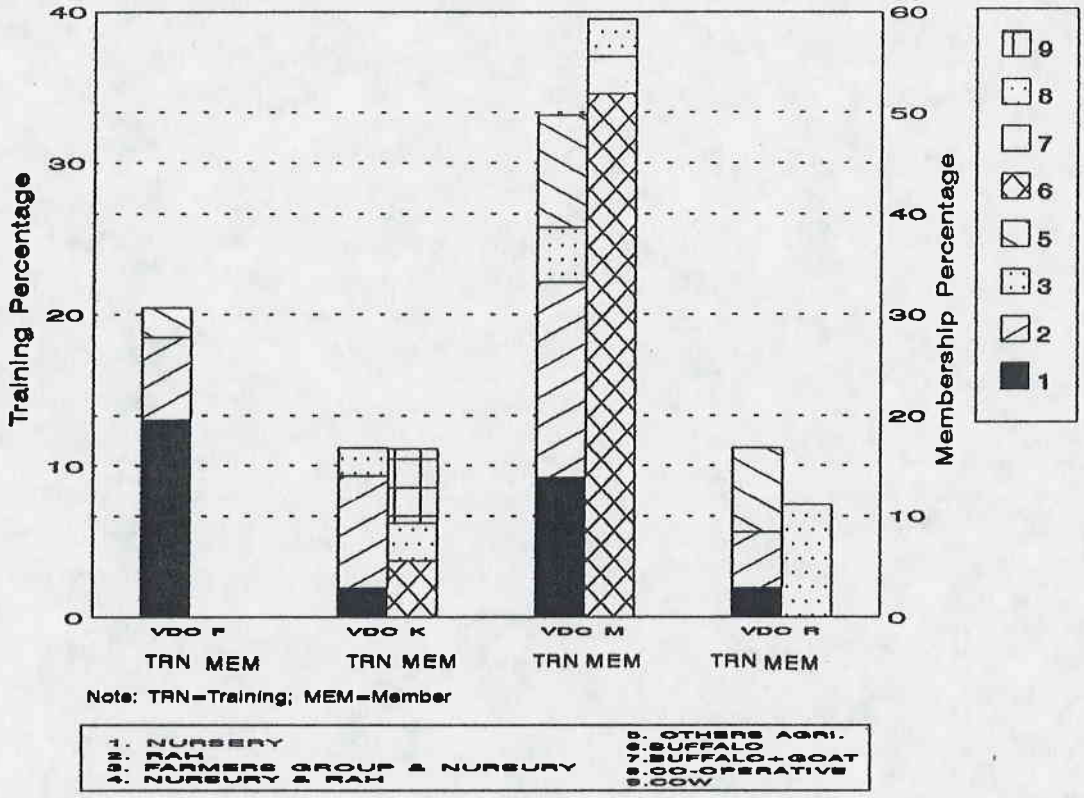

Figure 11 Percentage of Respondent Received Training and Membership
Source: Survey, 1993

4.4.5 Decision Making in Fodder Tree Management

In Nepalese context generally, the head of household has the highest status in the family, hence all most all decisions were carried out by household head. However, Dixit (1989) argued that the decision maker may be any member in the household i.e a grand son to a grand father and emphasized for identification of a decision maker especially for introduction of agroforestry.

Therefore, in this study interview was also taken with the decision maker instead of household head. Considering this, in case of decision making of fodder tree plantation and management (timely harvesting) male role was greater around 82% and 62% respectively compare to female (7% and 12%) among the adopters (Figure 12).

Similarly, in the combined group of adopters and natural growers (169) households, male decision making was found higher by 28.4% compare to female in management of fodder trees. Indeed the situation is realistic to Nepalese context where male dominance is very strong. Similar type of report was stated in LAC by Balagun (1986).

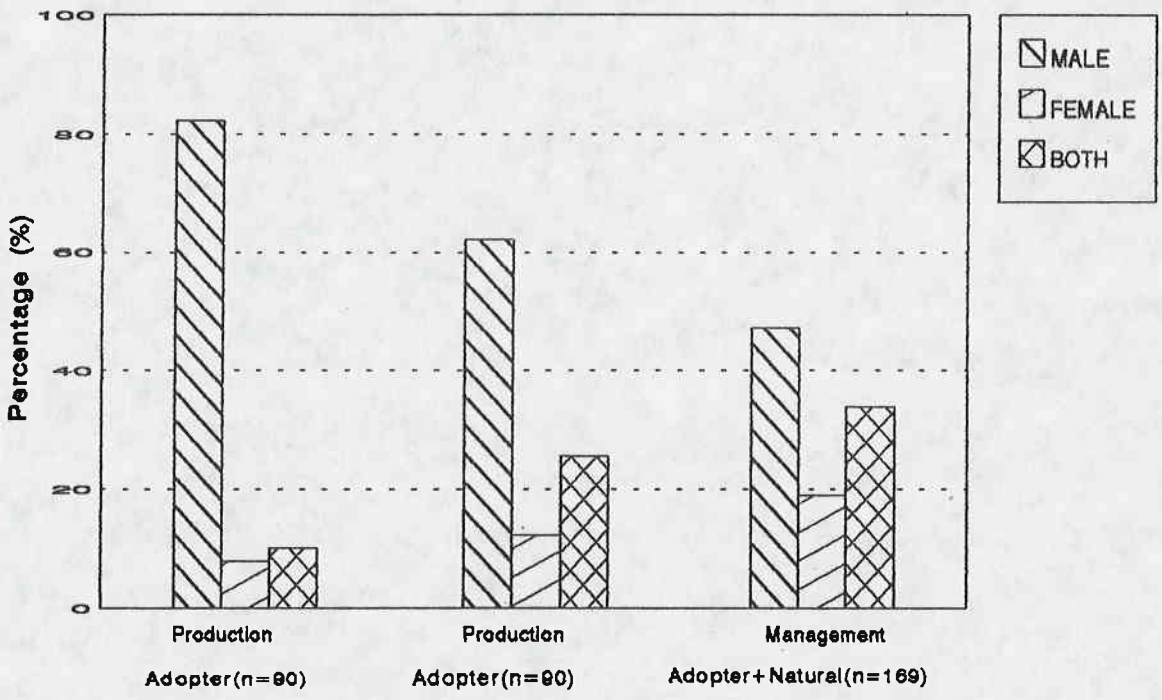

Figure 12 Percentage of Farmers in Decision Making of Fodder Tree Production and Management
Source: Survey, 1993

4.5 Integration of System Components on Farm Household

From the assessment, observation and evaluation of the research sites integrated crop, livestock and tree on the farm household stand out as an indispensable, self sustaining farming system. Because these sub-systems were found inter-wounded to each other by a strong linkage that the existence of one sub-system without the other is either impossible or unsustainable. Farm households were found playing a key role in interlining of all these three components together through their knowledge, skill and socio-economic background. Apart from these, the external factors like institutions (GOs and or NGOs) and market had great influence on the stability of the system as it is a media of production flow (inputs<--> outputs) from one component to others.

Such type of complementary relationship have been reported elsewhere in most of the farming system study (Shrestha *et al.*, 1992; Amatya, 1993; Osemeobo *et al.*, 1989). A major significant impact of farm land was seen in supplying farm by-products (concentrate and crop residues) for feed of livestock which was ranging 56%-100% in each VDC. Supply of crop residues (dry fodder) as a supplement of livestock feed reflected a positive interaction between the two sub-systems.

A reversible interaction was assessed from the close association between livestock and other components of the farming system. In general, it is reckoned everywhere that livestock play a subsidiary role to crops

in the small holder mixed farming systems (Reynolds, 1991). Regardless of primary and subsidiary enterprises, livestock serve as a buffer, a saving account with off-spring as interest (Gang *et al.*, 1989). Supporting this, farm livestock were considered as one of the major assets of the research sites (Figure 13).

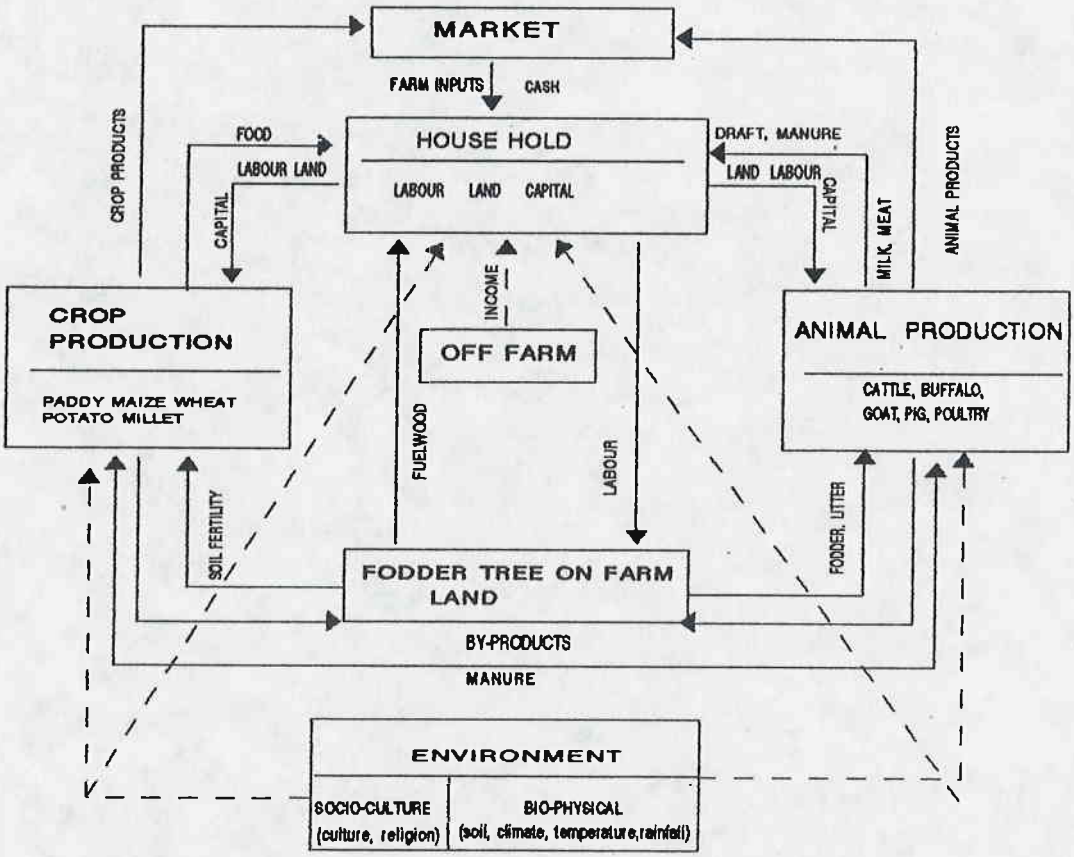

Figure 13 Integrated Farming System Components of the Study Area
Source: Survey, 1993

The ultimate goal of keeping these livestock in the farm household was mainly for cash generation, which was obtained directly as well as indirectly. Selling of livestock products like milk, ghee, eggs, meat or livestock provided cash generation directly. However the indirect method was conceptualized from the earnings of the crop productivity through manure.

A cyclic interaction of the farm fodder tree with other system components was realized in terms of fodder, fuel wood and soil erosion protection. But the most significant interaction exist between tree and livestock about feed and fodder especially during the scarcity period (dry) when the shortage of fodder was in peak. Households with its major inputs (land, labor and capital) were the major objects for meeting the stability of the whole farming system. Apart from internal factors, a combination of external factors like institutions (GOs and NGOs policy) and market had also the indirect influence in the system.

An investigation of the research sites in system analysis perspective revealed that, the per hectare holding of ruminant livestock (lu) was ranging from 3.5 to 2.8 lu (Table 33). However, over all ruminants lu/ha was computed more or less similar between adopters and non adopters. The figure was found low in VDC F by 1.07 than the survey carried by Gilmour (1991) and Oli *et al.* (1985) i.e 6.3 lu/ha.

Table 33 Availability of Fodder Trees per Livestock Unit of Household

VDC	lu/ha			Fodder Trees/ha			Fodder Trees/lu		
	Total	Adp	Non-adp	Total	Adp	Non-adp	Total	Adp	Non-adp
VDC F	3.2	2.9	3.6	16.4	24.4	7.0	5.1	8.5	1.9
VDC M	2.9	2.9	2.6	309.0	361.4	27.2	106.6	122.4	10.5
VDC K	3.5	3.4	3.6	20.3	35.0	14.6	5.8	10.4	4.1
VDC R	2.8	3.2	2.8	11.1	18.6	9.6	3.9	5.9	3.4
TOTAL	3.06	3.0	3.1	101.9	197.2	11.5	33.3	65.7	3.7

Source: Survey, 1993.
Note:
TOTAL=Total(216 hh); Adp(adopters 90 hh); Non-adp(non-adopters 126 hh)

The density cover of fodder trees/ha of land were computed as 16.4, 309, 20.3 and 11.3 for VDCs F, M, K and R respectively. It was observed that an average of 33.3 fodder trees was available for 1 lu of the sampled households. While the ratio was found higher in adopters (65.7 trees/lu) and distinctively, low in non-adopters (3.7 trees/lu). The finding holds true in each VDC. Table 33, clearly depicts that the condition of livestock of VDC M and adopters were better off than other VDCs and non-adopters.

The obtained findings seem contradict with Table 21 result where greater deficit of green fodder has been shown in adopters compare to non-adopters. However, this can be explained that the supply of green fodder among the non-adopters was from grasses rather than tree fodder. Further, it also reflects the immature adoption stage where the adopted fodder trees are not mature enough to harvest.

The result obtained of VDC F was found much difference than the findings reported by Gilmour (1989) in the same VDC, i.e 183 fodder trees/ha. Conversely, the figure was lesser than findings of VDC M (309 trees/ha) however, higher (8.5 in >1 ha of land) than the research carried out in Lumjung district by Gajurel (1987). This figure was found higher than the ratio reported by Pandey (1 tree/lu in 1976), Hopkins (<4 trees/lu in 1983) and Wyht and Smith (5.3 trees/lu in 1982). This reflects probably the plantation has been increasing over time.

4.6 Highlights

The chapter highlights the general farming system of the mid hills which was diversified and integrated with the system components. The intimate association between crop and other subsystems like livestock, tree, household were for feed, compost, food and income. The household system was found playing key role in system interrelationship as it is the center of management of the resources.

The research sites where there was availability of nursery and market, for example, VDC M condition in terms of feed, tree fodder supply to livestock was found in better condition. Therefore, keeping of ruminants especially buffalo was prevalent and consequently get higher income by the greater share of market was observed. Similarly, the existence of species of *ipil, mulberry* could also be assessed in the study sites as well as in VDC F. However, the study site where there was only

market no nursery availability like VDC K, small ruminants (goats) were common and the scarcity of fodder was maintained by natural grown fodder trees. The major cash generation was from off-farm activities as greater percentage of people were literate in this site.

Apart from comparison among VDCs, the chapter also focus the differentiation between adopters and non-adopters in some aspects. The higher deficit of green fodder in adopters compare to the non-adopters (Table 21), despite the availability of fodder trees/lu was 17 times greater than the non-adopters (Table 33) was explained due to the early stage of adoption. No such variation was observed in per hectare lu of adopters and non-adopters.

However, returns to cost in terms of farm and off-farm activities is higher for adopters inspite of high expenses than the non-adopters (Table 29). This reflects tree fodder adoption must have some positive impact in overall farming system activities. The opinion of the farmers about the tree fodder in feed value for increment of milk yield also confirm the findings. *Kutmiro, ipil and mulberry* were recognized as preferred species by the majority of the households for high fodder, nutritious and availability. Despite female contribution was comparatively higher in farming system activities, the decision making especially, in plantation and management of fodder trees was found over ruled by male of the households.

CHAPTER V

ANALYSIS OF FODDER TREES ADOPTION

This chapter explains much about the analysis of fodder trees adoption especially, adoption performance and determinants of fodder trees adoption are discussed here. The latter was analyzed by employing Logit model with Maximum Likelihood technique. While the former including the farmers' perception about the sapling distribution program, constraints and possibility of improvement of fodder problem were interpreted by using simple statistical tool like, index, score, percentage, mean etc. The details are explained as follows:

5.1 Adoption Performance Measurement

Assessment of adoption performance was carried out in order to understand the extent (degree) of adoption as well as the effect of fodder trees adoption to the households of the study sites. The former was computed in index form by the two major expressions; FAI (Farm Adoption Index) and AAI (Activity Adoption Index). The later whereas was expressed in percentages and number.

5.1.1 Extent of Adoption

The degree or extent of adoption was assessed from the spread

of plantation among the farmers of research sites or proportion of plantation (supply) with the proportion of requirement (demand) for each household of research sites. The former was expressed as FAI (Table 34) whereas the later in AAI (Table 35). Both the indexes were calculated in percentage form.

Table 34 Measurement of Farm Adoption Index (FAI)

VDC	Nursery	Non-Adopters no.	FAI no.	(N=54) %
VDC F	Yes	31	23	42.6
VDC K	No	40	14	25.9
VDC M	Yes	11	43	79.6
VDC R	No	44	10	22.7
Total 216		126	90	41.7

Source: Survey,1993.
Note: FAI = [(Adopters No.)/Total]*100

A look at the Table 34 illustrates, an overall 41.7% of FAI with highest in VDC M (79.6%) followed by VDC F (42.6%), K (25.9%) and the least in VDC R (22.7%). The variation in the percentage among the VDCs' shows positive relationship of adoption with the nursery establishment.

The plantation or adoption of fodder tree also depends upon the requirements or in other words "Needs" for each household. Hence, evaluation of AAI was done by using demand and supply terminology. Demand (required) here refers to the number of fodder trees actually required for the total number of ruminants raised. Supply in other hand is the number of planted trees that is available to ruminants in each household.

The calculation is done as analytical methodology applied by Leutel (1991), given in Appendix 5. The term "Actually" is used to distinguish from the total i.e (actual planted+natural grown). Because natural grown fodder trees also supplement fodder for livestock.

As visible from Table 35, apart from VDC M (391%), the estimated results of the AAI of other VDCs are very low (<20%). Inclusion of VDC M, in overall only 21.5% of shortage of tree fodder was observed and surplus in adopters by 73.1%. However, indeed there were a wide gap between demand and supply of tree fodder in other VDCs even among the adopters. The obtained results reflect the influence of nursery in the adoption performance.

Table 35 Adoption Activity Index

VDC	Adopters no.	Total Tree no.	APLT no.	TREQT no.	AREQT no.	AAI %
VDC F	23	820	716	3,922	3,818	18.75
VDC K	14	321	178	1,256	1,113	15.99
VDC M	43	19,422	17,395	6,476	4,449	390.98
VDC R	10	188	145	1,310	1,267	11.44
Subtotal	90	20,751	18,434	12,964	10,647	173.1
Total	216	22,015	18,434	26,957	23,376	78.85

Source: Survey, 1993.
Note:
APLT = Actual Planted Fodder Tree
TREQT= Total Required Fodder Tree
AREQT= Actual Required Fodder Tree (TREQT - Natural Grown Tree)
AAI = Adoption Activity Index (APLT/lu)/(AREQT/lu) =(APLT/AREQT)*100
Total Tree = Planted + Natural grown.

5.1.2 Effect of Adoption

Evaluation of changes that occurred in the farming system by the adoption of fodder trees is the other way to understand the adoption performance. Interview was carried out only with the farmers who grew the fodder trees on their farm land. Among the 90 adopters only 69 (76.7%) of them rejoined that changes has been remarked where as 14.4% reported no realization of such changes and 8.9% did not response anything (Table 36).

Table 36 Impacts on Farming System Response by Adopters (N = 90)

VDC	Farmers' Response					
	Yes		No		NR	
	no.	%	no.	%	no.	%
VDC F	19	82.6	1	4.3		13.1
VDC M	34	79.6	7	16.3	2	4.7
VDC K	10	71.5	4	28.6	-	-
VDC R	6	60.0	1	10.0	3	30.0
Total	69	76.7	13	14.4	8	0.9

Source: Survey,1993.
Note: NR = Not Response

The impact of adoption was reported in terms of changes that has been realized in livestock, crop and household sub-systems. The changes in livestock was assessed in number, types, breeds, milk production, fodder proportion and rearing system. Effect on production of crop and fodder collection time and feed expenses were estimated from crop and household sub-systems respectively (Table 37).

Table 37 Effect of Adoption Assessed by Adopters Number and Percentage of Change assessed in Livestock, Crop and Household Sub-Systems

Changes	VDC F		VDC M		VDC K		VDC R	
	Res. no.	change %	Res. no.	change %	Res. no.	change %	Res. no.	change %
A. Increase:								
Livestock Number	6	46.0	9	34.0	4	16.0	2	16.0
Milk Production	13	103.5	23	113.9	7	46.3	4	144.3
Crop Production	2	1.5	12	113.0	3	11.0	2	-
Fodder Proportion	8	16.3	10	68.1	-	-	1	13.3
Feed Expense	2	35.0	8	37.6	2	18.8	3	15.0
B. Decrease:								
Livestock Number	8	21.0	11	57.0	4	13.0	35	-
Crop Production	7	4.5	1	-	1	3.3	-	-
Fodder Collecting Time	16	56.9	24	68.7	4	57.0	4	63.3
C. Livestock types:								
Local-Improve (1)	5	-	9	-	3	-	3	-
Cattle-Buffalo (2)	2	-	4	-	-	-	2	-
Large-Small Ruminants	1	-	8	-	4	-	-	-
Both 1+2	3	-	3	-	-	-	-	-
D. Rearing System:								
Stall Feeding	14	77.8	13	81.2	7	72.7	3	66.7
Total Respondent	N=19		N=34		N=10		N=6	

Source: Survey, 1993.

As portrait in Table 37, the great impact was noticed in milk production which is more than 100% in all the VDCs except VDC K, where increment was observed only 46.2% responded by 77% of the total farmers of the 4 VDCs. The result obtained was quite relevant for the VDC K, where replacement was detected in livestock types mainly change of larger ruminants (bovine) to small ruminants (goat) rather than others. Similar in VDC R, however, the replacement was inspected in breed, local to improved especially in cows to buffaloes in VDC M and VDC F.

Majority of farmers reported decrease in livestock number ranging from 13 to 57%, while some of the farmers also mentioned increment from 16 to 46%, which is the highest in VDC F (46%). Inspite of increment of tree proportion in feed ration with an average of 27%, expenses on feed still found going up from 15-38%. Of all this, surprising percentage of crop production also responded in VDC M (113%). Contradictory to this negative impact was reported in VDC F and VDC K but in very low percentage (<5%).

A significant change was also mentioned in rearing system. At present, 67 to 81% of the sampled household adopted stall feeding system, consequently, more than 50% time saved was expressed by the respondents of all VDCs. This is because the plantation on private land caused farmers not to go for searching far-away and grazing of livestock, which could provide opportunity for other activities also. Thapa (1990) and Bajracharya (1993) have reported increment in school going percentage by the trees on farm land in eastern hills of Nepal. This shows that the adoption of fodder trees on farm land could bring both economic as well as social changes to rural society.

5.2 Relationship between Socio-economic factors and Adoption

The relationship between adoption and scio-economic factors are discussed descriptively as well as quantitatively (logit model).

5.2.1 Variables and their Measurement

Identification of the socio-economic factors (variables), that are more closely associated with farmers' decision making in fodder tree adoption is one of the major objectives of this study. As displayed in Chapter II (Figure 2) the variables employed are; Knowledge (Knds), Age, Education (Edu), Social participation (Socpat), Highest education (Hedu), Family size (Famsize), Private land size (Tpland), Total gross income (Totgrinc), Total number of natural grown fodder trees (Ngft), Extension contact (Ext) and distance to Forest (Fore), Nursery (Nur) and market (Mark). The dependent variables (adoption) is explained in binary form 1 (those who planted) and 0 (those who did not) as adopters and non-adopters respectively (details are discussed in Chapter II section 2.2).

The variables are subjected to a number of statistical tests both descriptive and quantitative. The former is applied for the comparison of adopters and non-adopters while, the later is selected as a tool for identifying the adoption determinants.

5.2.2 Descriptive Statistics Results

The descriptive statistics of adopters and non-adopters socio-economic characteristics are presented in Table 38. The difference in the characteristics of these two groups are tested by employing mean "t" test.

Table 38 Descriptive Statistics of the Variables and their Relationship with Adoption of Fodder Trees on Farm Land

Variable	Unit	Mean M1 (N=90)	Mean M2 (N=126)	difference (M1-M2)	t-Statistics#
Knds	score	60.59	31.76	28.83	14.5*
Edu	level	3.07	2.47	0.60	1.15 NS
Tgrinc(1)	(000 Rs.)	6.51	4.45	2.06	3.71*
Famsize	number	7.02	7.03	-0.01	0.02 NS
Socpat(2)	score	2.97	1.78	1.19	8.52*
Lru(3)	ha/lu	0.37	0.34	0.03	0.76 NS
Fdmru(4)	tons/lu	2.06	3.79	-1.74	2.94*
Nur	km.	3.16	4.78	-1.62	6.54*
Mar	km.	2.83	3.75	-0.92	4.56*
For	km.	2.58	2.89	-0.31	1.14 NS

Source: Data Analysis.
Two Sample t tests (Statistic 3.5)
* = P<0.01; NS = Not Significant.
(1) = Total gross income in Rs.(100 Rs.=50 baht) or (100 Rs.= 2$)
(2) = Social Participation
(3) = Hectare per Ruminant Livestock Unit
(4) = Supply of Fodder dry matter per Ruminant Livestock Unit.
M1 and M2 = Adopters and Non-Adopters groups respectively.

Looking at the mean differences of adopters and non-adopters, the differences ranging from 0.01 to 28.83. Lowest is for family size while the highest is for knowledge. Knowledge of all types especially, understanding the importance of tree fodder in feed value was found poor in non-adopters2 (47 hh). While in non-adopters1 (79 hh) group, the knowledge concerning about awareness (price, sources etc.) was found lacking (See Appendix 11 for details).

Comparing means of 10 variables chosen, 4 variables (education, family size, land per ruminant livestock unit and forest) are not significantly different. These variables have less than 0.9 mean

difference. Thus, except the above mentioned four variables, the rest of all variables are significant at (P<.01).

The frequency distribution table (Appendix 10) also shows that around 99% of adopters have greater than 34 score with 26.7% in higher level (>66 score) of knowledge while 55% of the non-adopters fall below 34 score. Similarly, in the case of social participation that 38.9% adopters were highly affiliated in participation of social affairs while only 5.6% of non-adopters were in the same rank. However, in case of formal education, the higher concentration of both adopters and non-adopters percentage were in primary level.

No significant variation can observe in land per ruminant (Lru) and family size (Famsize) even though it was considered important factor for the rural mid hills' farming system. Conversely, higher feeding of dry matter per ruminant livestock unit (Fdmru) is found by non-adopters as compared to adopters with a difference of -1.740 tons fodder dry matter. The greater use of crop residues and grasses stated in earlier Chapter (IV) also explain that the non-adopters were adopting other alternatives to maintain their livestock. However, still the deficit of fodder was assessed from the Tables 21 and 33. Because the excess supply of grasses during the monsoon season can not supplement to the dry season due to high moisture contain and lack of technical know how of storage. Besides, green fodder feeding to livestock is essential with regard to the nutritional diet technically and scientifically according to various

literature (Tulachan 1985; Amatya 1991) and widely prevalent throughout the country.

5.2.3 Logit Analysis Result

Application of qualitative choice models in explaining the socio-economic phenomena have a significant role especially in analyzing the relationship between dependent variables (adoption) and explanatory variables (Polson *et al.*, 1992). Therefore in this section a qualitative choice model (Logit) is estimated by the maximum likelihood technique.

While running the model with the hypothesized variables in software program LIMDEP, some of the coefficients gave unexpected result and correlation test shows high multicollinarity problem (r=>0.5) among the independent variables. Despite, the model still remains unbiased but is less efficient because of the large variance. This leads to rejection of null hypothesis (Ho). Therefore, certain modifications was made by dropping and adding of the variables so as to overcome this problem and attain the optimum estimation (Studenmund, 1985).

Regarding the former case, highest education, age, caste and extension were dropped out from the model. This does not mean these variables were not important instead excluding caste the results of all

these variables are still meaningful that can be expressed in one or the other way. These are explained as:

Highest education which was hypothesized that the educated people of the family also may play influential role in decision making, however, this may be the education of the decision maker. But the model consists of education as the other variable, hence this brought collinarity and come up with unexpected sign (negative) in coefficient.

Age, on the other hand though important factor from the various studies but all most all of the decision-maker who were household head were found middle aged. Inclusion of this factor in the model is meaning less hence, dropped out.

Similarly, for Caste 3 dummy variables were applied. But these were not found significant as have been hypothesized. Since there is no theoretical support that it need to be in the model and in order to improve efficiency of estimation of other variables, they were discarded.

Extension was defined as the frequency of the visit of extension people to the sampled households. However, majority of the households responded that they visited only if they were requested for. This could be assessed from social participation as farmers' visit to the concerning institution were used to measure participation.

Additionally, it would be worthwhile perhaps if frequency of contact could assess to evaluate the extension. Therefore, extension is dropped off from the model.

Apart from this, some changes also brought in the variable of land holdings by dividing it with the ruminant livestock unit (lru). Because while used in separated form, the sign of coefficient for land appeared negative due to multicollinarity with ruminants. The null hypothesis was rejected, despite in most of the literature it was mentioned as significant factor.

Similarly, instead of natural grown fodder trees, fodder dry matter per ruminant livestock unit was used (Fdmru). Because it is realized that the other sources of fodder like crop-residues and grasses in combination also supplement the livestock feed. Such surplus or deficit may be the major cause for adoption.

Thus, by all these modifications and combinations, a model containing 10 explanatory variables including constant term (β_0) is regressed against dependent variable (Y).

The variables with their estimated coefficients are presented in Table 39. Since, the study is socio-economic and moreover the adoption is very discrete (0,1), so in this study ($P<.15$) level of significance has been considered. Harper (1990) has also considered significant level up to 80% ($P<.20$) in his study of adoption.

Table 40 Quantitative Estimation of Coefficients for the Adoption of Fodder Trees on Farm Land

Variables	Coefficient	T-ratio	Significant Level (P)
One	-4.8581	-3.693	0.00022
Knds	0.1179	5.863	0.00000
Edu	-0.0441	-0.753	0.45166
Socpat	0.4960	2.005	0.04502
Tgrinc	-0.2344E-05	-0.306	0.75958
Lru	0.7961	0.805	0.42073
Fdmru	-0.1483E-03	-1.504	0.13249
Famsize	-0.0112	-0.148	0.88263
Nur	-0.2128	-1.497	0.13429
Mark	-0.2835	-1.600	0.10953
Fore	-0.4921	-0.421	0.67398

Log-Likelihood (Log Lmax) :-67.281
Restricted (Slopes=0) Log-Lo :-146.71
R^2 = 1- Lmax/Lo (%)
= (1-log Lmax/Log-Lo) : 54.2 (Mc. Fadden R^2)
Chi-square (df=10) : 158.85
Significance level : 0.32173E-13
Accuracy of Prediction of over all : 85.18%
Note: (See Appendix 13 for the details of the results)

Apparently, the output of summary statistics of the logit model shows that 5 parameters are significant out of 10 at different levels. The variables that influence the adoption of fodder trees are; Knds, Socpat, Fdmru, Nur and Mark. However, only knowledge is resolute as critical factor at 0.01 level of significance. The rest two, nursery and fodder dry matter per ruminants units while are significant at 85% (P<.15) level. The low intensity of significance in the Nur is actually due to the multicollinarity with Mark, which is suggested by the correlation test (Appendix 12) and the relationship with adoption shows good (r=0.4).

Further, even dropping of variables could not improve the model and these are important variables that could be explained within the considered level (P<.20).

The positive coefficient of the social participation implies that an increase in participation raises the average farmer probability of adoption through gaining the knowledge. The result is found consistent with the findings of Shah (1992). However, the probability of increase in adoption can not be read directly from the coefficient.

The negative sign in Nur, Mark are as expected, implying that nearer the distance the higher the probability of households to adopt.

Similarly, Fdmru which represents supply of fodder per ruminant lu (an aggregation of all types of fodder straw, stover, husk, grasses and tree fodder) in the form of dry matter, gives presumed result. It is logical that when such fodder dry matter is sufficient, farmers would have less attention to introduce the fodder tree on farm land as indicated by negative coefficient. However, during the peak dry season, availability of fodder (especially green fodder) is far from adequate as the surplus fodder of the flush season can not keep to dry season. Thus, the impact of the variable is not as great as Knds and Nur as shown in Figures 14 and 15 respectively.

Nevertheless, the negative sign for the Edu, Fore, Famsize and

Tgrinc are not as anticipated but insignificant. But these could be explained by taking the example of VDC K (Tables 4 and 29) that the majority of the households of the study sites have limited education and those who gained higher education may look for off-farm occupation rather than risky farming practice.

Similarly, the insignificance sign of forest refers that the legal prohibition for the encroachment to forest is strictly followed by the farmers so the distance of the forest does not affect the adoption. Small families have labor constraint to go to collect fodder in distant area so they are inclined to grow more fodder trees around homesteads than the larger families. However, it is insignificant and may not be appropriate explanatory variable as it can not reflect size of labor. Gross income on the other hand has negative sign because of inclusion of off-farm income. As since, farmer with high off-farm income is likely to divert his attention from farm and be less willing to put time and energy required to adopt new farming practices.

For illustration VDC K in Table 29. Moreover, the lesser the income, the more adoption also reveals that the technology could be transferred to small income group where resources are constraint. However, the variable is not significant. While the Lru even the sign is as expected but the result is insignificant. Because majority of the households (63%) were holding less than 1 hectare of land of the study sites.

The correlation test shows that inspite of majority of the coefficients are non significant, the overall sign of the model was statistically in the sense that Maddala (R^2) is fairly high (54.2). The Chi-square is significant (158.8) at 10 degree of freedom 99% level. The model could predict accuracy of 85.2% for over samples and 82.9% for adopters (Appendix 13).

Calculation of probability of adoption provides the probable role of each explanatory variable in adoption. Therefore, by taking the partial derivative the effect of change of each individual variable with respect to probability of adoption is measured (Appendix 14). The estimated probability of adoption for all variables at mean is 26.3%.

Since knowledge has influencing role in this study, relationship between knowledge and fodder tree adoption as well as with some selected coefficients (Fdmru and Nur) are simulated. With changing the value of the interested variable and keeping the others at mean level provides the result as shown in Figure. 14, 15, 16 and Appendix 14.

The simulated result depicts that, probability of adoption with the mean level of knowledge (43.77 score) is only 26.3%. The steep slope of probability shows its rapid increment (Figure 14). With in 70 and above score of knowledge, 88% and more probability could be attained. As soon as knowledge reaches to 100 score, the probability of adoption is 99.6%, i.e, approximately 100%.

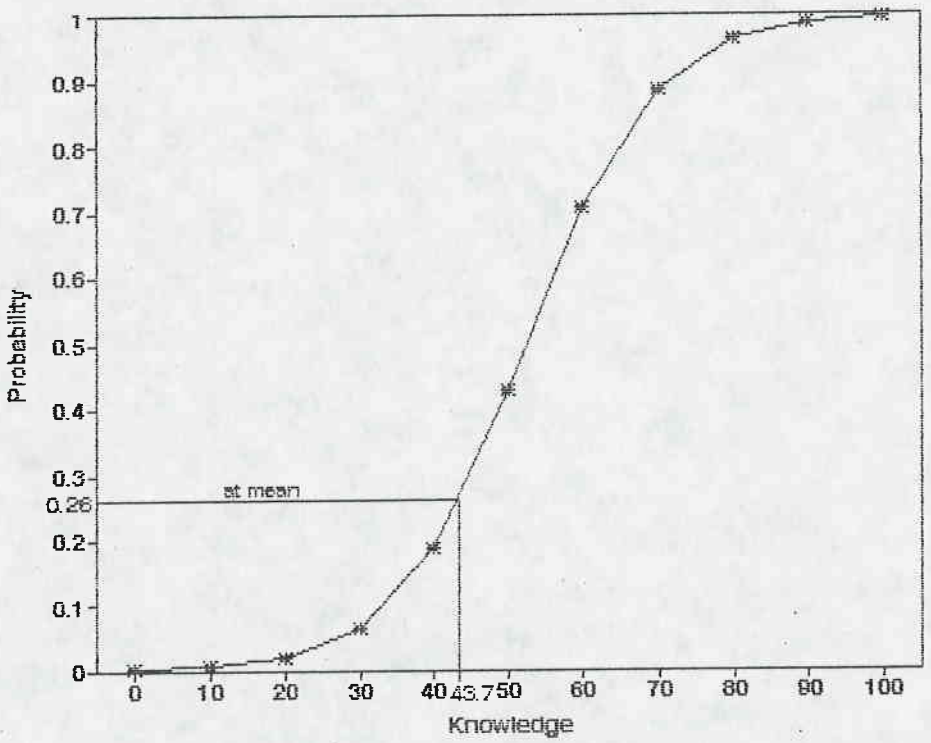

Figure 14 Probability of Adoption of Fodder Trees at Different Levels of Knowledge while remaining others variables are at their mean. Source: Survey, 1993

Comparing the probability of adoption at different levels of Knowledge and Nursery distances and former with Fdmru, it shows that the effect of change at nursery distance in every level is more compare to Fdmru. While considering the relationship of adoption with knowledge at different nursery distances (Figure 15), distance at 0.5 to 1 km. is found more effective in adoption as just 60 score will attain more than 80% of adoption. But with Fdmru, no such significant impact could be seen (Figure 16).

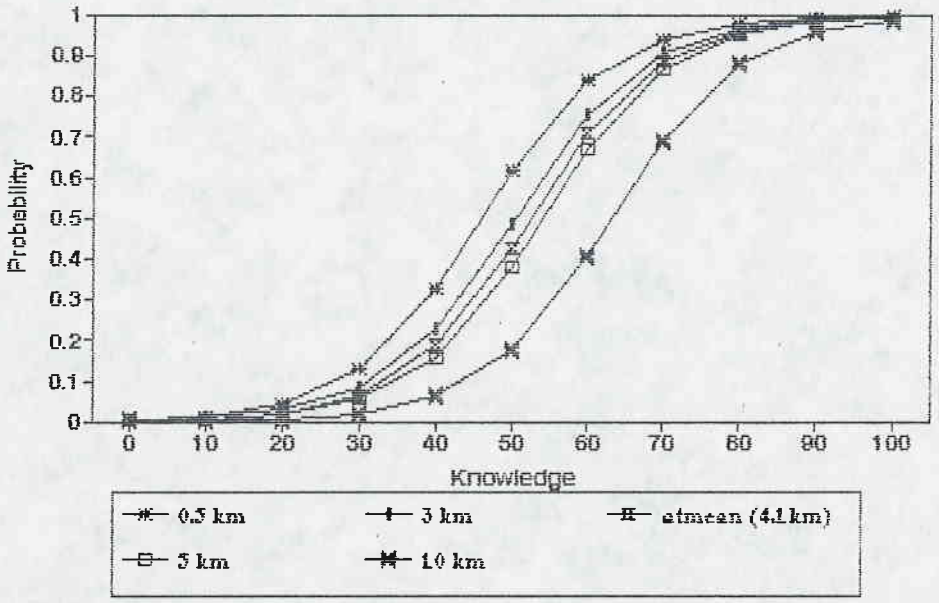

Figure 15 Probability of Adoption at Different Levels of Knowledge and Nursery Distances (Nur) in km. (Other variables at their mean)
Source: Survey, 1993

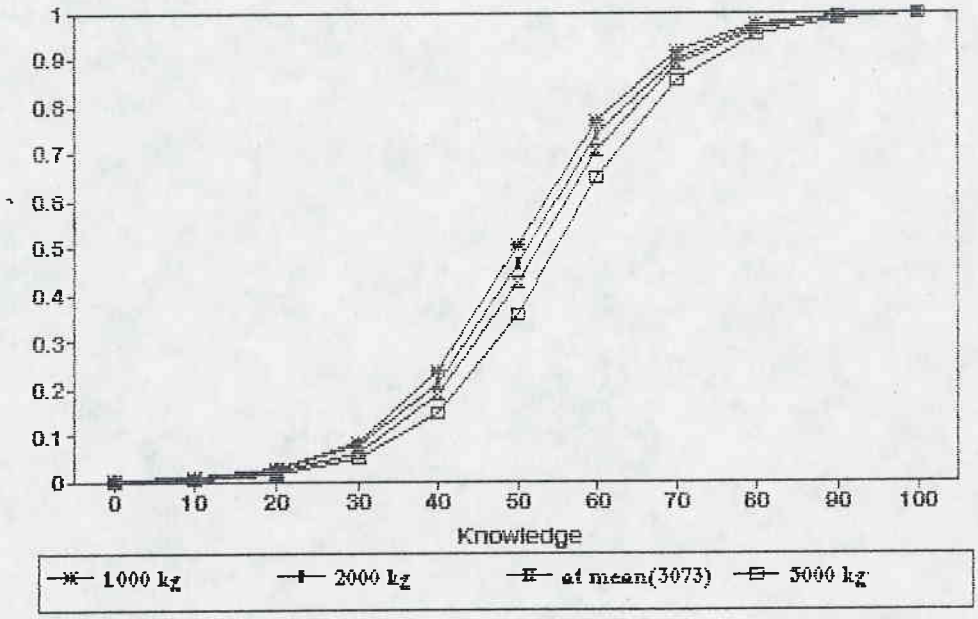

Figure 16 Probability of Adoption at Different Levels of Knowledge and Fodder Dry Matter Supply per Livestock Unit (Fdmru) While Other variables at their mean
Source: Survey, 1993

5.3 Perception about the Sapling Distribution Program

Farmers' evaluation about the fodder tree distribution program at the present context and in long term with reasons are discussed to meet this objective.

5.3.1 Agencies Involved and Preference

The implemented fodder distribution program carried out by GOs and NGOs was evaluated through the assessment of farmers' attitude towards the program. With out knowing the agencies involved and their activities, no one could give his idea about the implemented program. Hence, quantification carried out from farmers' awareness, preferences of agencies and motivation in fodder tree plantation.

The success and failure of any implemented program carried out by GOs and NGOs depend upon how it is accepted in a particular locality. Besides, in order to achieve positive impact, the goal of the agencies should be targeted towards the needs of the farmers. Tables 40 and 41 illustrate both GOs as well as NGOs were involved in one or other ways of the tree plantation program.

Out of 216 interviewees only 73 (33.8%) answered the realization about the agencies and most of them were of VDC M (18.5%). Considering the majority of the percentage of farmers response about the agencies in

each VDC, it was found that 66.3% of the total respondents (54) were familiar with Australian Forestry in VDC F. Bahudha Bahune Pati (BBP) Family Planning Nursery in VDC M (95%). More than 80% of the sampled households of VDC K and 60% of R were found accustomed with Livestock or Veterinary (Table 40).

Table 40. Awareness About the Agencies (GOs. and NGOs) Involved in Fodder Sapling Distribution Program.

VDC	Res. no.	Percentage of Household Aware of Agencies						
		Government			Non-Government			
		RK	LS	FO	FP	AF	SF	CN
VDC F	11	-	27.3	27.3	9.1	63.6	-	-
VDC M	40	-	50.0	10.0	95.0	-	-	-
VDC K	17	17.6	82.3	23.5	11.8	11.8	11.8	17.6
VDC R	5	-	60.0	20.0	-	20.0	-	-
Total	73	4.1	54.8	16.4	56.1	13.7	2.7	4.1

Source: Survey, 1993

Table 41. Most Preferred Agencies and Reasons for Preferences

Reasons	Number of Farmers Preferred the Agencies							
	VDC F		VDC M		VDC K		VDC R	
	LS	FO	LS	FP	RK	LS	AF	CN
Gives Suggestions			2			4		
Provide Training		1	1	3	1	1		
Accessibility			2	3		5		
Preferred Species	2	1	1	8		4		
	(N=4)		(N=20)		(N=15)		(N=0)	

Survey, 1993.
RK= Resam Kheti
LS= Livestock Department
FO= Forestry
FP= Family Planning Nursery (BBP)
AF= Australian Forestry
SF= Small Farmer Development Project
CN= Care Nepal

However, 39 out of 73 households responded the agencies they known were liked by them with some justifications. Both livestock and family planning were equally preferred by 40% of the responses. The former was liked for accessibility and extensions, whereas the later for providing better species and training aspects.

5.3.2 Usefulness of the program

A mixed type of answers was obtained as the farmers were asked about the program and its usefulness to them. Majority of the responding households (74% of 192) perceived the program positively (Table 42). The reasons given were ranked and quantified by scoring.

Table 42 Farmers' Perception About Distribution Program

VDC	Res. no.	Farmers' Response Number and % Useful		Not Useful	
		no.	%	no.	%
VDC F	49	36	73.5	13	26.5
VDC M	52	47	90.4	5	9.6
VDC K	46	24	52.2	22	47.8
VDC R	45	35	77.8	10	22.2
Total	192	142	74.0	50	26.0

Source: Survey, 1993

Table 43 Reasons for Liking of the Program (N=142)

Reasons for Liking	Res. %	Number of Respondent on Ranks				
		Rank 1	Rank 2	Rank 3	NR	Score
Supply Fodder in Scarcity	97.2	135	2	1	4	96.2
Soil Conservation	6.5	42	5	19	76	27.0
Pleasant Environment	11.3	-	7	9	126	5.4
Multipurpose	48.6	14	7	21	73	27.8
Others	1.4	-	2	-	140	0.9

Source: Survey, 1993

Table 43 reveals that among the several reasons supply of tree fodder during scarcity period was mentioned by highest percentage (97.2%) of the household representative. It was ranked first by 135 persons (95%), securing the highest score of 96.2. This explains fodder scarcity is the most critical problematic situation overwhelming to the study sites. Multipurpose aspects and soil conservation were ranked second and third securing 27.8 and 27 respectively.

In contrast 26% of the responded farmer argued on it. The reasons mentioned in order of score were lack of desired species (64.7), poor extension service (21.3) and not sufficient land (20) respectively. Some of them also put query about provision of subsidy and reward (Table 44). Nevertheless, the institutional and non-institutional problems mentioned were found not similar for all the VDCs.

Table 44 Reasons for Not Liking of the Program (N=50)

Reasons for not liking	Res %	Number of Respondent on Rank				
		Rank 1	Rank 2	Rank 3	NR	Score
Lack of Desired Saplings	66	31	2	-	17	64.7
No Subsidy	12	2	4	-	44	9.4
No Reward	4	-	2	-	48	5.3
No Land	22	9	1	1	39	20.0
No Extension Service	26	8	3	2	37	21.3

Source: Survey, 1993.

5.3.3 Source of Inspiration

According to the adoption theory, farmers first do not adopt any farming practice, certain sources of inspiration are essential in motivating the farmers (Feder, 1985). In this study, extension (50%), local knowledge (32.2%) were mentioned as the main motivating factor followed by NGOs, neighbor success, and Communication media (Table 45).

Table 45 Sources of Inspiration for Adoption of Fodder Trees

VDCs	Res. no.	Adopters' no. and (%) Expressed Sources of Inspiration				
		EX	NG	NGOs	LK	CM
VDC F	23	10 (43.5)	2 (8.7)	4 (17.4)	13 (56.5)	2 (8.7)
VDC M	43	26 (60.5)	11 (25.6)	10 (23.3)	7 (16.3)	4 (9.3)
VDC K	14	8 (57.1)	-	2 (14.3)	7 (50.0)	2 (14.3)
VDC R	10	1 (10.0)	-	-	2 (20.0)	3 (30.0)
Total	90	45 (50.0)	13 (14.4)	16 (17.8)	29 (32.2)	11 (8.2)

Source: Survey, 1993.
Note: More than one sources are mentioned by individual.
EX=Extension; NG=Neighbor; LK=Local Knowledge; CM=Communication Media

Majority of the VDC M and VDC K farmers responded extension as the most inspiring factor while, local knowledge and communication media in VDC F and VDC R respectively. The findings validate the extension service responded by the farmers in each VDC (Appendix 10).

5.3.4 Future Prospective of the Program

In general fodder tree plantation program carried out by different agencies have long term prospective rather than just to meet the present needs. Hence it is useful to understand the farmers' attitude (opinion) concerning about the consequences of such program. This will help to generalize (predict) the situational context of the future.

Table 45 and Table 46 indicate that rural farmers predicted both positive and negative impacts of the fodder tree plantation program. Nevertheless, majority of the farmers (83%) with highest in VDC K (95%) foreseen positive impact for long run in terms of increase in livestock number (61%), replacement of breed (10.5%). Both increment as well as replacement of herd was replied by 23.6% and 5% only responded about the surplus of fodder and fuelwood.

This verdicts the farmers inmost interest for livestock enterprise if the fodder shortage problem overcomes. The disadvantages in terms of shading effect was expressed by less than 5% of the farmers.

Table 46 Farmers' Expectation about the Consequence of the Program

VDC	Res. no.	Farmers' no. and (%) Expressed			
		Advantage (1)	Disadvantage (2)	Both(1+2)	No change
VDC F	50	43 (86.0)	3 (6.0)	1 (2.0)	3 (6.0)
VDC K	41	39 (95.1)	-	-	2 (4.9)
VDC M	53	43 (81.1)	1 (1.9)	5 (9.4)	4 (7.5)
VDC R	50	36 (72.0)	3 (6.0)	4 (8.0)	7(14.0)
Total	194	161 (83.0)	7 (3.6)	10 (5.1)	16(8.2)

Sources: Survey, 1993.

Table 47 Farmers' Number and Percentage for Reasons of Advantage

VDC	Res. no.	Increase Livestock(1)	Replace Breed(2)	Both (1+2)	Increase Fuel & Fodder
VDC F	43	22 (51.2)	1 (2.3)	20 (40.5)	-
VDC K	39	26 (66.7)	6 (15.4)	6 (15.4)	1 (2.6)
VDC M	43	20 (46.5)	8 (18.6)	9 (20.9)	6 (14.0)
VDC R	36	30 (83.3)	2 (5.6)	3 (8.3)	1 (2.8)
Total	161	98 (60.9)	17 (10.5)	38 (23.6)	8 (5.0)

Source: Survey, 1993.
Note: Figures in the parenthesis represent the percentage.

5.4 Assessment of Constraints and Improvement

Problems in adoption of fodder trees in both adopters and non-adopters group are discussed separately. The possible measures to overcome the problems from the farmers are also listed in order to improve in the future implementing program.

5.4.1 Constraints in Fodder Tree Adoption and Production

Both technical and non-technical problems were reported when assessment was made in identifying the constraints that influence the farmers in planting and planted fodder trees on the farm land. Among the 216 households sampled, 47 (21.7%) households did not have even single fodder trees on the farm land revealing that the livestock might have higher dependency either on farm land or forest.

An illustration of Table 47 emerges that maximum number of farmers (48.1%) of VDC K did not own fodder trees on farm land, followed by VDC F (18.5%), R (16.6%) and least (3.7%) in VDC M respectively. The main reasons mentioned by these farmers were unrecognization of the importance of fodder (40.4%). This statement indicates that still the farmers of the study sites were unfamiliar with the concept of growing fodder trees. The low score on purpose of growing fodder trees (Appendix 12) also proofs the poor knowledge of this group of farmers. This indirectly points out the weakness of the extension service.

Apart from this, lack of land (25.5%), not interest in growing (19.1%) and low economic status (14.9%) were the others compulsions. Similar reasons were mentioned in the study carried out by Gajurel (1987), and Gatenby (1990). The inadequacy of extension service can be proved from Appendix 10, which illustrates that majority of the household did not receive the extension service at all. Around 70 to 80% of the farmers of

VDC F and R were never exposed to extension contact. Among the farmers who were exposed also could not get sufficient services.

Mortality as the technical problems were mentioned by persons (78 of 216 hh) who had experienced of growing (Figure 10) is explained in Chapter IV. Therefore, non-technical constraints concerned mainly with institutional were documented as major problems from the survey.

Table 48 Farmers' Reasons for Not Having Fodder Trees on Farm Land

VDC	Res.	Farmers' no. and (%) Giving Reasons			
	no.*	No Land	No Income	No Interest	Unknown**
VDC F	10	3 (30.0)	2 (20.0)	2 (20.0)	3 (30.0)
VDC M	2	-	-	1 (50.0)	1 (50.0)
VDC K	26	9 (34.6)	2 (7.7)	5 (19.2)	10 (38.5)
VDC R	9	-	3 (33.3)	1 (11.1)	5 (55.6)
Total	47	12 (25.5)	7 (14.9)	9 (19.1)	19 (40.4)

Source: Survey, 1993.
Note : * = Farmers who do not have fodder trees
** = Unknown the importance of fodder trees

5.4.2 Possibility of Improvement of the Program

The solution of the encountered problems could make out once the farmers' need for the particular locality, sources of availability and farmers' interest to adopt is known. Based on the formal and informal survey conducted on the research sites, several operational measures were assessed. This does not only overcome the situational context at present but also assist to develop strategies for the future implication of the

program that will be helpful to implement the program in the Nepalese farming system by sustainable basis.

All the suggestions procured from each household were generalized and categorized into 5 different statements. Distribution of the desired saplings was mentioned as the most essential criteria for the improvement of the program by majority of the respondent (41.2% of 153 hh). Since, most of the cases, the distributed species are the same what locally available. Besides, extension and training and nursery establishment were also proposed to consider equally. Especially, VDC R respondent recommended nursery establishment for the improvement of their VDC condition (Table 49).

Table 49 Farmers' Suggestions for the Solving of the Fodder Problem

Most Common Suggestions	Percentage of Farmers' Responded in VDCs				
	VDC F	VDC M	VDC K	VDC R	Total
1.Desired Sapling Dist.	23.9	48.7	47.5	50.1	41.2
2.Dist+ Trn+ Ext+Nur	32.7	15.4	17.5	10.7	20.3
3.Dist+ Trn+ Ext	21.7	5.1	27.5	7.1	16.3
4.Dist+ Ext	4.3	28.2	5.0	10.7	11.8
5.Nursery Establishment	17.4	2.6	2.5	21.4	10.4
	N=46	N=39	N=40	N=28	N=153

Source: Survey, 1993.
Note: Dist:Distribution of Sapling; Trn:Training; Ext:Extension Service.

Regarding the desirable species, farmers were inquired about the sources if they were acquainted with. Out of 192, 140 (73%) mentioned "No". Among the 52 (27%) responded "Yes", majority (63.4%) specified Family Planning Nursery (BBP) where desired species could be available (Table 50). Because, the Nursery lying in VDC M consists of the diversified species with exotic species like *ipil, mulberry,* etc. which the farmers prefer the most. The highest percentage of adopters (79.3%) in VDC M is one of the reasons of finding the desirable species.

Table 50 Availability of Desired Species Mentioned by Farmers

VDC	Res. no.	No no.	Yes no.	no. and (%) of Farmers Response Sources			
				FP (1)	LS (2)	Both (1+2)	NGOs
VDC F	49	43	6	- -	3 (50.0)	2 (33.3)	1 (16.7)
VDC M	52	23	29	26 (89.7)	1 (3.4)	NR	NR
VDC K	46	35	11	1 (9.1)	2 (18.2)	8 (72.7)	
VDC R	45	39	6	6 (100.0)	-	-	-
Total	192	140	52	33 (63.4)	6 (11.5)	10 (19.2)	1 (1.9)

Source: Survey, 1993.
Note: FP= Family Planning Nursery; LS= Livestock Nursery; Both=FP+LS

Farmers were found even ready to pay (80% of 201) for the species they preferred (Table 51). Similar type of finding was reported by Evans (1991) in Terai region of Nepal, that 77% of 450 households were positive towards paying for the good seedlings.

Table 51 Farmers Readiness to Pay for the Fodder Saplings

VDC	Res no.	Response of the Farmers					
		Yes		No		NR	
		no.	%	no.	%	no.	%
VDC F	53	40	75.5	13	24.5	1	1.9
VDC M	53	47	88.7	6	11.3	1	1.9
VDC K	48	37	77.1	11	22.9	6	11.1
VDC R	47	37	77.1	10	21.3	7	13.0
Total	201	161	80.1	40	19.9	15	6.9

Source: Survey, 1993.

In chapter (IV) already depicted that *kutmiro, ipil, mulberry* etc. are the preferred species mentioned by the farmers of the research sites. Recognizing the source of availability, species preferred and farmers' attitude for the program could give some hints for the improvement of the program. Additionally, in order to overcome the bias towards the fodder trees as only the source of feed during the scarcity period, a query was put forward for the alternatives that could solve the problem of fodder deficit.

However, the findings of the Table 52 reveals that the greater percentage of farmers (64.7% of 153) stated that there is no other such alternatives except fodder trees. Forage grass, especially in VDC K (37.5% of 40) replied after the fodder trees. Hence, desired species should be provided by the establishment of nursery and monitoring and evaluation should be carried out through effective extension services.

Table 52 Alternative to Overcome the Fodder Shortage Problem

Alternatives	no. and % of Farmers' Response of VDCs				Total
	VDC F	VDC M	VDC K	VDC R	
Plantation Only	36 (78.3)	26 (66.7)	19 (47.5)	18 (64.2)	99 (64.7)
Making Silage, Hay	1 (2.2)	8 (20.5)	-	5 (17.9)	14 (9.2)
Forage Grass(Oat)	9 (19.5)	2 (5.1)	15 (37.5)	5 (17.9)	31 (20.2)
Communal Forest+GL(1)	- -	3 (7.7)	6 (15.0)	- -	9 (5.9)
Total N	46 (100)	39 (100)	40 (100)	28 (100)	153 (100)

Source: Survey, 1993.
GL(1): Grass Land.

5.5 Highlights

The heart of the research lies on this chapter. Analysis results and explanation are presented for almost all of the objectives, viz; adoption performance, indicators of adoption, and perception about the program. The VDC where both nursery and market for livestock inputs and outputs are available (VDC M) shows better performance while analyzing in terms of FAI and AAI and the effect of adoption. The greatest impact assessed were milk production and saving time. Both descriptive and quantitative methodology figured out farmers' knowledge, social participation, distance to nursery, market and supply of fodder per ruminant livestock unit are the important determinants for adoption.

However, only result of the logit model is discussed for the factors influencing adoption of fodder trees. Knowledge regarding

understanding the importance (purpose) of growing of fodder trees especially, in non-adopters2 group and creating awareness regarding market price of inputs and outputs of livestock, sources of availability of desirable species in non-adopters1 would increase the probability of adoption.

Especially, knowledge obtained by farmers' exposure to outside (social participation) could cause more adoption than formal education. The simulation result shows that just 70% of knowledge will lead to 88% of adoption and the relationship when compared with nursery and fodder supply, the former has higher probability compare to later. The result shows attention need to be paid in strengthening the local organization. Despite only 5 out of 10 parameters were significant, the model could predict correctly 85.2% of probability of adoption.

Both GOs/NGOs were involved in spreading the fodder tree adoption technology but only BBP of (VDC M), livestock sector was explained as better institution regarding availability of species in the former and services and near to visit for the later one. While unavailability of desirable species, land, extension were the important problems lined up by the non-adopters. Anyway, majority of the farmers have foreseen positive impact in over all farming system if the desirable species were distributed with effective extension program.

CHAPTER VI

SUMMARY, CONCLUSION AND IMPLICATION

6.1 Summary

Inspite of the enforcement of fodder tree plantation program, the scarcity of fodder and its consequent affect in the mid hill farming system of Nepal is the major concern of the study. Therefore, this study focuses on the measurement of adoption performance, investigation of factors that were responsible for the adoption and their relationship with farmers' adoption behavior. Furthermore, through the application of performance scoring technique, farmers perception about the program also evaluated to find out the probable measures for the overwhelming problem.

Applying the multistage purposive sampling 216 households from 4 VDCs of Kavre district were selected. Both nursery and market were confined in VDC M. While only market was existence in VDC K. VDC F had lack of market facilities but existence of nursery. Both nursery and market were lacking in VDC R. Despite proximity of the resources, (nursery, market and forest) majority of the households were 2–5 km distance, only VDC M and K were accessible as these were linked by road. All VDCs except K had forest area coverage but under the control of government.

Each household of 6-7 family members was composed of equal proportion of male and female population with greater percentage (55%) of economic active population (16-60 years). About 85% of labor supply was from adult population. Female contribution was envisioned higher to male by 3 hours. However, role of male was found dominating in fodder tree plantation and management decision by 80% and 60% respectively.

Around 85% of the households education was limited up to primary level. Heterogeneity was observed in caste composition and dominance among the VDC.

Integration of fodder trees on crop-livestock farming system was widely prevalent in the research sites. The average land holding size was less than one hectare (0.98 ha). While adopters holding (1.16 ha) was higher than mean and non-adopters (0.84 ha). Low land and upland were prioritized for paddy and maize crop respectively. Potato and tomatoes were the major cash crops for income generation. The upland terrace riser was found fully utilized by fodder trees for livestock feed.

The average livestock holding was 3.0 lu with highest in VDC F (3.7) where there is market and nursery while least in VDC K (2.1) where no market and nursery exist. Comparing to mean and non-adopters (2.7 lu), the holding was higher in adopters (3.5 lu). The average buffalo holding (lu) was higher to cattle in VDC M and F but vice versa for VDC R and K. The non-ruminant holding was higher in VDC R (0.4 lu) compare to (0.1) in other

VDCs. Raising of ruminants were mostly prevalent in higher caste while non-ruminants were mostly kept by small caste and low income group of farmers. However, greater diversification in species composition was observed in small farmers' (<1 ha.) farm.

Green grass and crop-residues (roughage) were the major constituent of feed inspite of, concentrate was fed through out the season. The supply of feed per livestock unit was highest in VDC M (over 4,000 kg) with comparatively greater percentage of concentrate (16%), forage (4%) and tree fodder (39%) than other VDCs. However, deficit of green fodder was prevalent through out the research sites ranging from 0.5 to 5 tons. The deficit in terms of fodder as well as supply of metabolic energy was higher in VDC F and R compare to VDC M and VDC K.

No variation was observed in average livestock per hectare of land among the research sites, a markable difference was seen in tree per hectare and consequently tree per livestock unit. Adopters had approximately 18 and 2 times greater number of fodder trees per livestock unit compare to non-adopters and over all sampled farmers. However, a deficit of 2.7 tons of green fodder was realized per annum. Inspite of this, the total gross income and net return to cost was greater among the adopters. Especially, when compare to other VDCs, with VDC M, it had highest tree/ha (309) and tree per lu (109). Hence, the share of income from livestock sector to total income was also more (Rs. 10,000) than other VDCs. The greatest contribution was realized from buffalo milk production

throughout the VDCs. The tree fodder in ration was reported as the essential constituent in feed for higher milk production and feed supplement especially during the peak dry season. The lopping seasons of fodder trees coincide with the findings (Figure 8).

Wide diversification was found in fodder tree species but major domination was of *kutmiro* in the household level of all the VDC except VDC K. Exotic species like *ipil and mulberry* were greater in number than natural grown in VDC M and F where there is nursery, while vice versa in rest of the two VDCs. *Kutmiro, ipil and mulberry* were ranked in first, second and third degree of preference for high bio-mass, nutritious and availability respectively.

Majority of the households (63%) had small holdings (<1 ha. of land). But the resource holdings in terms of income, family size as labor force, and livestock unit were not in measurable (poor) condition. Livestock contribution was in second position after crop in VDC M and F, while it was third in VDC K and R. VDC K had highest off-farm income among the other VDCs. The priority of farming system activities was found associated with income earned.

Evaluating the adoption performance in terms of extent of adoption, the farm adoption index (FAI) and adoption activity index (AAI) were 41.6% and 75.8% respectively. The fairly high AAI was due to the greater index from VDC M (173%). Increment in milk (46-146%) and saving

time in fodder collection (>56%), changing to stall feeding system (67-78%) were the major effect of adoption realized.

The descriptive analysis (average, percentage, mean "t" test) of the socio-economic characteristics was carried out mainly for comparison of adopters vs non-adopters. Except supply of Fdmru, in all adopters were found better off than non-adopters.

The logit model was employed for the investigation of influential indicators in fodder trees adoption. High accuracy in prediction estimation and consideration of influential behavior of other factors included are the major merits and concerned for selection of this model.

The proposed explanatory variables taken together as key determinants are: Knowledge (Knds), Social Participation (Socpat), Education (Edu), Nursery (Nur), Market (Mark), Forest (Fore), Family size (Famsize), Land per livestock unit (Lru) and Fodder dry matter supply per livestock unit (Fdmru).

Obtained result of the logit model proved that farmers' **knowledge, social participation, distance to nursery, market and fodder dry matter per livestock unit** are the major determinants for the adoption of fodder trees on farm land. The estimated result explains that social participation i.e. exposure to the VDC activities could create awareness about the situational context and increase the ability of understanding about the concept of technology. This is how the knowledge was gained.

The simulation result shows that knowledge at the mean level (43.7 scores), the probability of adoption is very low (26.3%). But invariably increases with increment of score i.e. reaches to 88%. in 70 units of score while keeping other factors at their mean level.

Considering the socio-economic study with very wide range of term "adoption" defined, Market ($P<.10$), Nursery ($P<.13$) and Fodder dry matter supply per livestock unit ($P<.13$) had also some influence in the adoption of fodder trees. The result implies that nearer the distance to the resources the higher would be the adoption. The prediction shows high influence in response to nursery distance compare to fodder dry matter supply.

The model predicts correctly of 85.2% of farmers probability of fodder trees adoption. Gross income and education did not have significant influence to adoption because the former includes off-farm income while later could not reflect size of labor. Extension contact, highest education, caste, age were though important but dropped out to avoid multicollinarity problem in estimation and attain optimum estimation.

Assessment of farmers' attitude about the fodder distribution program revealed that BBP family planning nursery and Livestock sector were only preferred agencies for species availability and training in the former while accessibility and extension for the later.

About 26% of the respondents did not like the program because of

unavailability of desirable species, lack of land and extension services. Unknown about the fodder trees importance, lack of land, interest and income were the major constraints expressed by the non-adopters of the research sites. While mortality of the seedlings by insect pest was mentioned as the serious problem among the adopters.

However, majority of farmers (74%) perceived the positively mainly for solving the problem of fodder scarcity. About 83% of the farmers had foreseen the program benefit in long term if desirable species were provided through effective extension program.

6.2 Conclusion

Based on the circumstances of fodder scarcity and requirements for the existing animals of the research sites of the mid-hills of Nepal, fodder tree plantation seem to be a promising program. However the deficit of green fodder through out the VDC even in VDC M where tree/Lu was so large, reflects the need of selection of species which could fulfill the need.

In the study sites, fodder is the primary priority product cited by majority of the farmers. In this aspect, high bio-mass, preferred to livestock and milk yield increment were the major needs that should be taken into consideration.

Generally in the case of technology adoption, the adoptability is greatly enhanced when a farmers' attitude towards adoption is affected by his/her perception of need for and economic resources. However, here the innovation promoted is not simply a reflection of perceived need and access to resources, but also a question of socio-economic and institutional arrangements within and between the households.

The impact of such institutional can be seen from the several changes that has occurred in the household farming system. The major changes could be best seen from the adoption performance. It can be concluded that the areas having both nursery and market i.e VDC M showed better adoption performance in terms of demands and supply or FAI and AAI both. Probably the accessibility to nursery and local markets may have greatly strengthened the adoption of farm practice in the study area, which contributed to increase in crop yields, crop diversification. This is by drawing out the nutrients from the deep soil level and the fertile soil can grow various types of crops. High bio-mass, dominance of exotic species and consciousness about the fodder shortage and impact to the environment are the other significant contributions. This is because of the high income from the livestock (milk production), replacement of breed and types and greater income provide a persisting scenario of the sustainable VDC by the adoption of technology.

The changes could be pictured out differently in VDC K, where replacement of holdings have been occurred from large ruminants to small.

Small land holding coupled with scarcity of fodder and high off farm income and employment opportunity may be the probable causes for the farmers to change. The highest income from goat among the other VDCs reflects that goat might be the most promising livestock for such areas. The other two VDC F and R where there is resource constraints could have such changes.

The high contribution of livestock income from VDC M and F reflects the importance of fodder nursery. The input and output flow i.e. the supply of quantity of feed/forage (oats) to livestock and percentage share of the livestock products to the markets shows that farmers of the VDC M and K are better off and adopted livestock enterprises in commercial scale. However, the shortage of feed and lack of market facilities had caused sluggishness in development of farm animals and human beings. Hence, there is an urgent need of feeding solution for the survival of farm community.

The findings of the study highlight that the adoption of fodder trees on the farm is dominated by size of holdings associated with socio-economic characteristics of the household. Particularly in a given socio-economic environment, the perception is dependent upon the knowledge of an individual. The formal and informal participation could widen the horizons of the farmers rather than the formal education.

Hence, it can be concluded that a knowledgeable person coupled with highly participation in social activities would readably accept the

technology than others. In this sequence, the role of extension activities could further enhance the rate of adoption process. The results further implies that farmers with primary or elementary school education are capable of adopting innovation and appropriate technology if proper extension services are provided.

In overall analysis of the study, the adopters were found resource full compared to non-adopters and average farmers in land, livestock and tree holdings. However, greatest deficit among such group implies low production of fodder. Which is due to the early stage of adoption or mortality of the species as was mentioned as the serious problem.

With all this it can be concluded with the reference to the VDC M and statistical test that market and nursery establishment seems necessary for over all development of the mid-hill farming system. Along with monitoring and evaluation through an effective extension service is considered as essential factor to accelerate the adoption of agricultural practice. Furthermore, it is the need that farmers put forward. Hence, a comprehensive government program is essential to ensure the timely availability of desirable fodder saplings and to strengthen the extension services for the adoption of fodder trees on the farm land. Above all, institution, extension and local social institution should be supported by government as well as NGOs in order to encourage farmers to participate in developmental activities for formulating plans.

Finally, it must be emphasized that the present analysis is based on a limited number of observations from 4 VDC of Kavre districts. Its limited observations, macro value and regional orientation make generalization difficult. Nevertheless, it may be indicative of the forces at work in the process of adoption of farm practices in Nepal. Additionally, adoption is defined in conceptual basis, which might not show the actual adopters characteristics. Hence, there is need of further study with clear concept in adoption.

6.3 Policy Implications

The outcomes of the study brings into conclusion of certain important points that might be helpful for the future policy implication which can be served as:

a) In order to improve the technical know how of introduced farming practices better extension service should be emphasized for the two way communication i.e farm to planners and vice versa.b)

Resource holding especially, small land is the major obstacles for the farmers to encourage adoption of fodder trees plantation. Therefore, it is essential to recommend the farmers of small holdings to shift towards the non-ruminants or small rearing rather to give the pressure to the resource or protect from keeping the unmanaged and unproductive stock.

The other alternatives may be that government should develop a scheme like community forestry for such group. An example of such scheme is Salle village of eastern hills of Nepal regulated by PAC.

c) Establishment of nursery coupled with desirable species, at certain distances seem essential for the easy assess of the farmer and booming up the adoption of fodder trees.

d) The findings also show that farmers are anxious to grow more trees, therefore development agencies should not only adopt a strategy focussing on seedling supply alone. An attempt must be made to promote the genetic improvement of the local species. The goal bring to help create an adequate source of desired quality of seedlings. Helping farmers to raise seedling for themselves is one of the other options to be explored.

e) There is need of dramatic improvement in fodder trees resources. The government could support research to identify the fast growing, high bio-mass nutritive fodder trees for specific agro-climatological condition.

f) Government and NGOs plans and programs have tended to overlook the importance of market places. Sometimes the key issues related to the adoptability of a new technique lies in market condition. Market analysis become thus an integrated part of farming system.

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APPENDICES

Appendix Table 1 Scoring of Farmers' Knowledge/Understanding

no: Questions	Score for each goup
1. Purpose of Growing Fodder Trees	(2.28 for each)
a. Livestock feed	
b. Fuel wood	
c. Multipurpose	
d. Soil conservation	
e. Utilize waste land	
f. Increase crop yield	
g. Wind break for crops	
h. Protection from animals	
i. Staking and fence	
j. Free available	
k. Others	
2. Skills Regardig Fodder Trees	(4.17 for each)
a. Identification	
b. Growing season	
c. Harvesting technique	
d. Spacing	
e. Management	
f. Others	
3. Opinion in Relation to Livestock Feed	(3.58 for each)
a. Acts as feed supplement	
b. Increase milk yield	
c. Maintain livestock health	
d. Supply fodder during scarcity	
e. Makes feed palatable by mixing	
f. Save time for searching	
g. Others	
4. Awareness	(4.17 for each)
a. Price of feed	
b. Price of Product	
c. Source of feed/fodder	
d. Problem about the fodder scarcity	
e. Environment for fodders	
f. Agencies involved in programs	
	Total = 100

Appendix Table 2. Bio-Physical Characteristics of the Study Sites

Characteristics	Unit	Village Development Committee			
		M	F	R	K
*Location[1]					
-East		Indrabati river	Methonkot	Anikot	Ganesthan
-West		Nayan Goan	Sarsa	Banepa	Sankhupati
-North		Gaire Goan	Patlekhet	Devitar	Panauti
-South		Jaishethok	Khanalthok	Dhulikhel	Balthali
*Topographical					
-Total Area[1]	(ha)	957 .9	540	507.2	232.5
-Distance from HQ	(km)	20	5	5	6.25
-Max.Altitude	(ft)	6000	-	4420	4600
*Climate and Soil					
-Av.temperature[2]	(OC)	21.3	18.9	18.1	22.8
-Rainfall[2]	(mm)	74.3	90.1	69.7	82.9
-Soil		Red	Red, black	Sandy	NA
-Climate		Warm	temperate	tem.cold	medium
*Socio-economic[3]					
-Total population	(no.)	7243	3878	3695	3507
-Male population	(no.)	3662	1941	1806	1723
-Female population	(no.)	3581	1937	1889	1784
-Av. household size	(no.)	6.2	6.1	6.3	6.0
-Av.land holding	(ha)	1.8	2.1	1.9	2.3
*Institutional Dev.					
-Schools	(no.)	9	3	2	3
-Local Market*	(type)	1,2,3,4,5	-	-	1,2,3,5
-Nursery	(yes/no)	Yes	Yes	No	No
-Farmers'Group Org.	(group)	Buffalo	Goat	-	Cattle

* Note: 1 = Feed Shop; 2 = Drug Dipo; 3 = Milk Collecting Center; 4 = Hat Bazar; 5 = A. I Center

Sources:1 PLBP/GTZ (1992)

2 Meterelogical Station Kathmandu (1989-1991)

Appendix Table 3 Scientific Name of the Fodder Tree Species

S.no.	Local Name	Scientific Name
1.	*bakina*	*Melia azedirach*
2.	*budhar*	*Artocarpus lakoocha*
3.	*chiple*	*Machilus gamblei*
4.	*colliandra*	*Colliandra species*
5.	*dudhilo*	*Ficus nemoralis*
6.	*gayo*	–
7.	*gogan*	*Saurauia napaulensis*
8.	*hatipile*	–
9.	*ipil*	*Leucaena species*
10.	*khanayo*	*Ficus cunia*
11.	*khasreto*	*Ficus hispida*
12.	*kimbu*	*Morus alba*
13.	*koiralo*	*Bauhinia variegata*
14.	*kutmiro*	*Litsea polyantha*
15.	*laherepipal*	*Poplar species*
16.	*painyu*	*Prunus cerasoides*
17.	*tanki*	*Bauhinia purpurea*
18.	*timilo*	*Ficus auriculata*

Source: Pandey, 1982

Appendix Table 4 Fodder Tree Species on Farm Land

Species	VDC F			VDC M			VDC K			VDC R			% to
	Pl	Ng	T	Pl	Ng	T	Pl	Ng	T	Pl	Ng	T	Total
Kimbu	104	0	104	5648	1	5649	30	2	32	-	12	12	26.3
Koiralo	62	19	81	164	350	514	-	-	-	-	22	22	2.8
Kutmiro	100	195	295	348	1622	1970	21	12	33	24	134	158	11.2
Khasreto	-	-	-	115	135	250	-	-	-	-	-	-	1.1
Ipil	63	0	63	10278	0	10278	11	-	11	4	2	6	47.0
Khanayo	22	43	65	53	102	155	-	20	20	1	26	27	1.2
Gogan	-	2	2	-	-	-	-	165	165	1	4	5	0.8
Hatipile	-	-	-	-	-	-	44	10	54	10	9	19	0.3
Tanki	10	0	10	115	29	144	5	60	65	-	2	2	1.0
Nivaro	0	3	3	-	9	9	4	17	21	-	47	47	0.4
Dudhilo	27	3	30	-	-	-	3	10	13	7	6	13	1.9
Painyu	46	23	69	30	-	30	36	107	143	35	135	170	1.9
Chiple	-	-	-	13	32	45	-	-	-	-	-	-	0.2
Bakaina	57	11	68	7	4	11	-	71	71	63	45	108	1.2
Colliandra	-	-	-	385	-	385	-	-	-	-	-	-	1.7
Budhar	73	0	73	139	2	141	-	-	-	-	-	-	1.3
Others	152	10	162	100	15	115	23	9	32	0	45	45	1.6
Total	716	309	1025	17395	2301	19696	178	482	660	145	489	634	100.0

Source: Survey, 1993.
Note:
Pl= Planted
N= Natural grown
T= Total (Pl+N)

Appendix Table 5. Calculation of Fodder

Calculations

1. Demand[1] (Refered from Agricultural Diary, 1993)
   1 Large Ruminant requires = 12 kg fresh green fodder/day.
   = 12*365 = 4380 kg/ annum
   1 Small Ruminant requires = 4 kg .....
   = 4*365 = 1460 kg/ annum
   1 Livestock Unit requires = 1 Large Ruminant Requirement
   = 4380 kg/annum
   Demand (Pandey, 1982)

2. On an Average tree fodder contains 30% of moisture
   TDN (Total Digestive Nutrient) of fresh tree fodder = 23%
   1 Fodder tree produce average 70 kg of fresh matter/annum
   = 80 kg from = calculation.
   1 Large ruminant requires = 4380/80 = 55 fodder trees **
   1 Small ruminant requires = 1460/80 = 18.2 .....
   1 Livestock unit requires = 55 fodder trees/annum

3. Required[3] (Refered from Luetel, 1991)
   1 Livestock Unit requires = 1.8 kg TDN day/LU/day
   = 1.8*365 = 657 kg/annum

   1 Livestock Unit requires = (657/0.23) = 2857 fodder/annum
   = 2857/70 = 40.8 fodder trees

4. Energy Calculation (Refered from Hopkins, 1983)
   Green Fodder (tree fodder+grass+forage) supply 2.5 MJ/kg fodder
   Dry Roughage (Straw+Stover) supply 5.3 MJ/kg.

   Energy Available:
   Green Fodder Supply quantity (kg)*2.5 +
   + Dry roughage quantity (kg)*5.3
   Total Energy Available = 36100 MJ
   Energy required for maintenance = 360*27* LU =30100 MJ

   . . Energy Deficit/Surplus = 36100−30100 =+6000 MJ.

5. Convesion unit for Dry Matter: (Adapted from Pandy, 1982)

   Crop Residues: .85
   Grass+forage : .17
   Tree fodder : .30

Appendix Table 6 Mortality Rate of Fodder Tree Species on the Farm Land

Species	Village Development Committees														
	VDC F			VDC M			VDC K			VDC R			Total		
	PL	EX	MR	PL	EX	MR	PL	EX	MR	PL	EX	MR	PL	EX	MR
kimbu	143	104	27.3	6021	5649	6.2	6011	32	99.4	12	12	0	12187	5797	52.5
koiralo	148	81	45.3	658	514	21.8	-	-	-	22	22	0	828	617	25.5
kutmiro	307	295	3.9	2072	1970	4.9	77	33	57.1	161	158	1.9	2617	2456	6.2
khasreto	-	-	-	255	250	1.9	-	-	-	-	-	-	255	250	1.9
ipil	169	63	62.7	13004	10278	21.0	383	11	97.1	6	6	0	13562	10358	23.7
khanayo	107	65	39.2	157	155	1.2	20	20	0	27	27	0	311	267	14.2
gayo	2	2	0	-	-	-	165	165	0	8	5	37.5	175	170	37.5
hatipile	-	-	-	-	-	-	54	54	0	23	19	17.4	77	73	17.4
tanki	50	10	80.0	164	144	12.2	122	65	46.7	2	2	0	338	221	34.7
timilo	3	3	0	9	9	0	67	21	68.7	48	47	2.0	127	80	37.1
dudhilo	30	30	0	-	-	-	17	13	23.5	14	13	7.1	61	56	8.2
painyu	88	69	21.6	30	30	0	151	143	5.3	173	170	1.7	442	412	6.8
chiple	-	-	-	77	45	41.5	-	-	-	-	-	-	77	45	41.5
bakaina	80	68	15.0	31	11	64.5	73	71	2.7	108	108	-	292	258	11.8
colliandra	-	-	-	520	385	25.9	-	-	-	-	-	-	520	385	25.9
budhar	109	73	33.0	321	141	56.0	-	-	-	-	-	-	430	214	50.2
others	174	162	8.0	115	115	0	59	32	45.7	55	45	18.8	403	354	12.2
Total	140	1025	27.3	23434	19699	16.0	7199	660	91.0	659	634	4.0	32702	22018	32.7

Source: Survey, 1993.

Note: PL= Planted; EX= Existing; MR= Mortality Rate [(PL-EX)/PL*100]

Appendix Table 7 Farmers Preferece of Fodder Trees (N=169)

Species	Number of Farmers Ranking the Species in VDCs															
	VDC P=44				VDC K=28				VDC M=52				VDC R =45			
	1	2	3	Score	1	2	3	Score	1	2	3	Score	1	2	3	Score
koiralo	1	2	4	8.3	-	-	-	-	1	2	4	7	2	1	1	6.6
budhar	1	2	1	6.1	1	-	-	3.6	2	4	-	9	1	-	-	1.9
kutmiro	25	11	3	75.9	5	4	1	28.7	25	10	4	63.5	18	13	1	60.1
dudhilo	5	-	3	13.7	2	-	1	8.3	-	-	-	-	3	1	1	8.9
panyu	1	3	3	9.2	4	6	1	29.7	-	-	-	-	-	2	2	4.5
timilo	-	1	2	3	1	1	1	7.2	-	-	-	-	-	5	2	8.9
gogan	-	1	-	1.5	1	2	-	8.4	-	-	-	-	-	2	1	3.7
hatipile	-	-	-	-	1	2	1	9.6	-	-	-	-	8	1	2	20.8
ipil	1	3	3	9.2	-	1	-	2.4	13	8	2	36.6	6	-	1	14.0
kimbu	6	3	-	18.3	4	-	3	17.8	6	2	2	15.4	1	3	1	7.4
khanayo	2	8	2	18.2	2	-	-	7.1	-	-	-	-	-	2	6	7.4
laharepipal	1	-	-	2.3	-	1	-	2.4	-	-	-	-	-	-	-	-
bakaina	-	2	3	5.3	1	2	1	9.6	-	-	-	-	1	-	1	2.9
chiple	-	-	-	-	-	-	-	-	-	1	1	1.9	-	-	-	-
khasreto	-	-	-	-	-	-	-	-	5	4	5	18.0	-	1	-	1.5
tanki	-	-	-	-	-	-		2.4	2	2	5.8	5	3	1	16.3	
others	-	-	3	2.3	-	-	-	-	-	-	-	-	-	-	-	-

Source: Survey, 1993.
Note: 1, 2, 3 are the rank for each species
Score = Popularity Score (Adopted from Leutel, 1991).

Appendix Table 8 Fodder Tree Preference by Matrix Ranking Technique

Fodder Tree in VDC M

Matrix Ranking in Increasing Order (1....8).

Fodder Criteria	Co	D	L	Lp	Bp	Fh	Ma	Al
1.Increase milk yield	2	3	6	5	1	7	8	4
2.Nutritious	6	4	8	3	1	5	7	2
3.High palatability	7	5	6	4	1	2	8	3
4.High bio-mass	2	1	4	8	3	5	7	6
5.Increase fat %	6	5	8	4	1	2	7	3
6.Compost	3	5	7	1	2	8	6	6
7.Fuel wood	2	1	3	8	6	5	4	7
Total Score	28	24	42	33	15	34	47	31

Source: PRA, VDCM (1993).

Fodder Tree Preference in VDCF

Matrix Ranking in Increasing Order (1....5).

Fodder Criteria	Lp	Bv	Fs	Al	Ti
1.Increase milk yield	5	2	4	3	1
2.High palatability	4	2	3	5	1
3.Nutritious	2	3	5	4	1
4.Digestible	5	3	2	4	1
5.Increase fat %	2	3	4	5	1
6.Fast growing	5	1	2	3	4
7.Like by livestock	5	3	3	5	1
8.Availability	5	5	5	5	5
9.High bio-mass	5	2	5	4	2
10.Fuel wood	3	5	4	2	3
11.Insect Susceptibility	3	2	5	4	1
12.Food	1	5	2	3	3
Total Score	45	36	44	47	24

Source: PRA, VDCF (1993)

*Note :

1.Lp:Litsea polyantha(Kutmiro)
2.Bv:Bauhinia variegata(Koiralo)
3.Ti:Ficus roxburghii(Nevaro)
4.Bp:Bauhinia porpurea(Tanki)
5.Fh:Ficus hispida(Khasreto)
6.Ma:Morus alba(Kimbu)
7. Fs:Ficus cunia(Khanyu)
8. Al:Artocarpussps.(Budhar)
9. Co:Femzinia comnuista
10. D:Desmodium species(Vatmas)
11. L:Luceana species(Ipil-Ipil)
12. Lp:Litsea polyantha(Kutmiro)

Appendix Table 9 Comparision of Feed Supply per Livestock Unit by VDCs and Adopters and Non-adopters in the Research Sites

Types of Farmers in VDCs		Feed Items Supply/lu/Annum in kg.					
		CON	TF	FO	GR	ROU	TOTF
VDC F	Both	240.1	95.0	-	1431.0	982.5	2749.5
	Adopters	260.1	125.2	-	1398.5	1151.3	2935.5
	Non-adopters	221.6	67.2	-	1461.1	826.5	2577.2
VDC M	Both	300.7	939.5	140.4	1311.5	1430.0	4112.6
	Adopters	297.3	999.0	159.1	1465.4	1453.0	4215.6
	Non-adopters	321.4	574.6	26.0	1370.0	1288.0	3554.8
VDC K	Both	256.1	317.4	101.1	2209.4	1882.8	4067.3
	Adopters	222.8	82.8	14.3	2105.1	1313.0	3724.1
	Non-adopters	267.2	404.5	133.3	2387.0	1134.5	4194.6
VDC R	Both	251.0	310.3	-	1788.0	1386.0	3737.8
	Adopters	155.0	364.5	-	918.7	869.2	2922.0
	Non-adopters	274.3	297.0	-	1851.0	1514.0	3939.4
Total (Both)* (N=216)		262.3	422.2	57.0	1676.0	1241.0	3658.5
Adopters (N=90)		264.4	582.0	81.0	1433.1	1289.2	3650.0
Non-adopters (N=126)		260.2	274.4	34.2	1876.0	1197.0	3592.0

Source: Survey, 1993.
Note: CON = Concentrate; TF = Tree Fodder; FO = Forage; GR = Grass
ROU = Roughage ; TOTF = Total Feed; Both = Adopter+Non-adopter
Roughage = (Rice straw+ Maize stover+ Millet stalk+ Husk)

Conversion Factor used man-load (ml) to kg as:
Tree fodder 1 ml = 30 kg
Forage + Green grass 1 ml = 20 kg
Roughage 1 ml = 30 kg

Appendix 10 Socio-Economic Characteristics of the Sampled hh.

Adopter (N=90) Non-Adopter (N=126)		Frequency distribution %				
Characters	Units	Mean	0	1	2	3	4
A. Personal							
Knowledge	(score)	43.77		32.4	55.6	12.0	
Adopter		60.59		1.1	72.2	26.7	
Non Adopter		31.76		54.8	43.7	1.6	
Age	(years)	45.39		13.9	73.6	12.5	
Adopter		42.17		22.2	67.8	10.0	
Non Adopter		47.70		7.9	77.8	14.3	
Education	(level)	2.718		27.3	51.9	17.6	3.2
Adopter		3.067		20.0	57.8	17.8	4.4
Non Adopter		2.468		32.5	47.6	17.5	2.4
Higher Educaton		7.509		5.1	27.8	44.4	22.7
Adopter		7.833		5.6	24.4	42.2	27.8
Non Adopter		7.278		4.8	30.2	46.0	19.0
B. Economic							
Land holding	(ha.)	0.98		63.0	27.3	9.7	
Adopter		1.169		53.3	33.3	13.3	
Non adopter		0.842		69.8	23.0	7.1	
Livestock	(lu)	2.835		4.2	40.3	55.6	
Adopter		3.432			34.4	65.6	
Non Adopter		2.409		7.1	44.4	48.4	
Gross Income	(Rs.000)	5.305		24.5	33.3	42.1	
Adopter		6.507		13.3	34.4	52.2	
Non Adopter		4.447		32.5	32.5	35.0	
NGfodder Trees	(no.)	16.58		70.4	12.0	17.6	
Adopter		25.74		62.2	12.2	25.6	
Non Adopter		10.03		76.2	11.9	11.9	
C. Soci-Inst.							
Participation	(score)	2.273	8.3	13.4	40.3	18.5	19.4
Adopter		2.967	3.3	5.6	21.1	31.1	38.9
Non Adopter		1.778	11.9	19.0	54.0	9.5	5.6
Family Size	(no.)	7.028		17.6	66.7	15.7	
Adopter		7.022		16.7	65.6	17.8	
Non Adopter		7.032		18.3	67.5	14.3	
Extension	(frequency)	3.176	53.2	10.6	6.9	10.6	18.5
Adopter		4.989	33.3	8.9	12.2	15.6	30.0
Non Adopter		1.881	67.5	11.9	3.2	7.1	10.3
Caste		1.986		6.0	26.4	27.8	39.8
Adopter		1.756		2.2	24.4	20.0	53.3
Non Adopter		2.151		8.7	27.8	33.3	30.2

Cont....Appendix 10.

Adopter (N=90) Non-Adopter (N=126)		Frequency distribution %				
Characters	Units	Mean	0	1	2	3	4
D. Spatial (km.)							
Nursury (Dis.)		4.108		9.3	59.5	41.2	
Adopter		3.164		18.9	57.8	23.3	
Non Adopter		4.782		2.4	43.7	54.0	
Market		3.365		10.6	68.5	20.8	
Adopter		2.831		18.9	68.9	12.2	
Non Adopter		3.746		4.8	68.3	27.0	
Forest		2.759		36.1	46.8	17.1	
Adopter		2.577		42.2	43.3	14.4	
Non Adopter		2.889		31.7	49.2	19.0	

Note	:	0	1	2	3	4
Knowledge	:		<34	34-66	>66	
Age	:		<30	30-60	>60	
Familysize	:		<5	5-9	>9	
Gross Income	:		<26000	26000-50000	>50000	
Caste	:		Brahmin	Chhettri	Vaisya	Sudra
Extension	:	Never	on call	Rare	Sometimes	Often
Education	:		Ill.	1-5	6-10	>10
Highest Education	:		Ill.	1-5	6-10	>10
Private Land Holding	:		<1	1-2	>2	
Natural Grown Fodder Trees	:		<10	10-20	>20	
Ruminants (lu)	:		<1	1-4	>4	
Nursury Distance	:		<2	2-4	>4	
Market Distance	:		<2	2-4	>4	
Forest Distance	:		<2	2-4	>4	

Source: Survey, 1993

Appendix Table 11 Evaluation of Farmers' Knowledge

Knowledge About	Average Knowledge Score in Different Groups of Farmers				
	Adopters (N=90)	Non-adp1 (N=79)	Non-adp2 (N=47)	Non-adop (N=126)	Total (N=216)
1. Purpose of growing	9.9	7.1	2.9	5.5	7.3
2. Skills	14.2	8.1	2.04	5.8	9.3
3. Value in Feed	17.2	12.4	5.1	9.6	12.8
4. Awareness of market price, agencies, Scource etc.	19.3	12.1	8.5	10.7	14.3
Total Score	60.59	39.6	18.6	31.8	43.8

Source: Survey, 1993

Appendix Table 12

MODEL COMMAND: DSTAT; RHS=Y,ONE,KNDS,EDU,SOCPAT,TGRINC,NUR,MARK,FORE,FDMRU, LRU,FAMSIZE;OUTPUT=2$

Descriptive Statistics - 216 observations used.

Variable	Mean	Std. Dev.	Skewness	Kurtosis	Minimum	Maximum
Y	.41667	.49415	.33728	1.1091	.0000	1.000
ONE	1.0000	.00000	.00000	.00000	1.000	1.000
KNDS	43.774	21.026	-.31130	2.2135	.0000	86.89
EDU	2.7176	3.7601	1.4073	3.4809	.0000	14.00
SOCPAT	2.2731	1.1672	-.12112	2.3608	.0000	4.000
TGRINC	53050.	39540.	2.0631	9.6623	3410.	.2722E+06
NUR	4.1076	1.9584	.38472	2.7048	.2500	10.00
MARK	3.3646	1.5213	.77952	4.5316	.2500	10.00
FORE	2.7588	1.9918	1.2030	3.9476	.4000	10.00
FDMRU	3073.2	5009.0	5.4113	41.912	83.69	.4969E+05
LRU	.35357	.26896	2.1881	10.486	.3125E-01	1.875
FAMSIZE	7.0278	3.0983	1.3374	5.6944	2.000	22.00

CORRELATION MATRIX

	1-Y	2-ONE	3-KNDS	4-EDU	5-SOCPAT
1-Y	1.0000000				
2-ONE	.0000000	.0000000			
3-KNDS	.6776459	.0000000	1.0000000		
4-EDU	.0786430	.0000000	.0843098	1.0000000	
5-SOCPAT	.5033533	.0000000	.5298840	.1840502	1.0000000

	1-Y	2-ONE	3-KNDS	4-EDU	5-SOCPAT
6-TGRINC	.2574541	.0000000	.3317732	.2030085	.3246545
7-NUR	-.4082336	.0000000	-.3145678	.0150431	-.2510051
8-MARK	-.2973623	.0000000	-.3000632	.0605667	-.1598141
9-FORE	-.0774611	.0000000	-.1512410	-.0220552	-.0379521
10-FDMRU	-.1716154	.0000000	-.0566902	-.0741479	-.1738198

	6-TGRINC	7-NUR	8-MARK	9-FORE	10-FDMRU
6-TGRINC	1.0000000				
7-NUR	-.0509392	1.0000000			
8-MARK	-.2017744	.5578594	1.0000000		
9-FORE	-.0401501	.1229479	.0600860	1.0000000	
10-FDMRU	.0057510	.2066115	-.0763155	-.0303455	1.0000000

	1-Y	2-ONE	3-KNDS	4-EDU	5-SOCPAT
11-LRU	.0534152	.0000000	.0459682	.0460442	-.0266363
12-FAMSIZE	-.0015190	.0000000	.0509888	-.1670074	.0056093

	6-TGRINC	7-NUR	8-MARK	9-FORE	10-FDMRU
11-LRU	.2034810	-.0395104	-.1040855	-.0191552	.2078092
12-FAMSIZE	.4221307	.1024169	-.0621057	.0325204	-.0132858

	11-LRU	12-FAMSIZE
11-LRU	1.0000000	
12-FAMSIZE	.1217265	1.0000000

Appendix Table 13

MODEL COMMAND: LOGIT; LHS=Y;RHS=ONE,KNDS,EDU,SOCPAT,TGRINC,NUR,MARK,FORE,FD
MRU,LRU,FAMSIZE;OUTPUT=5$

2 OUTCOMES ARE:
Y=00 Y=01

COEFFICIENTS FOR OUTCOME Y=00 ARE NORMALIZED TO ZERO

***** OUTCOME = Y=01

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-.760540E-01	.1235	-.616	(.53803)	1.0000	.00000
KNDS	.123260E-01	.1413E-02	8.721	(.00000)	43.774	21.026
EDU	-.139740E-02	.6795E-02	-.206	(.83706)	2.7176	3.7601
SOCPAT	.672763E-01	.2517E-01	2.673	(.00751)	2.2731	1.1672
TGRINC	.361371E-06	.7647E-06	.473	(.63650)	53050.	39540.
NUR	-.431800E-01	.1596E-01	-2.705	(.00682)	4.1076	1.9584
MARK	-.616490E-02	.1993E-01	-.309	(.75705)	3.3646	1.5213
FORE	.749415E-02	.1208E-01	.621	(.53485)	2.7588	1.9918
FDMRU	-.885307E-05	.5155E-05	-1.717	(.08593)	3073.2	5009.0
LRU	.786237E-01	.9245E-01	.850	(.39507)	.35357	.26896
FAMSIZE	-.545007E-02	.8964E-02	-.608	(.54317)	7.0278	3.0983

****

Method=NEWTON; Maximum iterations = 25
Convergence criteria: Gradient = .1000000E-03
Function = .1000000E-05
Parameters= .1000000E-04
Starting values: -.7605E-01 .1233E-01 -.1397E-02 .6728E-01 .3614E-06
-.4318E-01 -.6165E-02 .7494E-02 -.8853E-05 .7862E-01
-.5450E-02

Log-Likelihood..... -67.281
Restricted (Slopes=0) Log-L. -146.71
Chi-Squared (10)..... 158.85
Significance Level..... .32173E-13

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-4.85812	1.315	-3.693	(.00022)	1.0000	.00000
KNDS	.117973	.2004E-01	5.886	(.00000)	43.774	21.026
EDU	-.441270E-01	.5863E-01	-.753	(.45166)	2.7176	3.7601
SOCPAT	.496409	.2476	2.005	(.04502)	2.2731	1.1672
TGRINC	-.234478E-05	.7662E-05	-.306	(.75958)	53050.	39540.
NUR	-.212861	.1422	-1.497	(.13429)	4.1076	1.9584
MARK	-.283536	.1772	-1.600	(.10953)	3.3646	1.5213
FORE	-.492199E-01	.1170	-.421	(.67388)	2.7588	1.9918
FDMRU	-.148324E-03	.9860E-04	-1.504	(.13249)	3073.2	5009.0
LRU	.796191	.9889	.805	(.42073)	.35357	.26896
FAMSIZE	-.112783E-01	.7639E-01	-.148	(.88263)	7.0278	3.0983

Frequencies of actual vs. predicted outcomes
Predicted outcome has the highest probability.

		Predicted	
Actual	TOTAL	0	1
TOTAL	216	128	88
0	126	111	15
1	90	17	73

Appendix Table 14 Calculation of Probability and Marginal Probability of Adoption

Variables	Cof (β)	Mean (X)	Xβ	ΣXβ	dpi	dpi/dxi
One	-4.85812	1	-4.85821	-1.0276	0.2635	-0.94292
Edu	-0.04412	2.717	-0.11991			-0.00856
Knds	0.11797	43.774	5.16415			0.022897
Socpat	0.49640	2.273	1.12838			0.096348
Tgrinc	-2.3448E-06	53050	-0.12439			-4.55E-07
Lru	0.79619	0.353	0.28151			0.154534
Fdmru	-0.00148	3073.2	-0.45583			-2.88E-05
Nur	-0.21286	4.1076	-0.87434			0.041315
Mark	-0.28354	3.3646	-0.95398			0.055032
Fore	-0.04922	2.7588	-0.13578			0.099553
Famsize	-0.01128	7.0278	-0.07926			0.022189

Formulae: dpi/dxi = βk exp(-β'Xi)/((1+exp(-β'Xi)square
Pi = exp(β'Xi)/(1+exp((-β'Xi))
= 0.263550

Maddal (1983); Pindyck and Rubinfeld (1981)

Appendix 14 contd.....
Probability (Pi) of Adoption of Fodder Tree at Different Level of Knowledge Nursery Distances and Fodder Dry Matter Supply

Knowledge		Fdmru (kg)				Nursery Distance (km)				
Score	Pi	1000	2000	3073*	5000	0.5	3	4.1*	5	10
0	0.002042	0.00277	0.00239	0.00204	0.00153	0.00439	0.00258	0.00204	0.00168	0.00058
10	0.006613	0.00897	0.00774	0.00661	0.00497	0.01414	0.00835	0.00661	0.00547	0.00189
20	0.021200	0.02861	0.02476	0.02120	0.01601	0.04460	0.02668	0.02120	0.01759	0.00614
30	0.065831	0.08745	0.07632	0.06583	0.05029	0.13185	0.81901	0.06583	0.05507	0.01970
40	0.186533	0.23770	0.21187	0.18651	0.14696	0.33072	0.22494	0.18651	0.15938	0.06139
50	0.427245	0.50360	0.46657	0.42724	0.35918	0.61652	0.48567	0.42724	0.38153	0.17546
60	0.708194	0.76748	0.73997	0.70819	0.64584	0.83950	0.75443	0.70819	0.66745	0.40911
70	0.887590	0.91481	0.90252	0.88759	0.85576	0.94450	0.90905	0.88759	0.86719	0.69255
80	0.962532	0.97217	0.96786	0.96253	0.95074	0.98225	0.97016	0,96253	0.95504	0.87993
90	0.988177	0.99127	0.98989	0.98817	0.98432	0.99447	0.99063	0.98817	0.98573	0.95974
100	0.996336	0.99730	0.99687	0.99633	0.99512	0.99829	0.99710	0.99633	0.95573	0.98727

Note* = at mean

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