GENDER ROLES IN AGROFORESTRY SYSTEM IN THE EASTERN HILLS OF NEPAL : CASE STUDY OF SALLE VILLAGE

BIJAYA BAJRACHARYA

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

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Thesis Title	**:**	**Gender Roles in Agroforestry System in the Eastern Hills of Nepal: Case Study of Salle Village**
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ABSTRACT

The agroforestry systems practiced in eastern hills of Nepal including the major components of the systems, their uses and interaction are described. Salle village represents an example of low productivity agriculture surrounded by rapid environmental degradation as a result of deforestation.

This research identifies components of agroforestry systems and their inter-relationships, gender division on agroforestry activities and impact of the existing tree planting program, conducted by PAC (Pakhribas Agricultural Centre), on women.

Data was gathered through formal survey, PRA (Participatory Rural Appraisal) and RRA (Rapid Rural Appraisal) with five different socioeconomic groups of farmers representing the whole village.

Results indicated strong interaction among the components i.e. crops, trees and livestock. Crops are the main components followed by livestock and trees. In the last five years, the number of small ruminants (goat, sheep) was found to be decreasing by about 48 per cent. This is related to the prohibition of using grassland (now under tree plantation) for grazing animals. On the other hand, new tree species such as *Pinus wallichiana, Quercus glauca, Castanopsis hystrix* and *Juglans regia* have been introduced. However, these species are not suitable to fulfill the village fodder requirement.

The substantial role of gender with particular reference to women in agroforestry systems of mid hills are highlighted. The study showed that women make important decisions and contribute their labor in household, farm, livestock and forestry activities. The degree of their involvement, however, vary among socioeconomic groups. It was found that, on average, women worked in various activities for 12 hours 49 minutes in a day while men worked 8 hours 5 minutes. The working time of both were observed to be longer in monsoon than in winter.

Women have a significant role in the management of tree species. Although most of the tree management activities like fodder and fuelwood collection and planting of saplings were observed to be generally performed by both (56 per cent), it was noted that 38 per cent of respondents reported exclusive involvement of women in these activities. The analysis of labor use patterns also indicated significant difference in the involvement of women as compared to men. Preference criteria for tree species were also different between gender. However, some tree

species like *Saurauia napaulensis, Ficus roxburghii, Ficus nerifolia* and *Alnus nepalensis* were preferred by both men and women.

Overall, women as compared with men, involve more in agroforestry production and management activities. Tree plantation program conducted by PAC has brought some changes and consequences at Salle village. These include changes in livestock population, livestock management, availability of bedding material and some fodder and the division of labor. While the household changed from free grazing livestock system to stall feeding, the women find themselves with more work as children who once take care of the livestock are sent to school. In this context, the improvement of agroforestry systems in eastern hills of Nepal cannot be done without the contribution of women.

ชื่อวิทยานิพนธ์	บทบาทของสตรีและบุรุษในระบบวนเกษตรที่สูงภาคตะวันออกของประเทศเนปาล : กรณีศึกษาหมู่บ้านชาลี
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	ผศ. ดร. มนู ศีติสาร กรรมการ
	ผศ. ดร. ธวัชชัย รัตน์ชเลศ กรรมการ
	อาจารย์ พฤกษ์ ยิบมันตะสิริ กรรมการ

บทคัดย่อ

การศึกษานี้อธิบายถึง ระบบวนเกษตรที่ปฏิบัติอยู่ในบริเวณภูเขาทางภาคตะวันออกของประเทศเนปาล รวมถึงองค์ประกอบหลักของระบบ และความสัมพันธ์ขององค์ประกอบเหล่านั้น โดยได้ยกตัวอย่างหมู่บ้านชาลี เป็นกรณีศึกษา หมู่บ้านนี้เป็นตัวแทนของระบบการเกษตรที่มีผลิตภาพต่ำ มีความเสื่อมโทรมของสภาพแวดล้อมอย่างรวดเร็ว ซึ่งเป็นผลมาจากการทำลายป่าไม้ การศึกษานี้ได้ระบองค์ประกอบของระบบวนเกษตร และความสัมพันธ์ขององค์ประกอบเหล่านั้น รวมถึงการแบ่งงานกันทำระหว่างชายและหญิง ในกิจกรรมต่าง ๆ ในระบบวนเกษตร และผลกระทบของโครงการปลูกป่าของ PAC (Pakhribas Agricultural Center) ต่อบทบาทของผู้หญิง

การรวบรวมข้อมูลทำหลายวิธีคือ การสำรวจภาคสนาม, การประเมินสภาวะชนบทอย่างมีส่วนร่วมจากชาวบ้าน (PRA: Participatory Rural Appraisal) และการประเมินสภาวะชนบทโดยเร่งด่วน (RRA: Rapid Rural Appraisal) โดยสุ่มตัวอย่างจากเกษตรกรที่มีความแตกต่างกันในด้านเศรษฐกิจและสังคม รวม 5 กลุ่มด้วยกัน ซึ่งเป็นตัวแทนของทั้งหมู่บ้าน

ผลการศึกษาพบว่า องค์ประกอบต่าง ๆ ของระบบ เช่น พืชผล ต้นไม้ และปศุสัตว์ มีความสัมพันธ์เกี่ยวโยงกันในระดับสูงโดยมีพืชผลเป็นองค์ประกอบหลัก รองลงมาได้แก่ ปศุสัตว์ และต้นไม้ตามลำดับ ในช่วง 5 ปีที่ผ่านมา จำนวนสัตว์เลี้ยงขนาดเล็ก

(เช่น แพะ แกะ) ลดลงประมาณร้อยละ 48 ทั้งนี้เป็นผลเนื่องมาจาก การไม่อนุญาตให้ใช้ทุ่งหญ้า (พื้นที่บริเวณที่มีการปลูกป่า) สำหรับเลี้ยงสัตว์ ประกอบกับการนำพันธุ์ใหม่ ๆ เข้าไปปลูก เช่น *Pinus wallichians, Quercus glauca, Castanopsis hystrix* และ *Juglans regia* อย่างไรก็ตามพืชพันธุ์ใหม่เหล่านี้ยังไม่สามารถสนองตอบต่อความต้องการพืชที่ใช้เป็นอาหารสัตว์ของหมู่บ้านได้

การศึกษาบทบาทของชายและหญิงได้มุ่งเน้นไปที่บทบาทของผู้หญิงในระบบวน-เกษตรเขตภูเขาตอนกลางได้พบว่า ผู้หญิงมีบทบาทสำคัญในการตัดสินใจการทำงานในครอบครัว หรือในกิจกรรมทางการเกษตรต่าง ๆ ทั้งด้านปศุสัตว์ และด้านป่าไม้ ซึ่งระดับการเข้าร่วมในกิจกรรมดังกล่าว แตกต่างกันออกไปในแต่ละกลุ่มที่มีการศึกษา พบว่าโดยเฉลี่ยในหนึ่งวันสตรีจะทำงานในกิจกรรมต่าง ๆ ถึง 12 ชั่วโมง 49 นาที ส่วนผู้ชายจะทำงานเพียง 8 ชั่วโมง 5 นาทีต่อวัน ช่วงเวลาทำงานของทั้งชายและหญิงในฤดูมรสุมจะยาวนานกว่าช่วงเวลาทำงานในฤดูหนาว

สตรีมีบทบาทที่สำคัญในการจัดการเกี่ยวกับต้นไม้และพันธุ์ไม้ต่าง ๆ แม้ว่าโดยทั่วไปแล้วกิจการด้านการจัดการป่า เช่นการเก็บรวบรวมพืชอาหารสัตว์ และไม้ฟืน รวมถึงการปลูกป่าทั้งชายและหญิงจะมีบทบาทร่วมกัน (ร้อยละ 56) แต่ร้อยละ 38 ของผู้ให้สัมภาษณ์ทั้งหมด ระบุว่าผู้หญิงทำกิจกรรมเหล่านี้แต่เพียงฝ่ายเดียว เมื่อวิเคราะห์ถึงรูปแบบการทำงานระหว่างชายหญิงพบว่า มีความแตกต่างกันระหว่างหญิงกับชาย รวมถึงหลักเกณฑ์ในการคัดเลือกพันธุ์ไม้ที่จะปลูกด้วย อย่างไรก็ตามพันธุ์ไม้บางชนิด เช่น *Saurauia napaulensis, Ficus roxburghii, Ficus nerifolia and Alnus nepalensis* ทั้งชายและหญิงมีความชอบปลูกคล้ายคลึงกัน

ผลการศึกษาอาจกล่าวโดยสรุปได้ว่า ผู้หญิงมีบทบาททั้งในระบบการผลิต และการจัดการระบบวนเกษตรมากกว่าผู้ชาย โครงการปลูกป่าที่ดำเนินการโดย PAC ที่หมู่บ้านชาลีทำให้เกิดการเปลี่ยนแปลงบางอย่างในหมู่บ้าน ซึ่งได้แก่ จำนวนปศุสัตว์ การจัดการปศุสัตว์ วัสดุทำแปลงและพืชอาหารสัตว์ และการแบ่งงานกันทำ ครัวเรือนได้เปลี่ยนระบบปศุสัตว์จากแบบเลี้ยงปล่อยมาเป็นการเลี้ยงในคอก แต่กลุ่มผู้หญิงพบว่ามีงานเพิ่มขึ้นอีกเนื่องจากแต่เดิมลูก ๆ ของพวกเขาซึ่งเคยช่วยเลี้ยงต้องเข้าโรงเรียน ในสภาพเช่นนี้การปรับปรุงระบบวนเกษตรในเขตภูเขาภาคตะวันออกของประเทศเนปาลจะไม่สามารถเป็นไปได้ถ้าไม่มีส่วนร่วมจากกลุ่มสตรี

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ABBREVIATIONS AND SYMBOLS

APROSC	:	Agricultural Project Services Centre
*Bari*land	:	Dry upland area cultivated normally with maize
Chulo	:	Stove
Ek hall goru	:	One pair of oxen
FRP	:	Forestry Research Project
Ghee	:	A type of butter made from milk
ICIMOD	:	International Centre for Integrated Mountain Development
Jand	:	Alcoholic drink made from millet, maize etc
Kanjihouse	:	Animal pound
KHARDEP	:	Koshi Hill Agricultural Development Project
*Khet*land	:	Lowland wet terrace area cultivated with rice
Khole	:	Feed prepared for animals mixing leaves of vegetables and grains
Khola	:	Stream
msl	:	Metre above sea level
*Nagi*land	:	Upland grassland
NARC	:	National Agricultural Research Centre
NGO	:	Non-governmental Organization
Pandera	:	Water spring
PAC	:	Pakhribas Agricultural Centre
PRA	:	Participatory Rural Appraisal
RRA	:	Rapid Rural Appraisal
Terai	:	Low altitude area (< 500 msl)
VDC	:	Village Development Committee

CHAPTER I

INTRODUCTION

1.1 Statement of the problem

Agroforestry is a landuse system that involves socially and ecologically acceptable integration of trees with agricultural crops and/ or animals simultaneously or sequentially so as to get increased total productivity of plant and animal in a sustainable manner from a unit of farmland, especially under the conditions of low levels of technological inputs and marginal lands (Nair, 1990).

Combe (1982) has grouped the agroforestry systems into three categories: agrosilvicultural systems (integration of forest trees with agricultural crops), silvopastorial systems (integration of forest trees and livestock) and agrosilvopastorial systems (integration of forest trees, agricultural crops and livestock (Figure 1). These different types of agroforestry systems are practised by farmers depending on diversified climates and geographical situations in Nepal. There are three major agroecological regions in Nepal, high hills (above 4,000 m), mid hills (500 - 4,000 m) and inner *terai* (below 500 m). Great variations exist in terms of climate, soils (physical variation); cropping systems (biological variations); ethnic, culture, and economic systems (socioeconomic variations) in these regions.

Approximately three-fourths of Nepal's land area fall under the middle hills and high mountain categories with elevations ranging from 300 m to 8,000 m in the Himalayas.

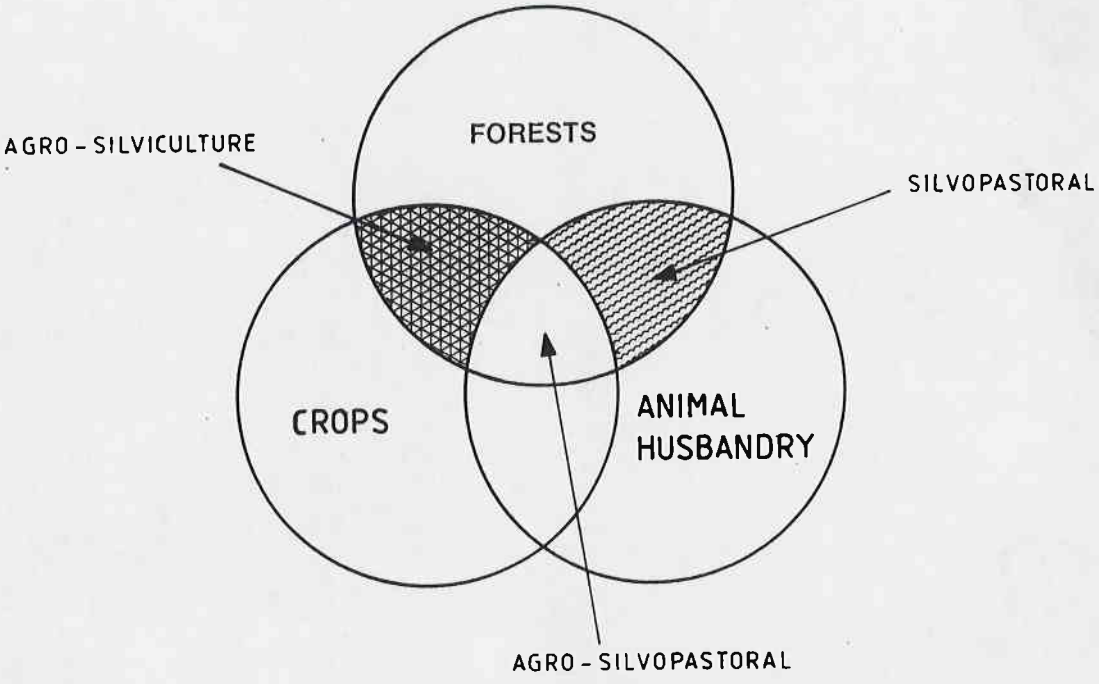


Figure 1 Land use and agroforestry systems

Source: Combe (1982)

The hill farming systems are based on strategies to manage forests, pasture and arable lands simultaneously and in an integrated fashion to obtain essential items of food, shelter and clothing (Denholm, 1991).

In the past, traditional agriculture and forestry practices were maintained in low population pressure. At present, it cannot meet the needs of current population. The hilly area is geologically unstable and every year landslides destroy the fragile hillslopes (Wallace, 1987). Landslides are mainly due to deforestation. The increasing needs of more agricultural land to feed humans and livestock, more fuelwood and felling of trees for short term gain have all contributed to a rapid rate of deforestation. Over 95 per cent of consumption of cooking energy is met by fuelwood (Denholm, 1991). The current livestock stocking rate in the hills is nine times larger than the carrying capacity (Shrestha and Evans, 1984). Some estimates suggest that in just over 10 years, from the late 1960s to the early 1980s, up to half of the forests in some hill regions have been cut down with the area under forests reduced from nearly 60 per cent to 30 per cent of the total area (Kumar and Hotchkiss, 1988). Because of heavy landslides and soil erosion in agricultural fields, a serious food deficit is being occurred.

The solutions to these problems will certainly be multifaceted and include the development of alternative, less energy intensive technologies and more efficient diversified farming systems. Agroforestry is one of proposed technological solutions to these problems (Thapa *et al.*, 1989).

The deterioration of forests and grazing lands across high and mid hills brings hardships to all of its inhabitants whose very survival is so tenaciously linked to forest-farm inter-relationships (Denholm, 1990). The gender-based division of labor that exists in hill societies indicates that caretaking of the family hearth and livestock

is primarily the responsibility of women. More than three-fourths of household time expended on collection of forest products is done by women (Kumar and Hotchkiss, 1988). As deforestation is high and tree species considered useful for daily needs become increasingly scarce, it is the women who must walk further distances to fetch fuelwood and fodder supplies, adding hours to their already long work days.

Kumar and Hotchkiss (1988) mentioned that where deforestation is high, time needed to collect one load of fuelwood increases by 75 per cent and less time allocated to agricultural activities.

Daily activities performed by men and women in Nepalese agroforestry systems reflect the prevailing sexual division of labor, skill, responsibility, and control within the larger society. The success or failure of research efforts depends on the ability of researchers to serve the social objectives of diverse groups of rural producers and to reconcile or accomodate the conflicts between men and women and between classes of rural clients (Rocheleau, 1987). In Nepalese context, generally, participation of the people for the public welfare activities is a sort of tradition in the society. Where, people are courteous and respectful in nature. They possess their own view on life, have natural dignity and respect that makes community based developmental activities into action. Those include use of natural resources, education and some primary health care services. However, the problems and opportunities inherent in the gender division of access and control to agroforestry activities, present a special challenge which must deal with women's relationship to

the community as well as between groups of women, based on caste, ethnicity and source of livelihood.

Moreover, as Nepal is culturally diversified country, the status of women rather varies from one ethnic group to another and in relation to the social status of different families. The major ethnic groups are Brahmin, Chhetri, Magar, Gurung etc. Despite the general view of women's role on agroforestry management, there is a great variation found in the access and involvement of women, with respect to ethnicity.

1.2 Objectives

Given the above background, this study has the following objectives:

1. To describe the various components and their interrelationships in the existing agroforestry system.
2. To identify and compare the participation of male and female farmers in the existing agroforestry and household activities.
3. To evaluate the constraints, opportunities and impact of the PAC's Private Tree Planting Program toward a sustainable agroforestry system using gender-based analysis.

1.3 Rationale of the study

To have a concrete knowledge about the agroforestry situation before recommendation and to improve the existing situation, it is essential to identify and analyze the underlying components of the system and their inter- relationships.

Both male and female farmers are responsible for maintaining and altering the components of agroforestry systems. But their distinct roles in different agroforestry activities have not been assessed so far. As actors to successful agroforestry activities, the analysis of their involvement in such typical situations will reveal important problems, areas of concerns, constraints and productive intervention points.

The problems and opportunities inherent in the gender division of access to land, labor, cultivated and wild plants, products present a special challenge to agroforesters. Gender-based differences in legal status, use of and access to space, type of activities, and control over labor and resources, all have a direct bearing on what type of crops can be planted, managed, used and harvested in terms of place, person, purpose and benefit (Rocheleau, 1987).

Despite the fact that women are involved in most of the farm and forestry activities regarding the agroforestry management, their roles have not been recognized. As women bring specific skills, resources and priorities to farm production, to ignore them is to ignore half or more of the system in which decisions

about farming are made (Feldstein *et al.*, 1987). Fortmann (1983) stated that most planners still think of the farmers as men and they simply fail to consider the impact of agroforestry projects on women or the role of women in implementing them.

The extent of female participation in agroforestry activities depends on different geophysical (hills and terai) and socioeconomic situations (age, ethnic group, size of landholding, farm mechanization, access to and control of land, labor and technologies etc.). So, a study done in one part may not give reliable representation for another part having different situations. Heavy housework and child care are also important factors for constraining women's participation (Shinawatra *et al.*, 1987). So, study on household and time consuming activities is also important for making women's work efficient and productive.

Many of the NGOs in Nepal have started recognizing the key role women play in activities related to cropping systems, forest use and livestock maintenance. Some of them have achieved success in forming user groups and eliciting the participation of women (Denholm and Rayachhetri, 1990). Pakhribas Agricultural Centre, one of the multidisciplinary semi-governmental organizations (established in 1972 through funding by the Overseas Development Administration of the British Government), located in the Eastern hills of Nepal, has encouraged farmers on private tree planting in the Salle village of Dhankuta since 1977. In late 1987, PAC helped farmers in planting trees on about 30 ha of *nagi*land (grass land located at above 1800 m) at the top of their farms. According to Thapa *et al.*, (1990), the

impact of this program on farmers resulted in stall feeding system of livestock management and reduction in livestock holdings. However, this impact has not been assessed to differentiate between male and female members of the affected households. This study is supposed to explain and analyze the gender roles in this regard.

The evaluation of PAC's activity on the agroforestry system based on gender analysis will strengthen future programs by highlighting its weaknesses and suggesting possible appropriate recommendation.

1.4 Literature review

It is found that in Nepal, women are involved in various agricultural activities including fuelwood, fodder and livestock management as much as if not more than men. Women farmers do at least half the work with animals - cutting and carrying fodder. They are also involved in carrying fuelwood and spliting logs for cooking purpose (Bhattarai *et al.*, 1989).

Women constitute 48.7 percent of total population in Nepal. Women outnumber men in the hills but not in *terai* (Acharya, 1980). Since agricultural system in the hills is more diverse and intensive and female participation in agroforestry activities is also higher in the hills than in *terai*, government priority is focussed on development of integrated farming systems like agroforestry in the hills

(Acharya and Benett, 1981; Timsina *et al.*, 1989; Timsina, 1990). It focusses on requirement of separate study for hills and *terai* women farmers. Furthermore, Axinn (1990) indicated that in the complex social systems of hills, the "who" of gender concerns is also a complex issue and women's participation in agriculture varies tremendously from one to other social groups. Khan (1992) added that different cultural values, beliefs and norms of different social groups have so pervasive influence on the behaviour of the people that it is necessary to understand them well before setting up of project in the rural areas.

Ojha (1989) and Tiwary *et al.*, (1988) emphasized that Nepalese women work harder than men. Authors further stated that the most tedious and tiring jobs, that is, collecting fodder, fuel and other products have traditionally been mainly performed by women. Axinn (1977) concluded that women play an active role both as decision makers and as participants, emphasizing that women share responsibility for obtaining supplies (wood and water), carrying grains to mill for grinding, collecting grass for domestic animals, planting and transplanting crops, weeding and harvesting and so on. It is mainly women who feed large animals such as cows and buffaloes (Acharya and Bennett, 1981). Women also play major role in the use of tree resource and feeds related activities to livestock (Acharya and Benett, 1981; Katuwal, 1990; Pandey, 1985).

Wickramasinghe (1991) reported that women in Sri- lanka are at the forefront of tree farming because of their knowledge, experience and ability. Almost 88 per cent of elderly women in rural households know which locations are most desirable for growing trees. Their knowledge enables them to identify specific locations like fences, hedges, homegardens, farmlands and common areas along with specific ideotypes and priority products. Research conducted in Sri Lanka on traditional tree use practices and gender issues in tree management shows that rural women are efficient users of tree products. For women, tree are of primary importance in meeting family needs i.e., fruits, food, fodder, fuelwood etc. (Wickramasinghe, 1991).

It is not only that women are highly responsible in many above activities, but it is also explicitly observed that women and men may be responsible for the different crops, for different fields of the same crops for different tasks in the production cycle and also for different livestock and forest activities (Cloud, 1984).

In order to make any technology appropriate to women, a study should be assessed by differentiating male and female (Dey, 1985; Timsina *et al.*, 1989). Rocheleau (1987) has also put stress on requirement of separate discussion since knowledge of male and female farmers are different for even same plant and places.

However, the importance of women's work has been downplayed by some surveys because of the myth that women are only for the care of the home and her family (Wangdali, 1988). Problems and constraints which women faced in

agricultural production are they trapped in drudgery and time consuming activities due to low technology (Supriadi *et al.*, 1989). Despite their importance to agricultural production, women face severe handicaps. Any development programs are usually planned by men and aimed at man. Extension workers, almost exclusively male, aim at men and at men's activities and crops. In some regions, this bias may depress production of subsistence food crops (often women's crops) (Swaminathan, 1982). In many instances, women are often invisible to researchers and decision makers, and to do research on women needs special efforts.

CHAPTER II

RESEARCH METHODS

2.1 Scope of the study

This study mainly deals with impact of private tree planting program initiated by PAC since 1987 in Salle village of eastern Nepal. Actually, PAC has encouraged the farmers for planting fodder and fuelwood trees on their private land since 1977 as there is increasing rate of deforestation and in turn increasing demand of fodder and fuelwood trees.

PAC is one of the multidisciplinary semi-governmental organizations located in eastern hills of Nepal. At the present, this project is assigned to be part of NARC (National Agricultural Research Centre). This project is responsible for the improvement of agricultural, livestock and forest situations of eastern hills. There are several working groups organized by the project for assessing needs and problems of farmers. Women development working group with multidisciplinary personnel in particular is studying about gender issues in order to reveal needs, priorities and problems regarding agricultural development from women farmers. Since 1990, it has also started involving women farmers in the selection of recommended crop varieties.

2.2 Selection of the study area

After reviewing literature and talking with the technicians working in this area, the Salle village was selected as a study site for the research. This village was suggested to be a possible research site by staff of PAC, an agricultural research and extension center supported by British technical aid. This village is one of target areas for extension and research work of PAC. PAC began implementing Private Tree Planting Program in Salle in 1987 and it has been supporting the village through technical knowledge for the past 15 years. This village is located in Hattikharkha Village Development Committee in the eastern Nepal.

The village has sufficiently large population to permit effective analysis of research data. Most of the households plant fodder and fuelwood trees on the edges of crop land and also on stream banks, barren land near farming area. Farmers are very much interested in tree planting on their private land. They also made committee for seedling arrangement and all those concerning with tree management by themselves.

2.3 Conceptual framework

There is a complete integration of crop, animal and tree production. These components are equally important. Integration of which, has made the agroforestry system more sustainable and improve the status of small resource holders.

Household is the centre in the utilization of crop, livestock and tree products, thereby all labor required for the maintenance of primary components are necessarily from the household. A complete relationship among these components and two way flow of materials and information is normally found for the very existence of agricultural practices (Figure 2).

Furthermore, these relationships manifest the nature and degree of regenerative processes (involving diversification, recycling, etc.) that are central to the sustainability of farming system in the hills (Jodha, 1990). However, despite their widespread presence, the existing agroforestry system and their linkages with respect to gender dynamics have not been examined so far.

In this given circumstance, gender analysis was applied as an analytical framework that examines male and female roles and responsibilities in a given society. It starts with a series of questions related to "who" (Banu *et al.*, 1990). The answers of the following questions were sought in this study.

Who performs each agroforestry activities?

What resources are available and who has access to and control of them?

Who makes decision?

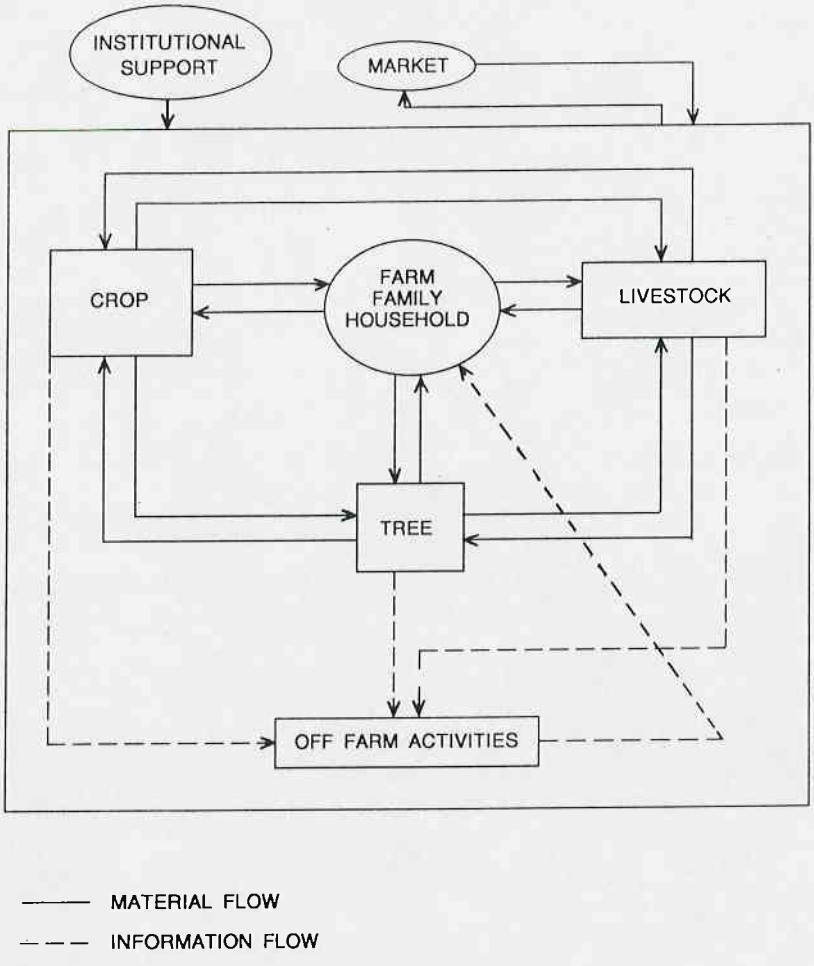


Figure 2 Conceptual model of Nepalese hill farm production system

Based on Beets (1990)

The following questions concerning patterns of agroforestry management practices were examined.

1. Among male and female farmers, who have greater role in tree management? What do they do differently?
2. Do women in high economic status groups involve less in crop, tree and livestock activities than those in low economic status groups?

3. Do Magar/ Gurung women have stronger decision making role in their households than Brahmin/ Chhetri women?
4. Do male and female farmers have different tree preference criteria?
5. For the villagers who do not have *nagi*land, are they benefitted in term of fodder, bedding materials than those having *nagi*land?
6. Is there an increase in work burden of women farmers because of the tree planting program?

Such activities are important for the national policy as they have effects on the nation's ability to improve agricultural productivity and the well being of the farm families. Understanding the gender division of responsibility for labor, management and disposal of production is crucial for understanding how and why households allocate their resources as they do. Understanding decision making process, the nature and degrees of men's and women's access to productive resources permits intelligent efforts to release constraints on their increased productivity.

2.4 Data Collection

Data collection was done using a combination of methods as follows:

1) Pre-diagnostic description

Selection of the site and an initial understanding of agroforestry system of the area was done through the review of existing sources of information. Available literature and other sources of information on secondary data such as climate, soil types, topography etc. were collected, examined and incorporated for the study.

The biophysical data for analyzing cropping systems, livestock and forestry components and also the knowledge on ethnic groups and livelihood system as crucial information for understanding clear picture of village as well as its agroforestry situation, were acquired from PAC.

The other supporting literature and information were sought for gaining more knowledge and confidence from FRP (Forestry Research Project), APROSC (Agricultural Project Services Centre), Winrock International, NARC (National Agricultural Research Centre), SATA (Swiss Development Project) and ICIMOD (International Centre for Integrated Mountain Development).

2) Participatory rural appraisal (PRA)

PRA was executed for one week with the help of PAC staff, as PRA is increasingly being recognized as a data collection method which increases farmers'

participation and focusses more on the farmers' decision making process than conventional methods do.

It offers a way in which both researchers and villagers try to discover the situation through the process of joint observation and interaction in considerably short time period, villagers are then no longer seen as informants, but as participants in a development process.

The following data collection methods were employed with PRA.

i) Wealth ranking

A list of households was obtained from the local primary school, it was made possible as the teachers had recently noted every household for collecting donation in order to repair school building. Every household is different in a true sense. These differences are due to natural factors (environmental) and socioeconomic conditions. Those households which fall under the same environment and economic situations will have similar farming practices and may have similar needs and priorities for farming.

The wealth ranking exercise was to group the households into different strata of wealth assessed by farmers' own opinion. This avoids assessment being made by an outsider using single or simplified criteria. Three farmers and three school teachers were chosen as informants and were asked how they assess wealth and poverty. The ideas of respondents were noted down. The list of

households was shown to farmers and they were asked to put each and every household in different three strata based on ethnic group and economic status.

ii) Agroecosystem mapping (resource mapping)

Two groups of farmers, one consisted of six male farmers and the other of three female farmers were asked to describe about the map of topography, hydrology, enterprises and social groups. The participants were requested to indicate spatial distribution of roads, forests, water resources and different social groups on the map made by stones and grasses on the ground. This map was then copied on the paper. This map is important to know the access of different ethnic groups to land areas and other important resources.

iii) Matrix scoring

This method was applied separately with the male and female group to establish farmer preferences for fodder trees and the criteria upon which those preferences are based. Firstly, the species of fodder trees in question were established and written along the top of the table.

All species were covered methodologically, identifying all good and all bad points for each, to produce an exhaustive list, which was written down the side of the page. The criteria were then considered one by one. Each of the species was ranked by the farmer in order of preference for that criteria scoring the

highest number for the best and lowest for the least preferred. It was started by asking the farmer to identify the best first, then the second best and so on. When it became difficult for him or her to differentiate, it was moved to identify the least preferred then forward positively till the completion. The table was made with the varied number of chickpea seeds to denote different scores. This allowed final review of the score and chance to change it if desired.

The final table gives a complete picture of how the farmer rates each of the species for all the criteria. It gives a lot of information about how farmers' choices and decisions are made.

iv) Activity profiles and daily routines

"Activity profiles and daily routines" exercise was applied for exploring daily patterns of activity through profiles and routines, time taken for each activities and location of work. This was done in the group of six to seven male and female farmers by noting down the different daily activities done by them. The list of activities along with the time allocation pattern, then, was summarized. This was again confirmed and cross checked through participant observation method.

v) Participant observation

Before formal interviewing, the "participant observation methodology" was utilized for six to seven households to observe both men's and

women's activities while taking part in their tasks and conversations. The problem of access to women as an informant was solved as the researcher became integrated into the domestic activities like preparation of family meals and maize husking. Basically, it entailed the active participation of the researcher in the conduct of research in as many spheres of activities as possible in the community. The objective here is to see the minute details involved in such activities, and to understand their dynamics (Rosario, 1990).

vi) Semistructured interviewing with key informant groups

Village headman, the school teachers, chairman of forest committee and leading male and female farmers were selected as key informants. In this type of interviewing, only some questions and topics were predetermined and questions arose during the interview. The interviews appeared informal and conversational, but were actually carefully controlled and structured using a guide or checklist. The main purpose of this interview was to know the exact situation of the village and to enumerate various problems related to farming.

vii) Group interviews

Group interviews were carried out with six farmers each from different strata e.g., rich Magar Gurung, medium Magar Gurung, poor Magar Gurung, medium Brahmin Chhetri, poor Brahmin Chhetri and female headed households. Based on information and conclusions of "interview with key informant

groups" the issues and questions to be asked were decided. The prepared checklist was used for this purpose.

3) Formal survey

Preliminary testing of questionnaires was conducted in 10 households and any improvements or changes needed were corrected. The number of households to be interviewed was decided on the basis of analytical results of PRA considering ethnic groups and economic status. Two way stratified sampling method (Cochran, 1977) was applied to select 103 households in the following way:

a)	Ethnic Group:	Magar	E1
		Gurung	E1
		Chhetri	E2
		Brahmin	E2

Magar and Gurung were considered under one group E1 likewise Brahmin and Chhetri in the another E2 group on the basis of similar social and cultural behaviour. In the caste hierarchy, Brahmin/ Chhetri are among the top levels. Their participation in politics, social and religious affairs is overwhelming in comparison to that of Magar/ Gurung. Their main occupations are priests, agriculture and government service whereas Magar/ Gurung are also diverted towards Indian and British armies in addition to farming. The concept of marriage among them is basically different and women do not have much say in the family and social

matters as in the Magar/ Gurung community. Marriage custom has its own distinctive features with the Magar/ Gurung and women of this community are very outspoken even with the strangers. Brahmin/ Chhetri do not raise pigs because of their religious belief whereas these animals are important part of Magar/ Gurung's livelihood.

b) Economic status:

Rich	R
Medium	M
Poor	P

Six groups from E1R, E2M,.....,.to E3P were categorized and then number and per cent of each group were calculated. All the households from E2M and E2P; and remaining households from E1R, E1M and E1P were considered and altogether 103 households were chosen in order to represent the whole village.

The corrected formal or structured questionaire was used to obtain quantitative and statistically more precise information such as farm size, family structure, land ownership, farmers' preferences etc. The interview was conducted not only with female farmers but also with male farmers of same household so as to remove sex bias and to get reliable results. Information was collected to identify women's status in the family including age, marital status, family size etc. This also included their farming knowledge with respect to agroforestry, access to and control of resources, skills, and interests and problems in the participation of training activities.

2.5 Data analysis

Data collected using various methods were compiled. Descriptive statistics were used to analyze data. When variables were quantified, classified, checked for consistency and village and household level information was clarified, such knowledge lead to the identification of decision making process of farmers, problems encountered and constraints to solutions to successful agroforestry programs.

Some of the questions concerning pattern of agroforestry management practices e.g., "who have greater roles in tree management ?" and "do women in high economic status groups involve less in crop, tree and livestock activities than those in low economic status groups?" were analyzed through approriate statistical tests of significance ("t test" and "Chi square test") to see differences among different groups of farmers. For other key questions where statistical tests were not possible, descriptive statistics were employed.

CHAPTER III

SOCIOECONOMIC AND DEMOGRAPHIC PROFILE OF THE STUDY AREA

3.1 General description of study area

3.1.1 Physical characteristics

Salle village of Hattikharka Village Development Committee (VDC) is situated in Dhankuta, the eastern hill district of Nepal (Figure 3). The village is about 15 km north from the nearby town, Dhankuta Bazar. It is close to Jorpati village located on Dhankuta-Basantpur road (Figure 4). The area falls steeply to the north west from an exposed ridge at 2200 m elevation down to 450 m and forms a part of the catchment area of Mangmaya *Khola*, which is a tributary of Arun river.

The climate is cold in winter and mild in summer. Normally, the temperature all year ranges from 9 to 21 degree centigrade. Frost can be expected from first week in December to the third week in February. There is occasional snowfall in the winter. The rainy season occurs from May to September, with an average rainfall per year of 1620 mm (recorded at the PAC meteorological station). The amount of rainfall during the rainy season is 80 to 90 per cent of the annual precipitation (Figure 5).

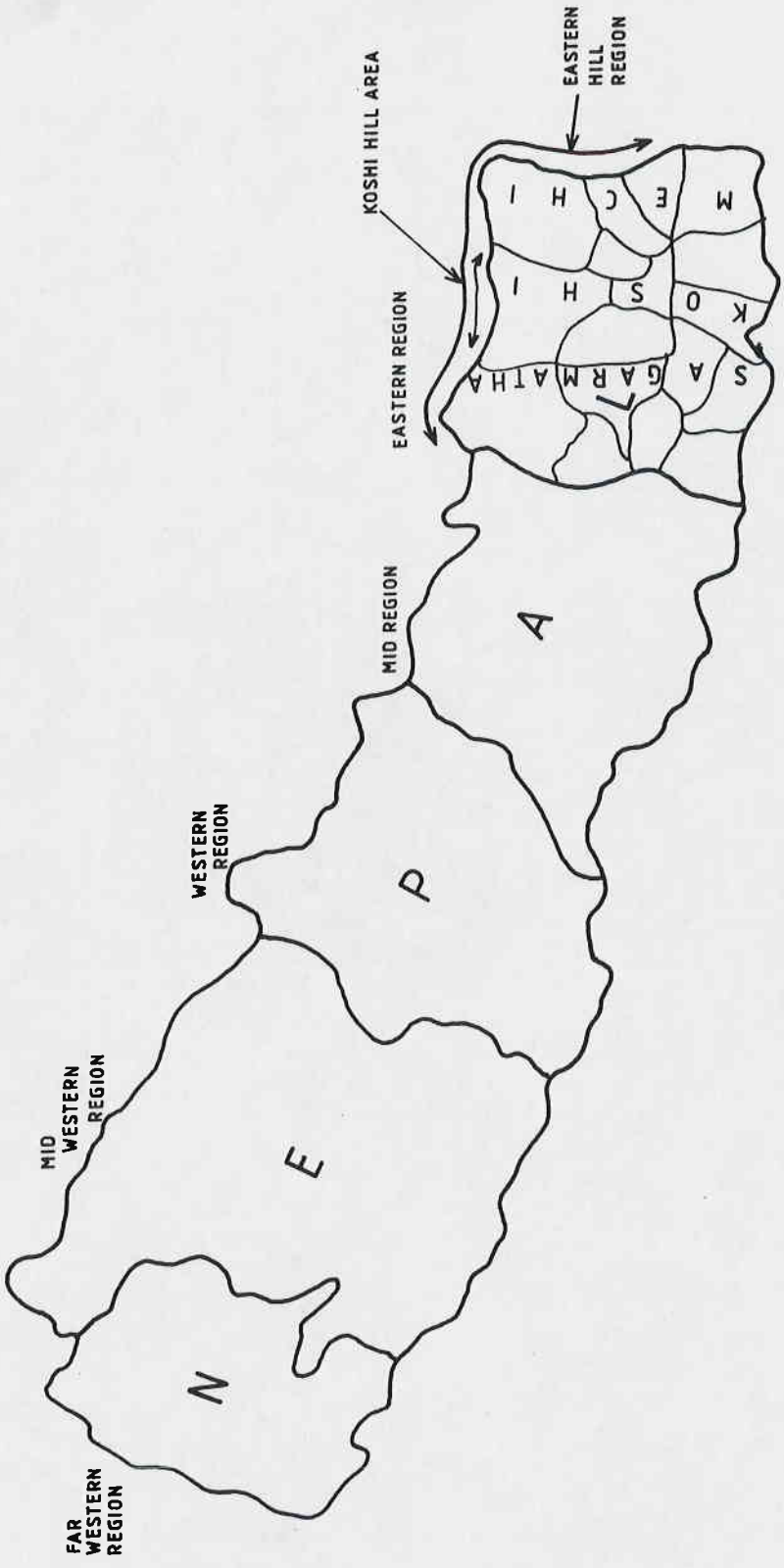


Figure 3 Map of Nepal showing the eastern hills
Source: David and Gibbon (1989)

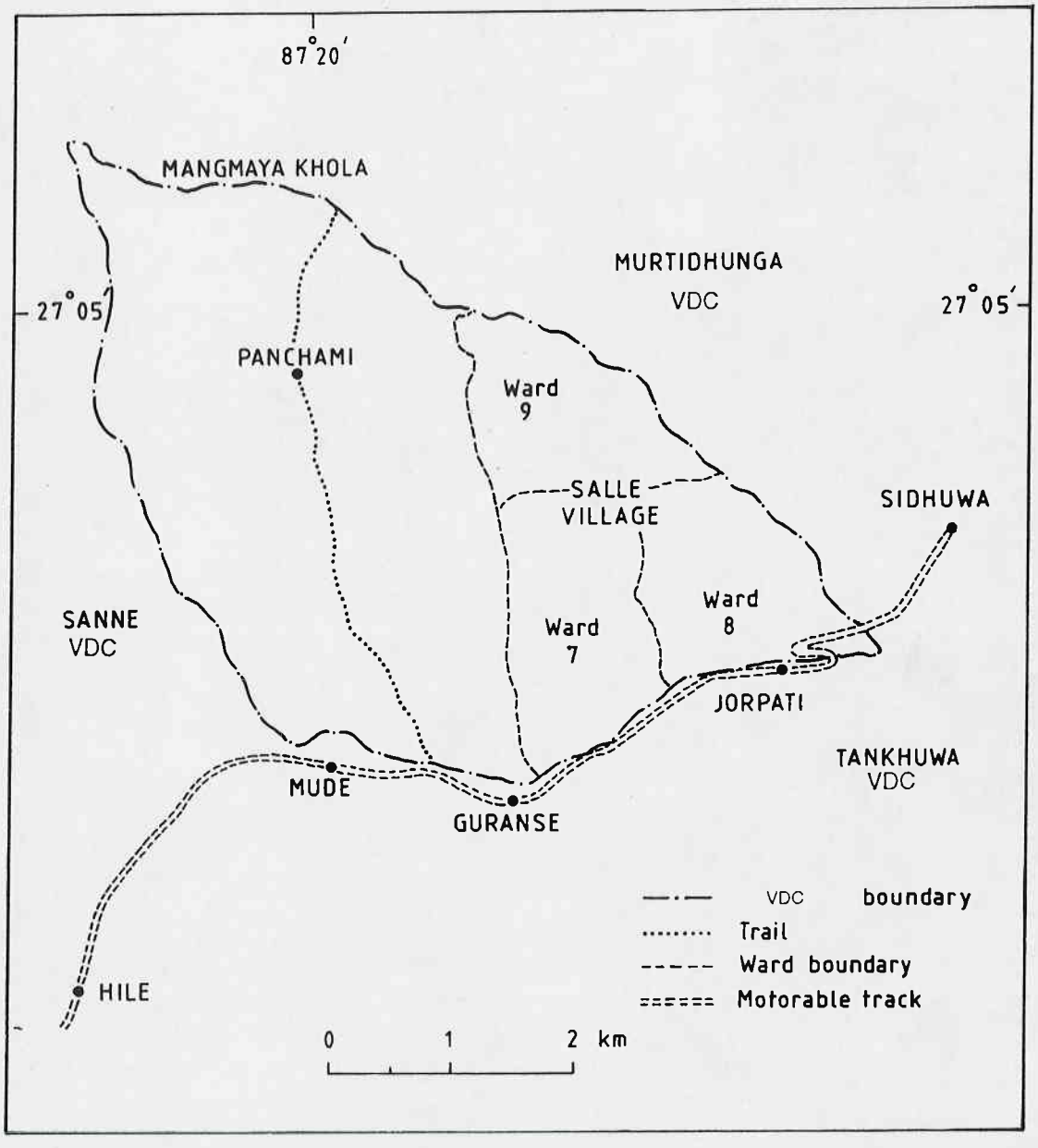


Figure 4 Map of Hattikharka Village Development Committee showing the study area
Source: Thapa *et al.*, 1990

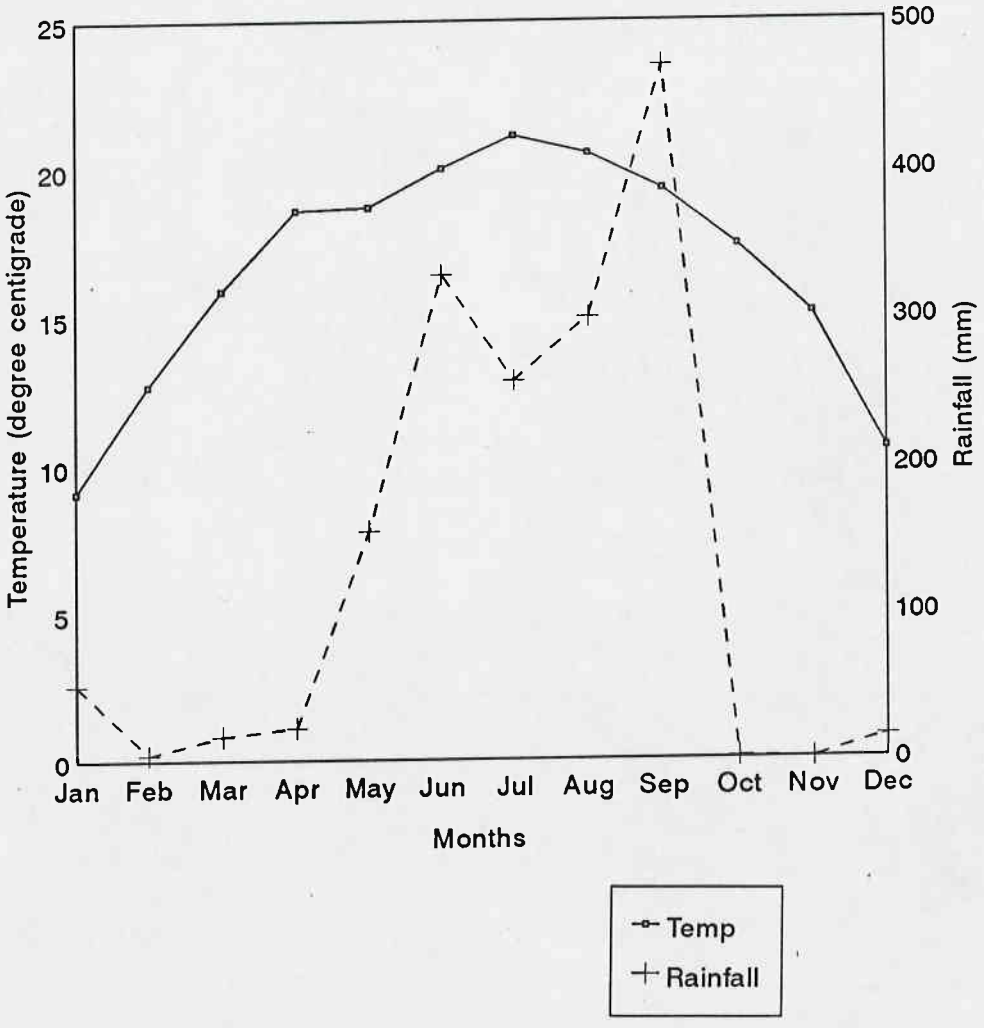


Figure 5 Average monthly temperature and rainfall pattern at Salle
Source: Data recorded at PAC (1992)

The soil in the area is acidic with high organic matter in the top layer. Most of the cultivated land is largely confined below 1800 m and above this there is an area of 30 ha of land stretching east-west which is locally known as *Nagi* (downs/ grassland) previously used for rough grazing. But now it is under private tree planting program and no more grazing system is practised. Some small private forests lie near to the residential areas.

3.1.2 Economic, demographic and social characteristics

The total population of Salle village (includes 7 and 8 wards) was 1332 comprising 226 households in 1990 (Thapa *et al.*, 1990). The total households in 1992 are 212. About 6 per cent of the households migrated to other villages or to the city area for employment during this period. The majority of the villagers are of Magar caste. The distribution of population by ethnic groups indicated 84 per cent Magar, 6 per cent Gurung, 4 per cent Chhetri, 3 per cent Brahmin and 3 per cent Damai. Magar dialect is widely spoken. However, the people generally speak the national language "Nepali".

Table 1 Farmers' categories according to socioeconomic status

Socioeconomic group	No. of HH surveyed	No. of respondents		Total respondents
		Male	Female	
Rich Magar/Gurung	9	6	8	14
Medium Magar/Gurung	48	30	32	62
Poor Magar/Gurung	31	15	27	42
Medium Brahmin/Chhetri	9	9	9	18
Poor Brahmin/Chhetri	6	5	4	9
Total	103	65	80	145

Source: PRA and RRA, 1992

A total of 103 households were sampled and 145 respondents were interviewed out of which 65 were male and 80 were female (Table 1). The household size varies in different socioeconomic groups showing larger household size in Magar, Gurung than in Brahmin, Chhetri. However, average size of household is 6 (Table 2). Household size is a direct indication of availability of household labor for various agroforestry and household activities.

The majority of households are male headed and only a few are female headed (6 per cent households) in this village. Female headed households are most typically with widow or wife of a migrant worker. Percent of such type of households in Salle is less than that found by McDougal (1979) in his survey of Chheskam, a village of Koshi hills. Among the respondents, the literacy rate is 26 per cent. However, there is an increasing trend for school attendance.

Table 2 Family size by socioeconomic group

Socioeconomic group	Total No. of HH#	Per cent	Av. HH size
Rich Magar/Gurung	9	4	7.3
Medium Magar/Gurung	96	47	7.2
Poor Magar/Gurung	86	42	6.2
Medium Brahmin/Chhetri	9	4	6.0
Poor Brahmin/Chhetri	6	3	5.7
Total	206	100	6.48*

Note: # and * indicate household and average household size irrespective of socioeconomic group.
Source: PRA, RRA and Survey, 1992

The livelihood of the village depends on agriculture. Magar, Gurung are prominent in terms of landholding, livestock holding, access to forest resources and directly to economic status (Table 3). However, they share a common mixed culture of Hindu and Buddhism and have a strong solidarity in different agricultural and social activities.

The village has access of two nearby markets; Sindhuwa and Hile. Despite this, the involvement of development institutions in the area is very negligible. There is a primary school , which is main source for disseminating information about local gathering, village meeting etc. The local *pandera* (spring) are the sources of drinking water in the village.

The rich and medium farm families are self sufficient or almost self sufficient in food requirements. To a large extent, poor farmers are food deficient up to six month a year.

Table 3 Land, tree and livestock holding by socioeconomic group

Socioeconomic group	Av. landholding (ha)	Av. no. of trees/HH (farmland)	Av. no. of livestock per HH*
Rich Magar/Gurung	4.39	112	15.6
Medium Magar/Gurung	2.85	111	8.9
Poor Magar/Gurung	1.71	44	4.9
Medium Brahmin/Chhetri	1.88	98	7.5
Poor Brahmin/Chhetri	1.16	45	6.5
Mean	2.39	82	8.7

Source: Survey, 1992

*HH indicates household.

3.1.3 Categorization of household

The households were categorized into five types on the basis of socioeconomic status through Wealth Ranking procedure (Table 2). Magar, Gurung are characterized by three economic groups rich, medium and poor with 4 per cent, 47 per cent and 42 per cent of the total population respectively where as Brahmin, Chhetri are categorized into only two medium and poor groups which consist of 4 per cent and 3 per cent population. The criteria for rich, medium and poor listed by farmers are as follows:

Rich

1. Food sufficient and some surplus.
2. Pensioners/ army services outside the country.
3. Enough land for cultivation and some rented out.
4. Own animals for meat, milk and draft purposes.

Medium

1. Food sufficient for 8 to 10 months only.
2. Service holders and/ or having outside sources of income.
3. Working elsewhere as the farm labor.
4. Keep animals for milk, meat and income.
5. Have just enough land for cultivation.

Poor

1. Food sufficient for 6 to 8 months from their own agricultural production.
2. Working as farm labor, porter and wage labor e.g. road construction.
3. A few number of animals (but only few have milch animals).

3.2 Land use patterns and farming system

3.2.1 Land use

The land use types in the Salle village includes *"Bari"* (non irrigated), *"Khet"* (irrigated paddy land), *"Nagi"* (grassland) and private forestlands. The farmers practise subsistence nature of agriculture in the fragmented small pieces of land. Almost all the households own upland and 52 per cent of the households own upland as well as paddy land. The access to *nagi*land and forestland is limited, with 21 per cent household owning *nagi*land and only 13 per cent households having private forest land (Table 4).

Average size of landholding is 2.39 ha, but the average farm size is 1.71 ha. This figure is higher than either the national average (0.4 ha) or the 0.5 ha reported by Conlin and Falk (1979) for the Koshi hills.

Table 4 Average size of landtypes owned by household (ha)

Socioeconomic group	Land types							
	IL[1]		RL[2]		NL[3]		FL[4]	
	Av. size	HH owning (%)	Av. size	HH owning (%)	Av. size	HH owning (%)	Av. size	HH owning (%)
Rich Magar/ Gurung	1.27	100	1.89	100	0.65	50	0.58	88
Medium Magar/Gurung	0.33	19	1.26	100	0.76	26	0.50	11
Poor Magar/ Gurung	0.17	3	0.84	100	0.40	16	0.30	2
Medium Brahmin/Chhetri	0.62	56	1.06	100	NA	11	0.20	56
Poor Brahmin/Chhetri	0.20	17	0.91	100	None	None	0.05	17
Mean	0.52	52	1.19	100	0.60	21	0.33	13

Note: 1: indicates Irrigated/ *Khet* land (mainly for rice)
2: indicates Rainfed/ *Bari* land
3: indicates *Nagi*land/ Grassland
4: indicates Private Forestland
Source: Survey, 1992

3.2.2 Cropping pattern

Dryland farming is widely practised in the study area. The cropping systems vary according to altitude. The major cropping patterns at the mid altitudes (1100 to 1700 msl) are potato intercropped with maize and soyabean intercropped with maize. Other minor patterns are maize/ millet- fallow and maize - wheat. At

low altitudes (< 1100 msl), the dominant patterns are rice- rice- fallow, maize- rice- fallow and rice- wheat- fallow. The general patterns of cropping over the season by land type and altitude are presented in Figure 6.

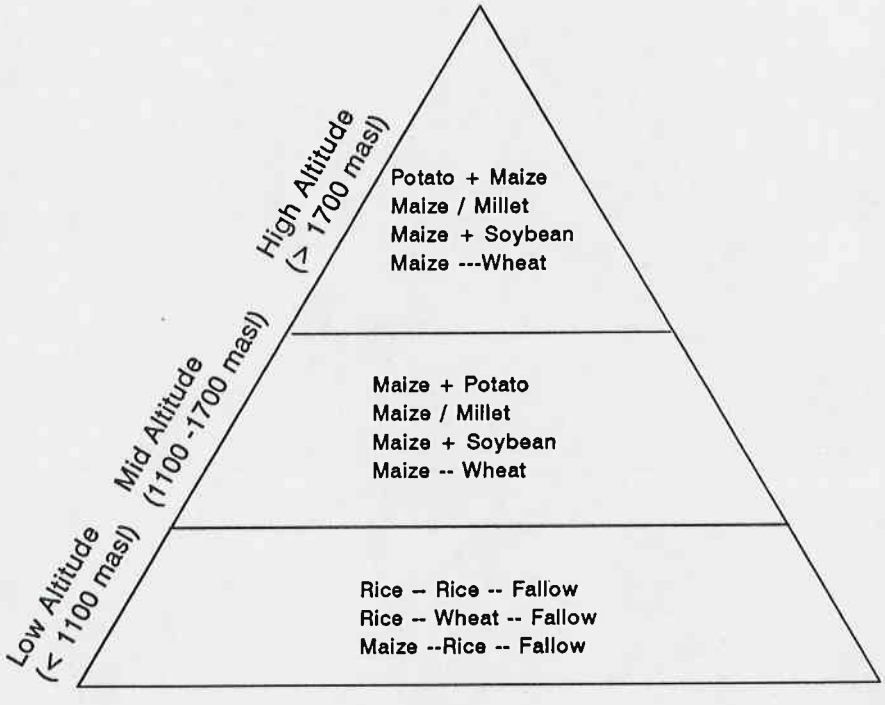


Figure 6 Cropping pattern by altitude in Salle village
Source: Survey, 1992

Lower cropping intensity may be attributed to longer growing periods for crops due to prevalence of relatively lower temperature and problems of frost and snowfall in winter in mid and high altitude areas.

3.2.3 Animal raising and tree management

Livestock enterprises are highly diversified with predominance of buffaloes and pigs. Currently, all households rely mainly on stall feeding with grazing on fallow *bari*land during winter. The total number of livestock has decreased over time because of increased scarcity of livestock feed that resulted from restriction of grazing in *nagi*land (grassland) after tree plantation.

Only few farmers have large area of land, so that almost all face problem of inadequate forest and grazingland. The grassland which was previously need for grazing is now become private land. Grazing in that area is prohibited. A large number of fodder and fuelwood trees per farm are observed because of poor proximity and access to natural forests.

3.2.4 Off farm activities

The seasonal labor, portering, wage labor on road construction and army service are the main sources of off farm income (Table 5). Besides, selling of agricultural products and also small stocks (pig, poultry, goats etc.) are major sources of income for the farmers. The wages from agricultural labor and portering are the main source of income for poor farmers whereas for rich and medium farmers, the important source is remittances (army and police pension). According to Conlin and Falk (1979), the contribution of portering to annual cash income works

out to 35 per cent per family, however, it differs depending on land holding and economic status.

Table 5 Sources of income

Sources		Per cent of households	Rank
1.	Sale of agricultural products and livestock	70	1
2.	Daily wage labor	38	2
3.	Family member in service or army/ pension	24	5
4.	Portering	19	4
5.	Seasonal labor	30	3

Source: Survey, 1992

The income earned from off farm activities are used for different purposes depending upon the type of farmers and family needs. Poor farmers spent off- farm income primarily on food whereas rich farmers would use it for clothing, schooling of children and for farm investments. Sale of livestocks e.g. buffaloes, cows, goats, sheep, pigs etc. is also a major source of cash income and an important reason for fluctuation in the livestock number. However, sale of livestock products for cash is not a major activity in Salle. Only, 29 per cent responded that they sold livestock products and these were usually in smaller quantities (Campbell *et al.*, 1990). From the Table 5, it is noted that most of the households get higher income from sale of agricultural products and livestock. It is follwed by daily wage labor, seasonal labor, portering and remittances.

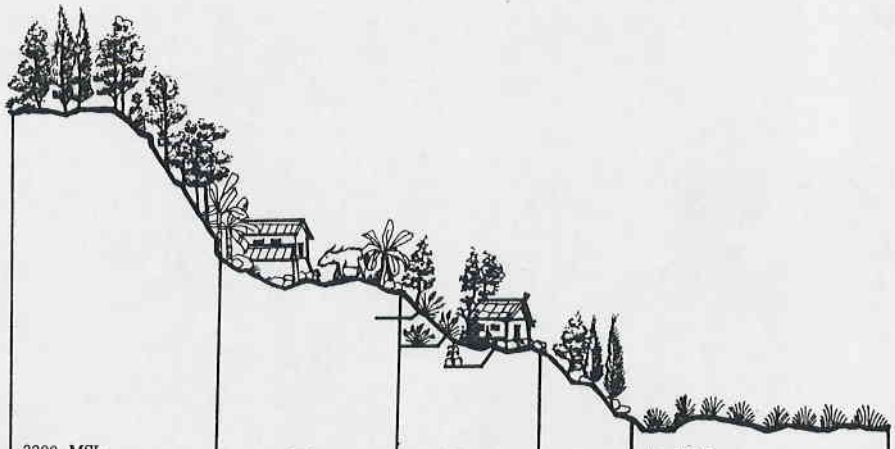
CHAPTER IV

AGROFORESTRY SYSTEMS AND THE ROLE OF GENDER IN THE STUDY AREA

From the knowledge of socio-economic and demographic profile presented in the previous chapter, one can see that Salle area is endowed with the diversified social strata of different ethnic group where Magar is the dominant. Like in other parts of mid hills of Nepal, Salle also comprises of distinct components of the agroforestry systems. The transect of the village (Figure 7) shows different components of agroforestry system and their locations.

4.1 Agroforestry systems

The definition of agroforestry i.e., intentional manipulation of land unit to satisfy subsistence needs for food, fodder, fuelwood, timber and soil protection through the practice of cultivating crops and trees is applicable also to the eastern hills situation of Nepal. In the Salle village of eastern hills, agroforestry system has evolved over a much longer time historically where most commonly encountered agroforestry system is combination of annual crops and multipurpose trees, or in other words, it is the crop/ tree/ livestock mix typically found around homesteads.



ALTITUDE	2200 MSL	—	—	—	450 MSL
LAND TYPE	NAGI LAND (Tree plantation area and grass land)	UPLAND (Homestead Area)	UPLAND (Bari land)	PRIVATE FOREST	LOW LAND (Irrigated field)
CROPS	—	Vegetables, (Kitchen garden)	Maize Potato Millet Soybean Wheat	—	Rice Wheat Maize
CROPPING PATTERNS	—	—	Potato+Maize Maize/Millet Maize+Soybean Maize-Wheat	—	Rice-Rice-Fallow Rice-Wheat-Fallow Maize-Rice-Fallow
LIVESTOCK	—	Ox Cows Buffaloes Sheep Goats Pigs Poultry	—	—	—
TREES	Salla Utis Nevaro Masala Falant	—	Nevaro, Bains Dudhilo, , Dhupi Gogan, Bans Painyu, Khanyu, Ghurmiso Utis	Nevaro Dudhilo Utish Khanyu, Ghurmiso	—
ACCESS AND CONTROL BY GENDER	Access by both Control by male	—	Access and Control by both	Access by both, control by male	Access by both Control by male

Figure 7 Transect of the Salle village
Source: PRA, RRA and Survey, 1992

4.1.1 Components of agroforestry systems

The main components of agroforestry systems can be categorized as crop, tree and livestock relating directly with the farm household. Agroforestry systems comprise of some cereal crops in a complex interaction with tree species like *Nevaro, Duhilo, Utis* etc. These trees are normally grown on the marginal lands, on terrace risers and are also essential components of livestock subsystem in the village.

1) Crop Production

The main field crops grown on the *bariland* are potato, maize and other minor crops are soybean, millet, wheat etc. (Figure 8). Small areas of a limited range of fruit and vegetables are grown around homesteads. A small area of rice is also grown on irrigated lowland fields. Maize and potatoes are staple food crops. Potato and millet are major cash crops. Findings show that the ethnicity and economic status of the farmer has no relation in the selection of these crops. Even though 52 per cent of the households own paddy land, the average size is only 0.52 ha. Thus, paddy land represents a small portion of the land which is generally kept free of trees.

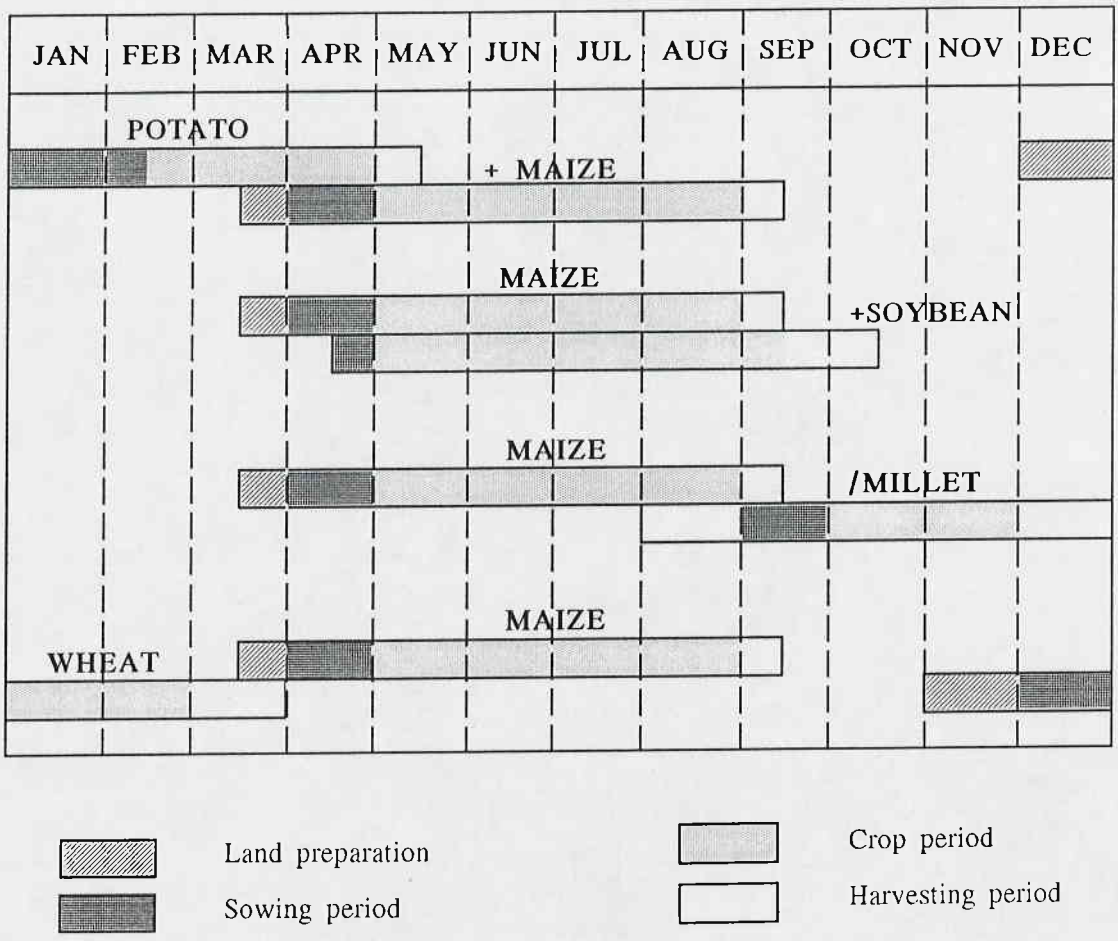


Figure 8 Cropping calendar (on *Bari*land)
Source: PRA and RRA, 1992

2) Animal production

Almost every household maintains a range of animals, namely cow, buffalo, sheep, goat, pig and poultry. The average number of which was found as 1.6 cows, 3 she-buffaloes, 1 he-buffalo, 0.2 sheep, 1.9 goats, 1.2 pigs and 16.9 chickens (Table 6). Almost all farmers raise chickens, whereas only 4 per cent farmers own sheep. Similarly, cows, buffaloes and pigs are reared by 57, 95 and 92 per cent farmers respectively.

Different ethnic group have different priority for each species of animal. Brahmin and Chhetri give priority to buffaloes, cows and goats. Traditionally, they do not keep pigs and poultry but some farmers are now beginning to do so as they realize the economic benefits of pigs and chickens. In the other hand, Magar and Gurung are culturally allowed to rear any species. However, they are dependent on pigs and poultry for ritual purposes.

Cows and buffaloes are the most prevalent and economically important livestock and they bear close relationship with the prevailing resource and agricultural features in the village. They are raised as sources of earning and saving and also for manure and draught power. The seasonal feeding patterns for the livestock production depends in general on five major food sources: fodder from farmland and private forestland, fodder and grasses from *nagi*land, crop residues, field crop areas and rice fields. Livestock subsystem is regarded as secondary in priority to crop production despite a comparable economic return and income generation from this subsystem. The animals are always underfed and their feeding type is confined to stall feeding system. There is no more communal grazing land after the *nagi*land has covered with tree plantation.

Table 6 Livestock ownership pattern

Livestock type	Av. holding	Per cent of farmers owning	Uses
Cows	1.6	57	manure, milk, religious need
Oxen	0.8	40	draught and manure
She-buffaloes	3.0	95	milk, manure
He-buffaloes	1.0	85	draught, manure, meat
Sheep	0.2	4	wool, meat, manure
Goats	1.9	42	meat, manure
Pigs	1.2	92	meat, manure
Chickens	16.9	100	meat, eggs, manure

Source: Survey, 1992

3) Tree growing

Studies in the hill region of Nepal, have shown that a household own an average of 28 trees (Foley and Barnard, 1984) on the farmland, however, its exceptionally high (82) in case of Salle village. But, poor farmers have half of this number (Table 3). An average number of trees available to the households on *nagi*land and private forestland are 1232 and 244 respectively (Table 7). In addition, there is an average 31 tree seedlings under cultivation. Most of these trees are grown by natural seeding or transplanted by farmers from other parts of their land or from the nursery.

Almost all households have *Utis (Alnus nepalensis), Gogan (Saurauia napaulensis), Dudhilo (Ficus nerifolia)* and *Painyu (Prunus cerasoides)*

on their farmland and average number of these trees are 300, 27, 24 and 11 respectively (Table 46). *Utis* is the most common tree for fuelwood and timber but the farmer is not satisfied by quality of timber produced by *Utis*. *Gogan, Nevaro, Dudhilo, Painyu and Bans* are main tree fodder for livestock feed.

New tree planting is generally done on the *nagi*land and cultivated farmland. Mainly fodder trees are planted on cultivated farmland. Rusten (1989) showed that in hills of Nepal, an average of 54 per cent of all trees grown on privateland are potential sources of animal fodder, and 33 per cent are primarily cultivated to supply animal fodder. Tamang (1990) has described the increasing number of trees on private land will transfer the pressure of demand for forest products (fuel, fodder, timber) as an alternative source. The main sites for planting are along the terrace edge, banks, around house and cattle shed and along gullies and streambanks. A few farmers also have underplanted fodder trees in previously established *Utis* blocks and in combination with cardamom plantations. It is interesting that 90 per cent of farmers plan to sell trees for cash in the future. This suggests that access to markets and existence of road network has to some degree influenced tree planting activities in the area.

Table 7 Average number of trees available on *nagi*land/ forestland to the farmers of different ethnic group

Ethnic group	Hectare/ HH*		Average number of trees/ HH	
	*Nagi*land	Forestland	*Nagi*land	Forestland
Brahmin/Chhetri	NR	0.13	NR	58
Magar/Gurung	0.60	0.49	1232	430
Mean	0.60	0.31	1232	244

Note: * and NR indicate household and No response respectively.
Source: Survey, 1992

Decreasing of fodder trees in forest and marginal areas increase the pressure towards the private land. At the same time, the qualities and quantities of private fodder trees is decreasing due to the heavy lopping. Therefore, planting of multipurpose tree species in and around the farmland is realized to be crucial for sustaining the hill farming system.

4.1.2 Inter-relationships existing among components of agroforestry systems

For the purpose of analyzing the interrelationships, the components of agroforestry system have been identified as crops, livestock, trees, pasture and farming household (Figures 9 and 10). There exists a complementary relationships between crops and livestock and also between livestock and tree.

Crops provide feed and sometimes bedding materials as well to livestock and in return, receive draft power and manure from livestock. The range of manure application rates in the sample is 6- 30 tones/ ha with an average of 9 tones/ ha. This is very low compared to average of 31 tones/ ha FYM (Farm Yard Manure) applied to potato in the maize/ potato system, calculated from field measurement by Gurung and Neupane (1992). Conlin and Falk (1979) noted that smaller farms use higher application rates.

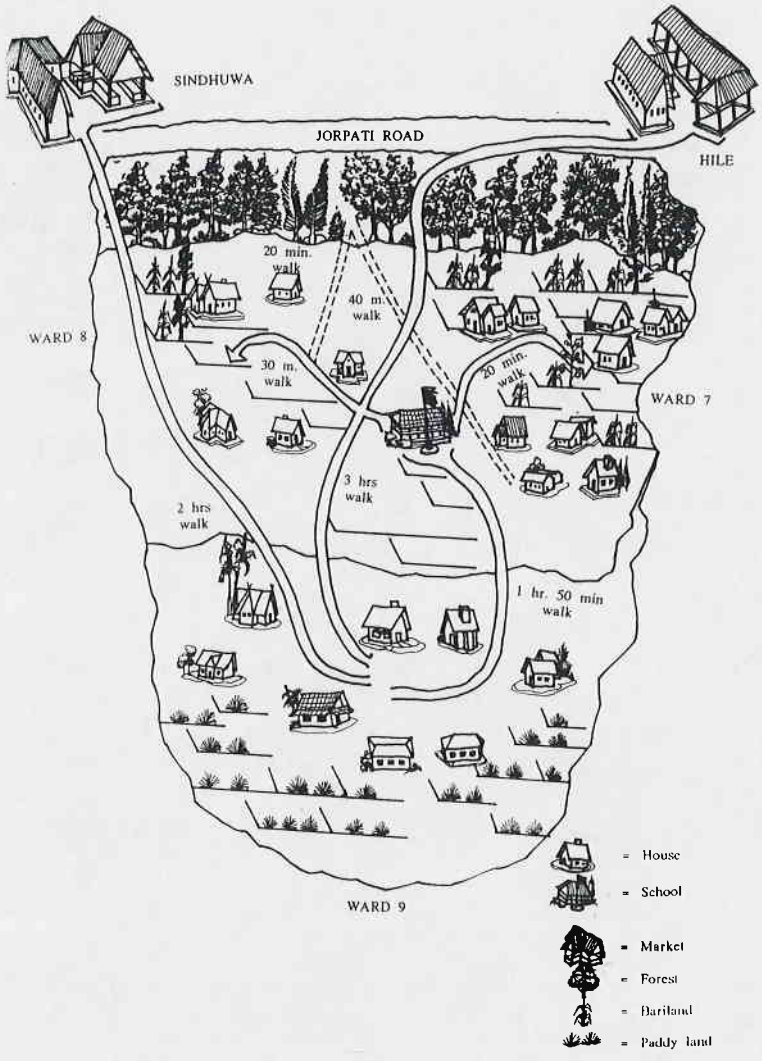


Figure 9 Location of different components of agroforestry system
Source: PRA and RRA, 1992

Manure is also expressed as an important product of all ruminants by respondents in a survey on the benefits of animal keeping in the Koshi hills (Gatenby *et al.,* 1990) and this is true for the case of Salle village too. Higher production levels of manure by buffalo and cow compared to other ruminants by respondents in a survey are indicated by Campbell *et al.,* (1990). Even though pig manure is assessed as best in terms of increasing crop production, the preference of farmer is on the quantity but not the quality of manure produced.

Livestock feed supplied by crops, mostly consists of roughage such as crop by-products (straw and stover) and some concentrates such as cereal grains, maize. The crop by-product (mainly rice straw) is used as livestock feed due to reduction in feed supply from nonfarm sources, particularly forests and pastures. Regarding livestock feed from crop by products, 80, 90, 50, and 10 per cent of total by-product are used as fodder in case of maize, millet, rice and wheat respectively (Pandey, 1982).

The contribution of oxen and he-buffalo to farming, especially in providing the draft power, is enormous. Roughly, 75 per cent of the cultivated land is ploughed by these animals, and 90 per cent of the work is done by pair of oxen (*ek hall goru*). Campbell *et al.,* (1990) reported that only 52 per cent of farmers have a pair of working oxen. However, those not owning any stated that timely unavailability of those oxen was a constraint to crop production, although a loan system operates for using other farmers' oxen.

Trees on farmland directly influence crop production by supplying compost materials, in addition, trees plantation on grassland (*nagi*land) that located on upper slopes, provide protection to cropland against landslides and erosion. Forest is the principle source of fallen, dry leaf litter and lopped green foliage of trees and herbaceous species which are used for animal feed, bedding and composting. Forest biomass when mixed with animal excreta, yields organic compost manure which forms the principal source of soil nutrients for hill agricultural land. It is worth noting that crop- forestry linkages are one way at all the sites i.e., only crops benefitting from the forests and not vice versa (Yadav, 1990). Khadka *et al.*, (1984) have estimated that about 50 per cent of litter production is removed annually from the same forests in Nepalese midhills. This seriously interrupts nutrient cycling within the forest.

In general, forest and pasture are more closely linked with livestock than with any other component. In the hills, the number of livestock kept per household is mainly determined by the available forests. More land holding group has strong relationship between fodder trees and large/ small animal holding (Chapter III). This relationship seems weak in case of poor Magar/ Gurung, medium Brahmin/ Chhetri and poor Brahmin/ Chhetri group. Their grazing management might be therefore, more related to the forestry component, rather than indigenous fodder trees planted on farmland. The quantity of feed supplied by forests is not only determined by the area of available forest lands but also by the availability of fodder trees in the forest; as the green grasses and tree fodder from forests are usually collected and stall fed to livestock. But as the farm animals are prohibited

in grazing, there is no provision of manure to forest. Fodder is required for domestic animals. A large animal consume about 2 metric tons of fodder annually. The animals obtain an estimated 35 per cent of their feed from trees (Pandey, 1982).

The linkages of three production sectors (e.g. crop, tree and livestock) with the household sector is the main actor as it plays a key role in overall operation of the agroforestry system (Figure 10). To seek and sustain the contribution of three sectors, the household sector has to manage activities through labor and other inputs.

The households obtain food, fuel and cash from crop, livestock and tree components of agroforestry system. Leutel (1991) in his study indicated that in middle hills of Nepal, the amount of firewood consumption for a household is 581 kg per year. It is generally mentioned that farming households maintain two-way direct linkages with crops and livestock but their direct linkages with trees/ forests are rather one way (Yadav, 1990).

However, in Salle village, direct linkages of households with trees tend to be two ways as the farmers are much interested in tree plantation on their *nagi*land privatized later. For the protection of trees, they have made rules and regulations which required each to be watchman for one day on rotational basis. And they have comparatively more trees on their farmland too.

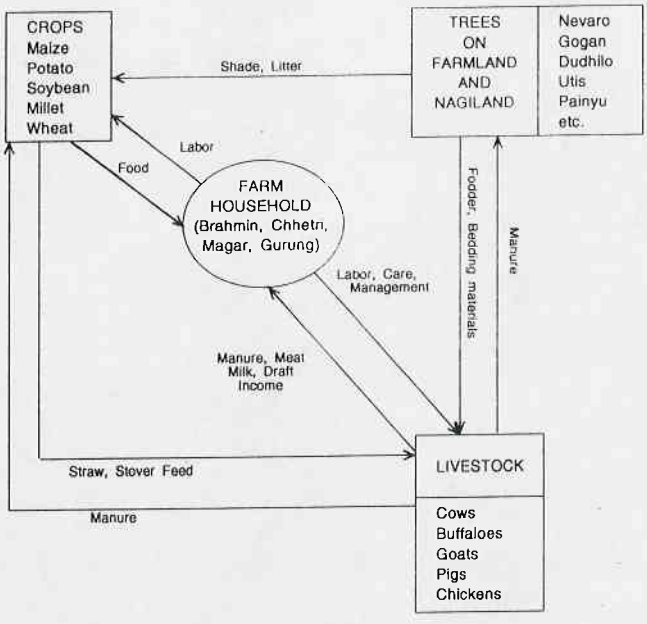


Figure 10 Components of agroforestry system and their inter-relationships
Source: PRA, RRA and Survey, 1992

The farm, tree and livestock linkages is thus strong in Salle village as there are only few interventions from market forces with negligible transformation in agriculture. But in order to cope with decreasing availability of trees/ forest, the farmers change their farming practices by reducing size of livestock holdings, changing in herd composition, increasing stall feeding practices and increasing use of crop by products for livestock feed, that also helped reduce dependency on forest resources. However, these type of activities are directly related to the household labor dynamics. For some of the items such as stall feeding and making use of crop by-products required more labor for livestock management. Likewise, due to reduction in livestock number, a certain part of the labor force are found to change to other alternative activities.

1) Interaction among crop, tree and livestock components

When a question regarding the tree and crop interaction was posed to the farmers, they responded that there were many effects caused by trees either positive or negative, or a combination of both. Among those, 46 per cent of farmers replied that the tree influenced crops on both ways: positive and negative. However, 31 per cent replied that tree had positive effects. The other 18 per cent reported negative effects of trees on crops (Table 8).

Table 8 The tree and crop interaction

Tree and crop interaction (positive, negative or both)	Farmers' Response	
	No. of respondent	Per cent
Positive effect	45	31
Negative effect	26	18
Both (positive & negative)	66	46
No idea	8	5
Total	145	100

n = 145

Source: Survey, 1992

a) Positive impact of tree and crop interaction

The rural farmers have realized positive impact (advantages) of farm tree growing practices (Table 9). The main advantage is primarily based on fodder production (Leutel, 1991). Twenty nine per cent of farmers responded that as fodder is available nearby house from farmland, they can cut whenever needed

for feeding livestock and 14 per cent respondents indicated saving in time of fodder collection because of their accessibility, namely, nearer to their house and can be cut at any time.

Table 9 Advantages of tree growing on the private land

Advantages (identified by farmers)	Farmers' Response	
	No. of respondent	Per cent
Soil[1]	5	11
Land[2]	1	2
Fodder[3]	2	4
Time[4]	13	29
Soil & Land	4	9
Soil & Fodder	4	9
Soil & Time	4	9
Land & Fodder	4	9
Land & Time	2	4
Fodder & Time	6	14
Total	45	100

n = 45

Note: 1 = Increase organic matter and soil productivity.
2 = Land conservation
3 = Less time for fodder collection
4 = Can be cut at any time

Source: Survey, 1992

The other advantages like increase in organic matter and land productivity and soil conservation are also realized by the sampled farmers. Fonzen and Oberholzer (1984) stated that the farmers of mid hills of Nepal were very aware and appreciative of positive interaction effects of the woody perennial strips so that they reconcile to the negative interaction effects over crops.

b) Negative effects of farm trees to field crops

The most realized negative effect of the tree to the field crops are shading effect, difficulty in agricultural operations like hoeing, weeding, harrowing, etc. and low yield of crops due to space and nutrient competition (Table 10). Random plantation of trees on the edge of cropping terrace with approximate distance between trees are shown in Figure 11, from which the spacing between crops and trees could also be clear. Fonzen and Oberholzer (1984) also mentioned some of the negative interactions of crops and trees such as shading effect of woody perennial at around the cultivated land, consequently lower yields of crops near the trees, damage to young crops by dripping of large drops of rain from the over storey trees.

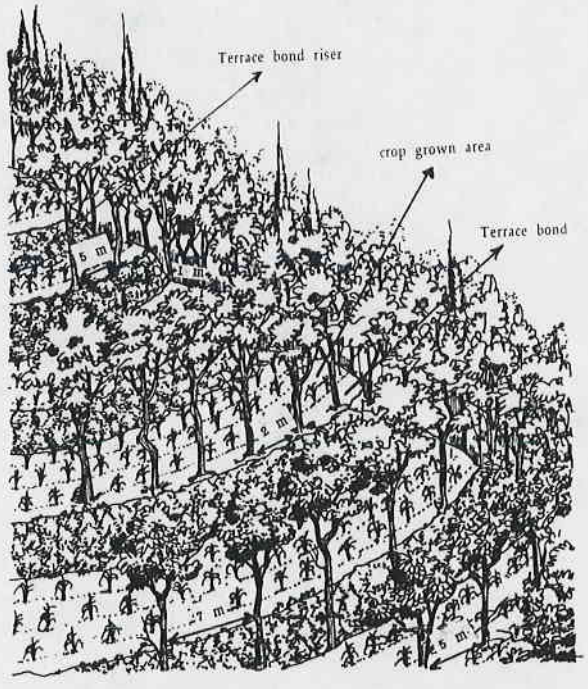


Figure 11 Random plantation of trees on terrace bond, bond riser with approximate distance between trees
Source: PRA and RRA, 1991

Table 10 The negative effects of tree species to field crops

Disadvantages (identified by farmers)	Farmers' Response	
	No. of respondent	Per cent
Shading effect	13	50
Difficulty in agricultural works	2	8
Shading effect & low yield of crops	7	27
Shading effect & difficulty in agricultural works	4	15
Total	26	100

n = 26

Source: Survey, 1992

The underlying principle in judging crop and tree interaction is based on the crop yield. The RRA (Rapid Rural Appraisal) and PRA (Participatory Rural Appraisal) results revealed farmers' views on this aspect. *Nevaro* and *Utis* are regarded as preferred tree species for agroforestry. Paddy is indicated to be badly affected by tree shade. Trees are as resting place for many birds during day and night causing damage to maize crops. Millet and soybean are also adversely affected through shading effect of companion trees. However, the importance of tree species to the maintenance of livestock components can easily trade off this disadvantage. Fonzen and Oberholzer (1984) also indicated same observation from farmers of western region of Nepal. Livestock is an inseparable component and there is an acute need of tree species around farmland to secure the subsistence of livestock system. Moreover, farmers can minimize the shading effect by adopting a traditional indigenous knowledge of tree management practices by cutting twigs and branches at appropriate time of the year, planting of trees on bunds of terraces to reduce shading effect and maintaining wide spacing of trees (Table 11).

Table 11 Farm tree management

Tree management strategies	Farmers' response	
	No. of respondent	Per cent
Tree[1]	53	38
Bund[2]	23	16
Space[3]	11	9
Tree & Bund	20	14
Tree & Space	19	13
Bund & Space	14	10
Total	145	100

n = 145

Description of strategies
1 = By trimming trees
2 = Planting of trees on bunds of terraces to reduce shading effect
3 = Maintaining wide spacing of trees
Source: Survey, 1992

4.1.3 Importance of tree and its preference

Tree fodder is a primary constituent of all animal feed used. Animal productivity can be improved or sustained by increasing the number of fodder trees (Pandey ,1982). The percentage of tree fodder to total fodder consumed exhibits considerable seasonal, geographic and environmental variation. It is estimated that on an average annually over 50 per cent of all fodder is acquired from tree fodder sources (Pandey, 1982). Other estimates are: 30 per cent (Fonzen and Oberholzer, 1984); 35 per cent (Brewbaker, 1983); and 87 per cent (Singh *et al.*, 1984). Private trees contribute, on average, one fifth of tree fodder demand and in some areas, 50 per cent or more of tree fodder comes from private trees (Wyatt-Smith, 1982 and Mahat, 1985). Fox (1983) determined that in middle hill

community, an annual average 13 per cent of total fodder demand is met from tree fodder resources, with 72 per cent of this demand being met from private trees.

Number of tree plantation on different types of land has been presented in Table 12. It is clear from the table that *nagi*land comprises more trees in terms of number. This statement is true for Magar, Gurung ethnic group. In case of Brahmin/ Chhetri, as they do not own *nagi*land, concentration of tree plantation is more on farmland. Accessible forest land is also more in rich Magar/ Gurung followed by medium Magar/ Gurung and least to the medium Brahmin/ Chhetri.

Table 12 Average tree available per household on various types of land.

Socioeconomic group	Farmland	*Nagi*land	Forestland
Rich Magar/Gurung (E1R)	112	2834	657
Medium Magar/Gurung (E1M)	111	588	203
Poor Magar/Gurung (E1P)	44	273	NR
Medium Brahmin/Chhetri (E2M)	98	NR	55
Poor Brahmin/Chhetri (E2P)	45	None	60
Mean	82	1232	244

Note: NR indicates no response.
Source: Survey, 1992

1) Status of tree plantation

Nevaro, Dudhilo, Gogan are dominant trees existing on farmland. This case is true for all types of socioeconomic strata. Besides, *Utis,*

Painyu and Khanyu are equally available to all other except rich Magar, Gurung (Table 13). In case of *nagi*land, *Salla* and *Utis* are predominated to all group owning *nagi.* However, *Masala, Falant and Nevaro* are also existing to rich and medium Magar, Gurung.

Forest land, on the other hand, comprises *Utis* as a dominating tree species. Several other local bushes and shrubs are also prevailing in the forest. The characteristics of tree species are described below.

Utis (*Alnus nepalensis*):

This tree is widely distributed at elevations above 900 msl (metre above sea level). It is liable to damage by browsing animals when young, but seedlings over 50 cm high are relatively immune (Jackson, 1987). It is not a very good fuel from the point of view of kilojoules per cubic metre, though this is compensated for by its high volume increment. It dries rapidly and burns easily. It is not considered to be among the best timbers for construction, but is widely used of this purpose because of the scarcity of better timbers. Despite the shortcomings, it is widely planted mainly because of its rapid growth, good form and the relative ease by which it can be established. It is a useful species for planting in ravines and other small areas near farms where crops cannot be grown. The leaves are used as fodder for sheep and goats.

Nevaro (*Ficus roxburghii*):

It is a medium sized tree which is widely used for fodder. It grows up to about 2000 msl. The leaves are used for fodder during December and March, and again after the flush of new leaves in April, May and June. One vigorous tree will produce 60- 80 kg of fresh leaves each year. It is evergreen tree. It causes dysphagia in case of ruminants (Pandey, 1982).

Dudhilo (*Ficus nerifolia*):

This tree species occurs between 900 msl and 2200 msl. It is a small deciduous tree. It is widely used fodder tree, and popular among farmers. The trees are lopped for fodder from January to February and again from May to June after the flush of new leaves has appeared.

Gogan (*Saurauia napaulensis*):

It is a small tree fairly tolerant to shade and occurs between 750 and 2100 msl. It is mainly valued for its fodder. The trees are lopped from December to early March. The large leaves are used for plates. Despite its being one of the most valued fodder trees, it has only so far been raised on a relatively small scale, perhaps because it has a very small seed and needs quite a lot of care in the nursery.

Ghurmiso (*Leucosceptrum canum*):

This shrub or small tree is said to be good fodder for sheep and goats, some people say that larger animals can also use it. This tree has also been used for roadside slope protection.

Table 13 Dominating tree species grown on various types of land

Socioeconomic group	Farmland	*Nagi*land	Forestland
Rich Magar/Gurung (E1R)	*Nevaro* *Dudhilo* *& Gogan*	*Salla* *Utis* *& Masala*	*Nevaro* *Dudhilo* *Utis* *Painyu* *Khanyu &* *Ghurmiso*
Medium Magar/Gurung (E1M)	*Nevaro* *Painyu* *Dudhilo* *Gogan* *Utis* *Khanyu* *& Ghurmiso*	*Nevaro* *Falant* *Salla* *Utis* *& Masala*	*Utis*
Poor Magar/Gurung (E1P)	*Nevaro* *Painyu* *Dudhilo* *Gogan* *Bains* *Dhupi* *Utis* *& Khanyu*	*Utis* *& Salla*	-
Medium Brahmin/Chhetri (E2M)	*Nevaro* *Painyu* *Dudhilo* *Gogan* *Bains* *Utis* *Khanyu* *& Bans*	-	*Utis*
Poor Brahmin/Chhetri (E2P)	*Nevaro* *Dudhilo* *Gogan* *Utis* *Painyu* *Bains* *& Khanyu*	-	*Utis*

Source: Survey, 1992

Painyu (*Prunus cerasoides*) (Wild cherry):

It is a medium sized fodder tree occurring from 1300 to 2400 msl. According to Pandey (1982), it is used almost exclusively as fodder for sheep and goats, not cattle, and causes urinary problems and reduced milk yields. The flush of new leaves begins in November or December after flowering, but the trees are lopped in June and July when they are mature and have been washed by rain. According to Pandey (1982), one tree will yield 80 - 120 kg of fresh fodder per year. It has also been planted as an avenue tree. Ill effects of this species on ruminants are urinal problems and milk yield decrease.

Khanyu (*Ficus cunia*):

This species occurs from the terai to 1700 msl. It is a small to medium tree which is deciduous for a short time in the year. It is a light demander and is said to have some tolerance to frost. It is one of the first species to regenerate naturally on eroded sites. It is a useful fodder tree, though not among the most highly regarded. The leaves are lopped from January to April. Yields of fodder are rather low.

Katus (*Castanopsis hystrix*):

This species grows between 1000 msl and 2500 msl. It is a good timber for house buildings, the leaves are used for fodder and nuts are edible. It is excellent for firewood but has slow growth and good reseeding characteristics. It is excellent for fuelwood but has slow growth and good reseeding characteristics.

Okhar (*Juglans regia*):

It is a large deciduous and light demanding tree occurring from 1200 msl to 2500 msl. It is used for firewood and timber purpose and nuts are edible.

Salla (*Pinus wallichiana*):

It is very characteristic of abandoned fields and grazing land. The timber is of better quality and durable and where the tree is plentiful it is widely used for house building. Where it occurs naturally it is highly valued as a firewood. It is regarded as an important species for afforestation at higher altitudes, because it is more cold resistant and produces a better timber.

Falant (*Quercus glauca*) (White Oak):

It is a large evergreen tree over 30 m. Its natural occurrence indicates that it should only be planted in localities with a high annual rainfall. The wood is hard and durable. It is a good firewood and the leaves are a valued fodder. The wood from this is also used to make plows.

Bains (*Salix babylonica*) (Willow):

It is a deciduous tree, used for fodder and also for basket making.

Bans (*Bambusa sp.*) (Bamboo):

It is evergreen tree. All ruminants can be fed on this fodder species, whereas it is used most exclusively as feed for sheep and goats. The mature bamboo

clumps produce new shoots every year throughout rainy season and growth take place rapidly. Bamboo is traditionally propagated by vegetative means (sucker) throughout the middle hills.

Dhupi (*Juniperus spp.*):

It often occurs as prostrate shrub especially at higher altitudes and in dry places. The wood is an excellent fuel and will burn when still green. The timber is of high quality being aromatic, easy to work and very durable. Although it is important source of fuel, its very slow growth reduces its value as plantation species.

2) Tree preference category

In order to understand the preferential category among the available tree species, PRA (Participatory Rural Appraisal) was conducted in the village. Participants were male and female from different social strata of the village, and PRA was done differently among the male group as well as female group. Tree preference by male and female farmers was determined through matrix scoring.

It is found that male group prefer *Bans* the best one considering overall advantage for nutrition, durability, tolerant to pest and diseases and palatability to livestock (Table 14). It is followed by *Khanyu, Nevaro* and *Dudhilo* with the criteria for high milk production in addition to durability and

palatability to livestock. Therefore, their selection criteria of the fodder is found exclusively related to livestock need and preferences as well as durability.

Table 14 Tree preference by male farmers through matrix scoring

Fodder criteria	Ne	Kh	Go	Du	Pa	Gh	Ba	B
Effect on milk production (farmers' experience)	8	7	2	6	1	3	4	5
Tolerant to pest/disease	1	2	7	6	5	4	3	8
Nutritious	7	6	4	3	1	5	2	8
Prevent shading effect on crop	3	7	4	6	5	1	2	8
Long duration	7	5	4	6	1	3	1	8
Tolerant to snow/hailstone	1	2	5	7	8	6	3	4
Available during dry season	4	3	8	2	6	1	7	5
Fast growing	7	8	5	1	4	2	3	6
High palatability	6	5	4	7	1	2	3	8
Total score	44	45	43	44	32	27	28	60

Note: Score is based on increasing order from 1 to 8.
1 = least preferred & 8= most preferred.
Kh : *Ficus semicordata* *(Khanyu)*
Pa : *Prunus cerasoides* *(Painyu)*
Du : *Ficus nerifolia* *(Dudhilo)*
Ne : *Ficus roxburghii* *(Nevaro)*
Go : *Saurauia napaulensis* *(Gogan)*
Gh : *Leucosceptrum canum* *(Ghurmiso)*
Ba : *Salix sp* *(Bains)*
B : *Bambusa sp* *(Bans)*
Source: PRA, 1992

Almost similar to male group, female group preferred more for *Nevaro, Khanyu and Gogan* (Table 15). But their criteria of selecting tree species were high productivity, palatability and nutritious, related to the livestock component. Besides, interestingly, their preference of trees showed to be related with some household

activities for e.g., preference of *Nevaro, Gogan and Katheber* necessary to make local leaves plate.

Table 15 Tree preference by female farmers through matrix scoring

Fodder criteria	Kh	Pa	Du	Ne	Kb	Go	Gh
Household use of leaves	-	-	-	7	5	6	-
High productivity	6	1	4	7	3	5	2
High palatability	6	1	5	7	4	3	2
Available during dry season	5	-	-	6	3	4	7
Nutritious	6	1	4	7	3	5	2
Trees tolerant to pests/diseases	5	4	4	7	3	1	2
Total score	28	7	17	41	21	24	15

Note: Score is based on increasing order from 1 to 7.
1 = least preferred & 7 = most preferred
Kh : *Ficus semicordata* *(Khanyu)*
Pa : *Prunus cerasoides* *(Painyu)*
Du : *Ficus nerifolia* *(Dudhilo)*
Ne : *Ficus roxburghii* *(Nevaro)*
Kb : *Kathe Ber*
Go : *Saurauia napaulensis* *(Gogan)*
Gh : *Leucosceptrum canum* *(Ghurmiso)*

Source : PRA, 1992

It was noticed that women had acquired an intimate, practical knowledge of the suitability of different tree species for cooking. They knew which trees burn slowly and which fast, which smoke and which kindle easily. These were the main criteria for preferring the fuelwood/ timber tree species. Timsina and Paudel (1992) reported that one of the main preference criteria for fuelwood is less smoke when burnt.

Table 16 Tree species preference by men
(n = 65)

Tree species (Local names)	Preference categories			Popularity score
	Liked very much	Liked	Liked a little	
Nevaro	65	-	-	100
Khanyu	14	9	-	30.8
Gogan	8	31	16	52.4
Dudhilo	27	26	6	71.4
Painyu	3	6	44	33.1
Ghurmiso	2	9	4	14.4
Bains	1	7	5	11.2
Utis	48	2	-	75.9
Phusre	25	-	-	38.5
Patle	12	-	-	18.5

Mean = 44.62 and St. Dev.= 28.10
Source: Survey, 1992

Later on these results were verified by conducting a formal survey among male and female of different socioeconomic strata. The farmer preference in trees includes those tree species which are socially adopted, economically viable and producing more yield. Here, the preference of likeness is categorized into the following three group:

Farmers' preference categories	**Percent likeness**
Liked very much	100
Liked	67
Liked a little	33

Source: Leutel (1991)

The following method is developed and applied to assess farmers' preference, fodder and firewood qualities based on farmers' knowledge or responses.

Popularity Score (PS) for each tree species equals

(No. of farmers in liked very much category * 100/ total respondent)
+
(No. of farmers in liked category * 67/ total respondent)
+
(No. of farmers in liked a little category * 33/ total respondent)

The tree species according to male farmers' preference are listed along with popularity score in Table 16.

Result showed that all respondents are positive to consider *Nevaro* as a very much liked fodder (Table 18). They preferred *Dudhilo* as the second important fodder and *Gogan* as the third (Table 16). The same case is observed in case of women too (Table 17). The difference in popularity scoring for various tree species by gender is shown in figure 12.

Table 17 Tree species preference by women (n = 80)

Tree species (Local names)	Preference categories			Popularity score
	Liked very much	Liked	Liked a little	
Nevaro	80	-	-	100
Khanyu	21	18	-	41.3
Gogan	16	29	18	51.7
Dudhilo	47	32	3	86.8
Painyu	5	4	56	32.7
Ghurmiso	6	3	6	12.5
Bains	3	6	5	12.5
Utis	78	2	-	99.2
Phusre	26	-	-	32.5
Patle	18	-	-	22.5

Mean = 49.34 and St. Dev.= 31.90
Source: Survey, 1992

This result of formal survey (Table 18) is not correlated with the PRA result for some cases because *Bans* and *Khanyu* are categorized as most and second most preferred fodder by men and women farmers respectively in PRA procedures (Tables 14 and 15). But these are not mentioned as highly preferred species in formal survey. For fuelwood and timber purpose, only *Utis* is most preferable however, *Phusre* and *Patle* are also preferred by men and women farmers (Table 18).

Table 18 The preferred tree species by gender (farmers' response, n = 145)

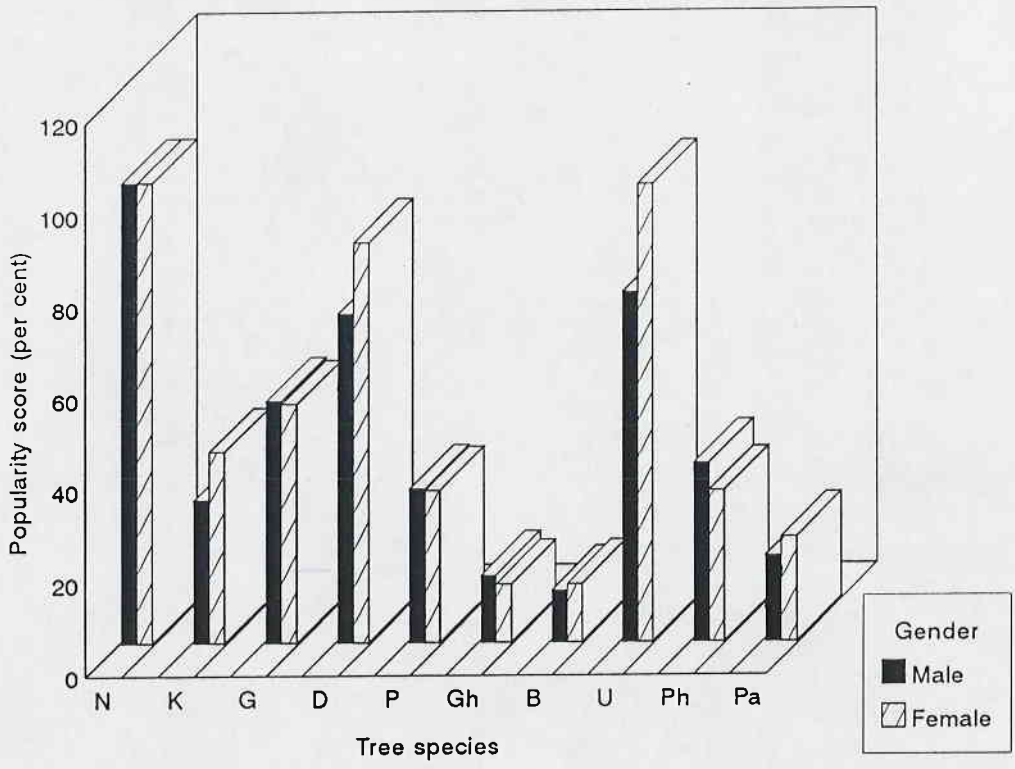
Preference categories	Fodder trees		Fuelwood/timber trees	
	Male	Female	Male	Female
Liked very much	*Nevaro* *Dudhilo*	*Nevaro*	*Utis*	*Utis*
Liked	*Gogan* *Dudhilo*	*Gogan* *Khanyu*	*Phusre* *Patle*	*Phusre* *Patle*
Liked a little	*Painyu*	*Painyu*	-	-

Source: Survey, 1992

Table 19 Ranking of preference criteria for fodder trees by gender (farmers' response, n= 145)

Preference criteria	Per cent of respondents															
	Nevaro				*Dudhilo*				*Gogan*				*Khanyu*			
	M[1]	R[2]	F[3]	R[2]	M[1]	R[2]	F[3]	R[2]	M[1]	R[2]	F[3]	R[2]	M[1]	R[2]	F[3]	R[2]
High milk production	72	1	86	1	46	2	31	2	28	3	40	3	23	1	23	2
Nutritious	28	2	40	2	49	1	53	1	43	2	45	1	12	2	31	1
Available during dry season	12	3	8	3	18	3	5	3	12	1	20	2	6	3	3	-

Note:
1 = Male farmers; 2 = Rank; 3 = Female farmers
Source: Survey, 1992



N= Nevaro; K= Khanyu; G= Gogan; D= Dudhilo; P= Painyu; Gh= Ghurmiso; B= Bains; Ph= Phusre; Pa= Patle

Figure 12 The popularity scores for different tree species by gender
Source: Survey, 1992

Regarding farmers' reaction on preference criteria, high milk production is assigned as the main reason for preferring *Nevaro* as the best fodder. *Gogan* and *Dudhilo* are preferred as these are nutritious to livestock (Table 19). *Painyu* is characterized as evergreen tree species. For making household plate from leaves, *Nevaro* is mostly used by female farmers. *Utis* is the preferred fuelwood and timber by both male and female farmers for various reasons e.g. strong timber for house construction, furniture, long durability, giving less smoke, easy to burn, fast growing etc. Furthermore, ranking of these preference criteria by gender are found to be different. The criteria of male by rankwise are fast growing, strong timber for house

construction, agricultural tools and furniture whereas for female, easy to burn, give less smoke, less quantity enough for cooking and gives tasty food, available for every season etc are criteria of preferring *Utis* (Table 20).

Table 20 Ranking of preference criteria for fuelwood tree (*Utis*) by gender (farmers' response, n= 145)

Preference criteria	Per cent of respondents			
	Male	Rank	Female	Rank
Fast growing	25	1	16	4
Improve soil condition	14	4	8	5
Easy to burn, give less smoke, less quantity enough for cooking and gives tasty food.	31	3	26	1
Available for every season	23	5	25	2
Strong timber for house construction, agricultural tools and furniture.	35	2	28	3
	n = 65		n = 80	

Source: Survey, 1992

3) Fodder tree cutting and management

Nevaro, Khanyu and Gogan are mostly cut and fed to animals from November to May, *Dudhilo* and *Painyu* from February to July, *Ghurmiso* from October to May. *Utis* actually is cut for fuelwood and timber whenever necessary, but, most of the villagers reported cutting from December to July (Figure 13).

Figure 13 Availability period of different fodder and fuelwood trees

Tree species (local name)	Lopping Months J	F	M	A	M	J	J	A	S	O	N	D
Fodder:												
Nevaro	**********										****	
Khanyu	**********										****	
Gogan	**********										********	
Dudhilo		**********										
Painyu		**********										
Ghurmiso	**********										********	
Bains		**********										
Fuelwood:												
Utis	**********										**	

Source: Survey, 1992

Most of the farmers of all socioeconomic strata indicated January to June as fodder scarcity months however some other also reported nonavailability of fodder until September (Figure 14). Therefore, there is more deficit of fodder during winter (September to June) than in summer (July to August). Farmers generally feed their livestock with fodder trees, grasses, bushes, weeds, grain feeds along with rice straw or other crop residues.

Figure 14 Fodder scarcity months in Salle

Socioeconomic group	Months J F M A M J J A S O N D
Rich Magar/Gurung(E1R)	**********
Medium Magar/Gurung(E1M)	********** *******
Poor Magar/Gurung(E1P)	********** *******
Medium Brahmin/Chhetri(E2M)	**********
Poor Brahmin/Chhetri(E2M)	**********

Source: Survey, 1992

Table 21 Feeding management practices during dry season

Strategies[1]	Per cent of respondents				
	E1R[2]	E1M[2]	E1P[2]	E2M[2]	E2P[2]
Grass	36	42	24	28	-
Rice	-	16	50	11	78
Stock	50	16	6	11	22
Grass & Rice	-	6	5	50	-
Grass & Stock	14	18	7	-	-
Rice & Stock	-	2	8	-	-
Total	100	100	100	100	100
	n = 14	n = 62	n = 42	n = 18	n = 9

1. Description of strategies
   Grass : Feeding grass from own forestland and *nagi*land
   Rice : Buying rice straw
   Stock : Feeding stock fodder and own rice straw

2. E1R : Rich Magar/Gurung
   E1M : Medium Magar/Gurung
   E1P : Poor Magar/Gurung
   E2M : Medium Brahmin/Chhetri
   E2P : Poor Brahmin/Chhetri

Source: Survey, 1992

But in deficit months, most of the farmers (32 per cent of total respondents) managed grasses from forest or *nagi*land for feeding livestock, buying and feeding ricestraw is second alternative (28 per cent of respondents) for them (Figure 15). The management practices vary among socioeconomic group (Table 21).

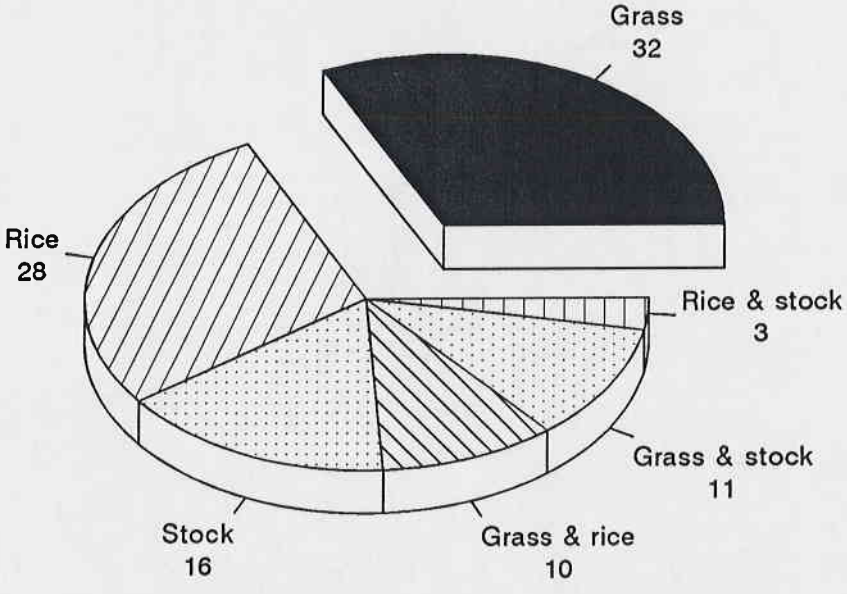


Figure 15 Feeding management practices during dry season
Source: Survey, 1992

4.2 Gender analysis in agroforestry systems

After knowing the components of agroforestry system and inter-relationships among them, it is necessary to reveal the labor involved in different agroforestry activities for sustaining the existing system. It is known that both men and women have been involved in production and management aspect of the agroforestry system. The roles and responsibility of gender in agroforestry in a given society are examined through gender analysis. It helps to visualize the access and control of resources/ activities/ benefits in a given circumstances. It is believed that cross sectional understanding helps better to concurrent the particular situation and thereby contribute to strengthen the household activities.

4.2.1 Gender role in various agroforestry activities

Womens' participation in agroforestry began when mesopotamians first domesticated animals and planted food near home and it is thought that women were the first to do this. In subsistence food production, women's role has always been a central one, and this includes crop production, care and management of livestock and birds and their products for family consumption and use. Women contribute 50 to 80 per cent of total labor in crop farming depending on ecological niches and the ethnic group (Adhikary, 1988). Female labor participation is more than 80 per cent of the total labor required for livestock farming (Mathema and Vanderveen, 1981). Such literatures indicate the important role of women in agroforestry. However, their precise role and contributions should be well

documented in order to know their problems and constraints regarding these aspects. Here gender analysis is employed for noting gender involvement in these sectors. Chi square test is also used to indicate whether there is significant involvement of women in various agroforestry activities. However, this is discussed by categorizing agroforestry into crop, tree and livestock subsystems.

1) Crop subsystem

The results of the observations showed that all members of the farm family (men, women and children) participate actively in crop production. Although, women perform almost at par with men, there are certain operations which are performed exclusively by men and others exclusively by women. For instance, in land preparation the ploughing of fields is exclusively done by men (77 per cent of respondents), so that in the absence of men of the household i.e., mostly in case of female headed household, labor is hired for this operation. Several studies in Nepal (Bajracharya, 1990; Bhattarai *et al.*, 1989; Pradhan, 1983; Timsina *et al.*, 1989; Vaidya *et al.*, 1990) and also in India (Chauhan *et al.*, 1992) indicated the same observation. Actually, ploughing is sometimes assisted by children as it is reported by 13 per cent of respondents.

More than 50 per cent respondents of Magar, Gurung reported clod breaking and digging operations as female activities. However, large proportions of respondents (41 per cent) in Brahmin, Chhetri indicated participation of both sex in these activities (Appendix Table 1). But among different economic

group, medium status women are found highly involved (47 per cent) followed by poor (36 per cent) while involvement of rich women is the least (22 per cent) (Appendix Table 2).

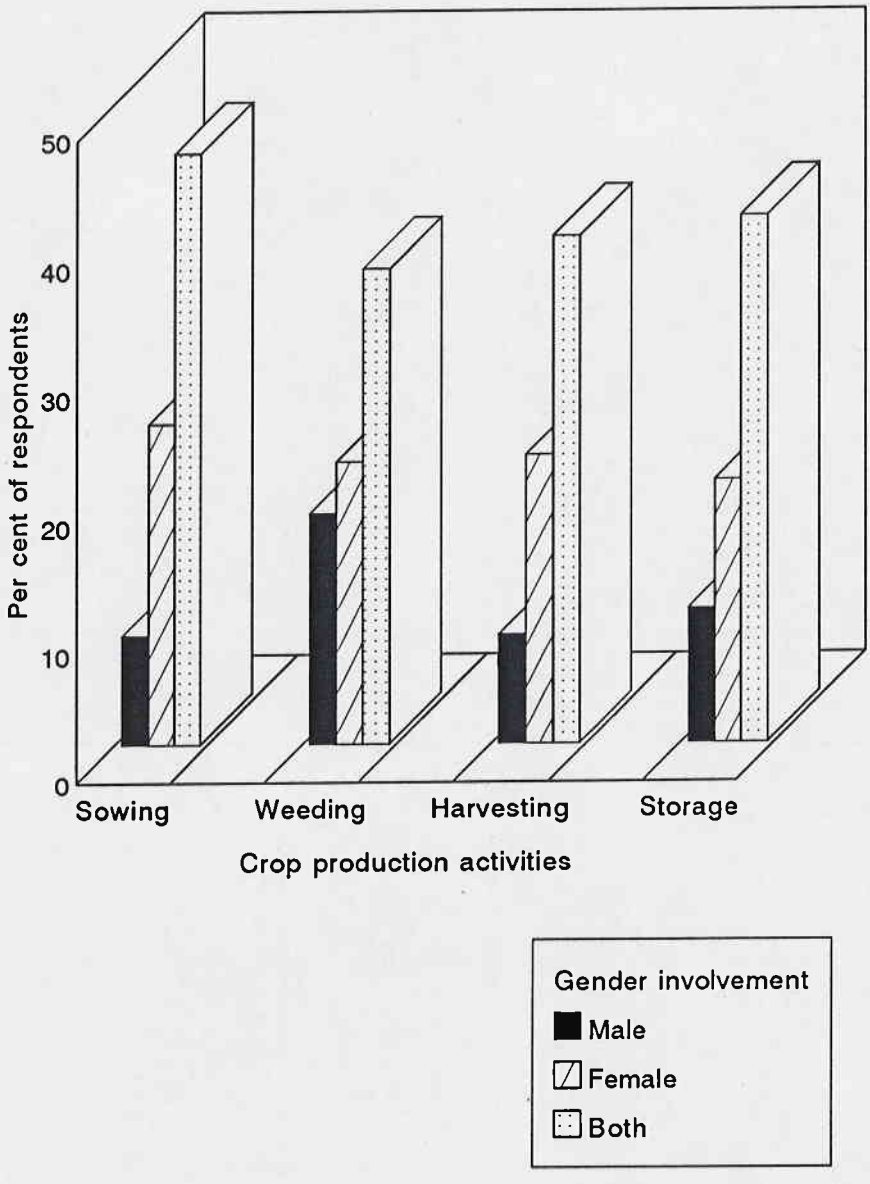


Figure 16 Gender participation in crop production activities
Source: Survey, 1992

The reasons for this situation may be larger land holding size of medium than poor and the ability of hiring labor by rich. The involvement of gender in various crop production activities and in cultivation of different crops are shown in figures 16 and 17.

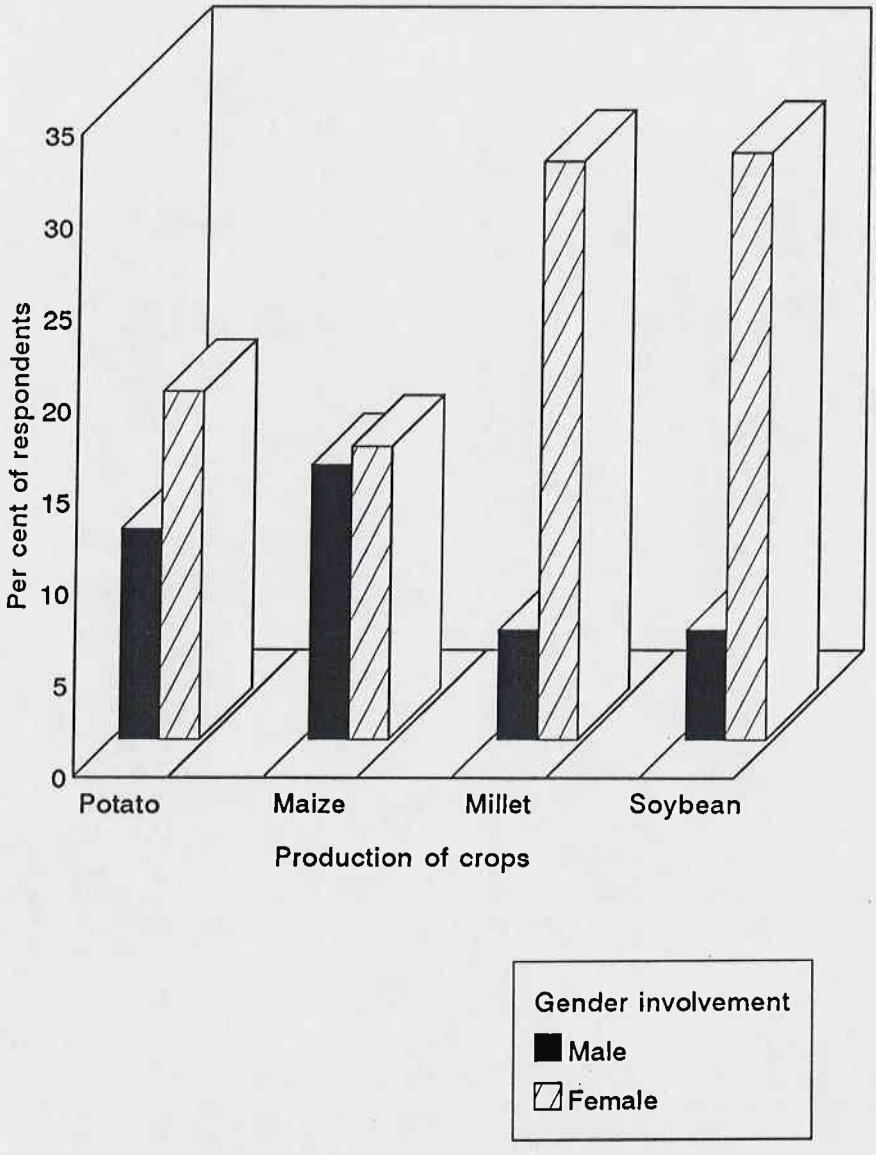


Figure 17 Gender participation in cultivation of different crops
Source: Survey, 1992

Potato and wheat are sown by both male and female, maize is sown by both with assistance of children. Millet and soybean are sown mostly by female in Magar, Gurung whereas these are performed by both sexes in Brahmin, Chhetri (Figures 18 and 19). But equal involvement of male, female and children are found for intercultural operation in all crops. Pradhan (1981) reported that sowing, transplanting and weeding are mostly done by women and both sexes acknowledge that women are better planters than men.

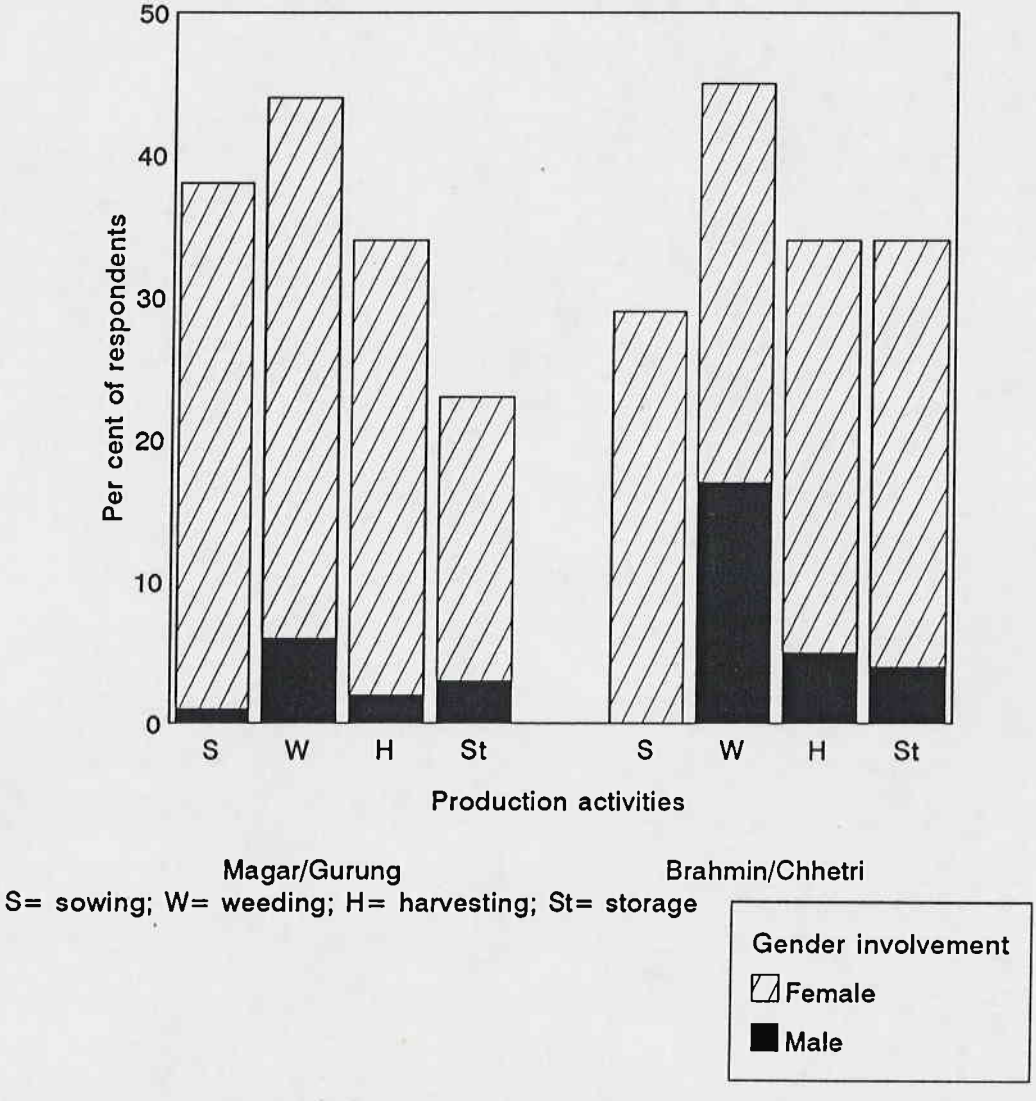


Figure 18 Gender participation in millet production by ethnic group
Source: Survey, 1992

There is a belief that if sowing and transplanting is done by women there will be a better yield (Majupuria, 1989). In harvesting of potato, maize and wheat, both sexes are equally involved. However, 35 per cent of Magar, Gurung respondents reported female involvement in millet and soybean harvesting. Chauhan *et al.*, (1992) observed that in India also, women are solely responsible for weeding, transplanting and harvesting. Regarding post harvest activities, only in millet and soybean, women are mostly engaged but in other crops, participation of both are observed. Women do drying of crop residue, storing or bagging of grains, threshing of wheat and cleaning of grains. All the food processing activities: threshing, drying, husking, roasting and grinding is entirely the responsibility of women (Pradhan, 1981).

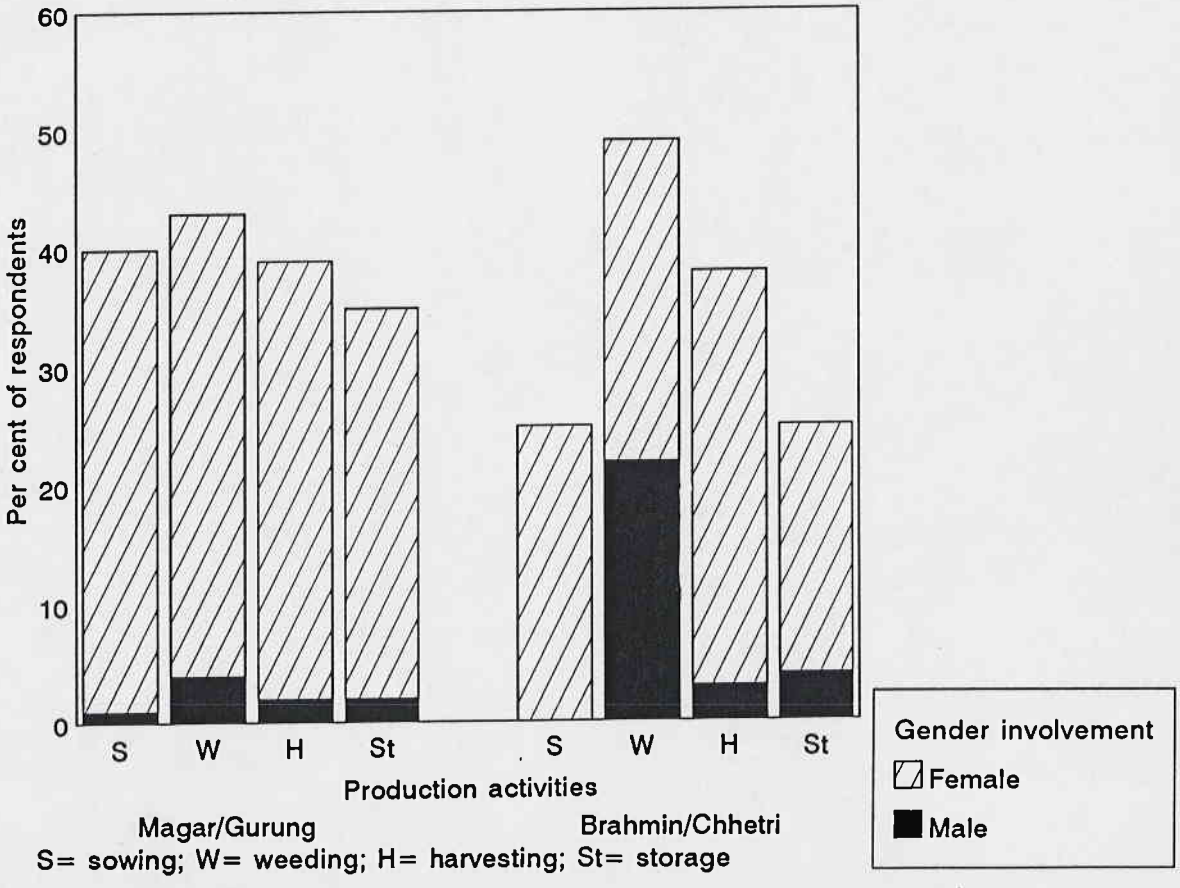


Figure 19 Gender involvement in soybean cultivation by ethnic group
Source: Survey, 1992

Vaidya *et al.*, (1990) reported that womens' participation is higher than men in wheat production in central hill region of Nepal. However, in Salle, this case is opposite. The cause may be that wheat is not staple food in that location and only 67 per cent of households are growing wheat. The farmers are still unaware of best way of its consumption.

Table 22 Gender participation in agroforestry activities by ethnic group

Activities	Per cent of respondents							
	Magar/Gurung				Brahmin/Chhetri			
	M[1]	F[2]	B[3]	A[4]	M[1]	F[2]	B[3]	A[4]
Crop production:								
Sowing	6	29	40	25	11	21	52	16
Int. operation	12	25	37	26	24	19	37	20
Harvesting	8	24	40	28	9	21	39	31
Post harvest	10	23	38	29	11	18	44	27
Livestock management:	5	28	67	-	15	24	61	-
Tree management:								
Farmland	24	32	28	16	20	30	34	16
*Nagi*land/forestland	10	50	20	20	15	33	31	21
	n = 118				n = 27			

Note: 1: male, 2: female, 3: both, 4: all family members
Source: Survey, 1992

Analyzing the situation with respect to ethnic group reveals more participation of Magar, Gurung women than that of Brahmin, Chhetri in almost all of crop production processes (Table 22 and Figure 20), however, this result is found not significantly different through Chi square test. This fact may also be correlated

with larger landholding, livestock size and more numbers of trees available to the Magar, Gurung. Acharya and Bennett (1981) reported that womens' participation is higher in the more disadvantaged ethnic group, which is in conflict with the Salle finding.

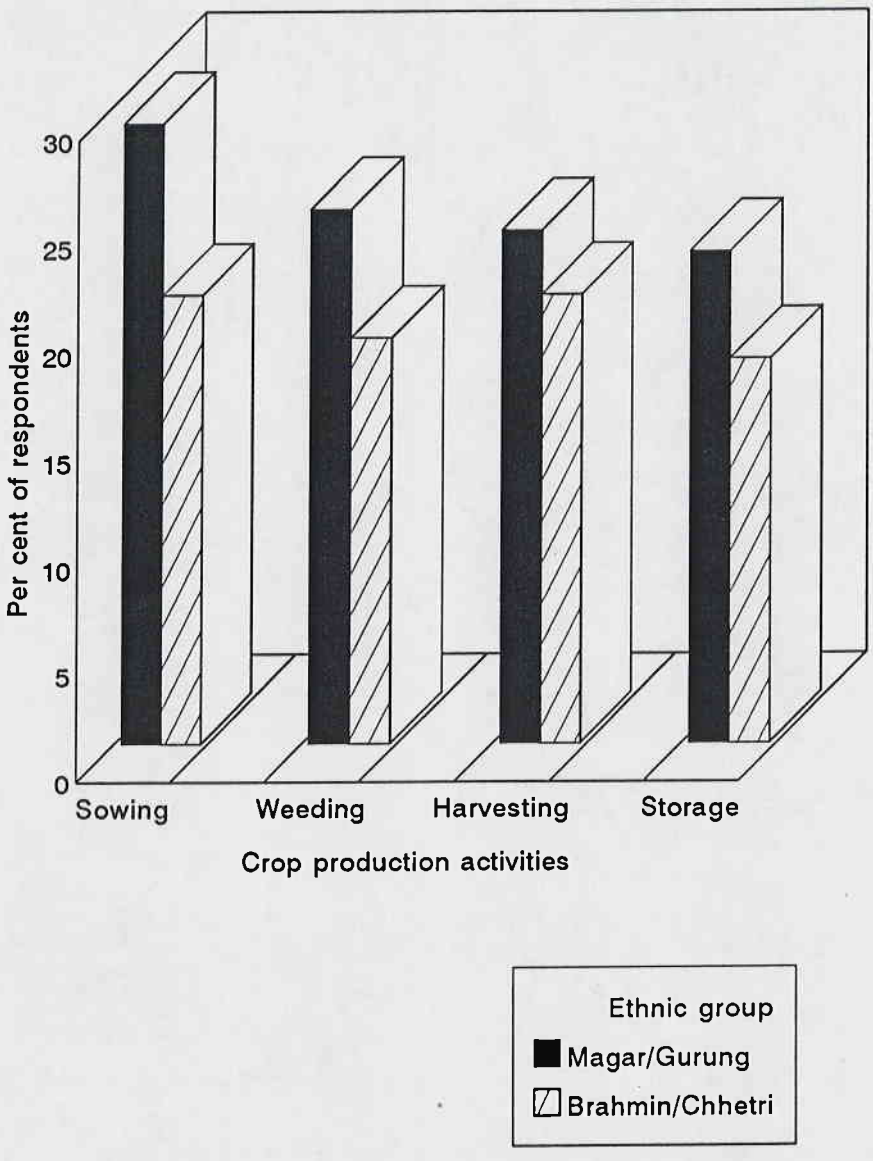


Figure 20 Womens' participation in crop production activities by ethnicity
Source: Survey, 1992

In this case, Brahmin, Chhetri can be referred as disadvantaged group in terms of low access to resources. But their involvement seems to be less and this may be due to the uncoverage of wage labor. However, Loutfi (1985) also indicated that upward social mobility tends, in India, to lead to women's inactivity and lower relative status within the household.

Little is known about effect of downward mobility, although it is noted that some particular hardships for women as families become landless. Majupuria (1989) highlighted in "Nepalese Women" that Brahmin, Chhetri women as belonging to higher caste, are involved more on household jobs than in crop production.

Table 23 Gender participation in agroforestry activities by economic group

Activities	Per cent of respondents											
	Rich				Medium				Poor			
	M[1]	F[2]	B[3]	A[4]	M[1]	F[2]	B[3]	A[4]	M[1]	F[2]	B[3]	A[4]
Crop production:												
Sowing	8	12	54	26	8	22	29	41	9	17	37	37
Int. operation	8	18	66	8	6	23	25	46	16	18	40	26
Harvesting	7	16	60	17	7	24	27	42	15	19	53	13
Post harvest	8	10	59	23	6	20	32	42	4	20	46	33
Livestock management:	18	7	75	-	4	39	57	-	5	22	73	-
Tree management:												
Farmland	16	16	48	13	13	23	27	37	16	19	43	22
*Nagi*land/forestland	14	54	32	-	14	67	10	9	15	22	38	25
	n = 14				n = 81				n = 50			

Note: 1: male, 2: female, 3: both, 4: all family members
Source: Survey, 1992

Finding shows more involvement of medium and poor economic status women irrespective to ethnic group in crop production than that of rich women (Table 23 and Figure 21). This might be true that the rich households can hire labor for most of the crop activities, which is further supported by the fact that most of the rich farmers get income through remittances (pension/ army service) which enable them to afford in hiring labor.

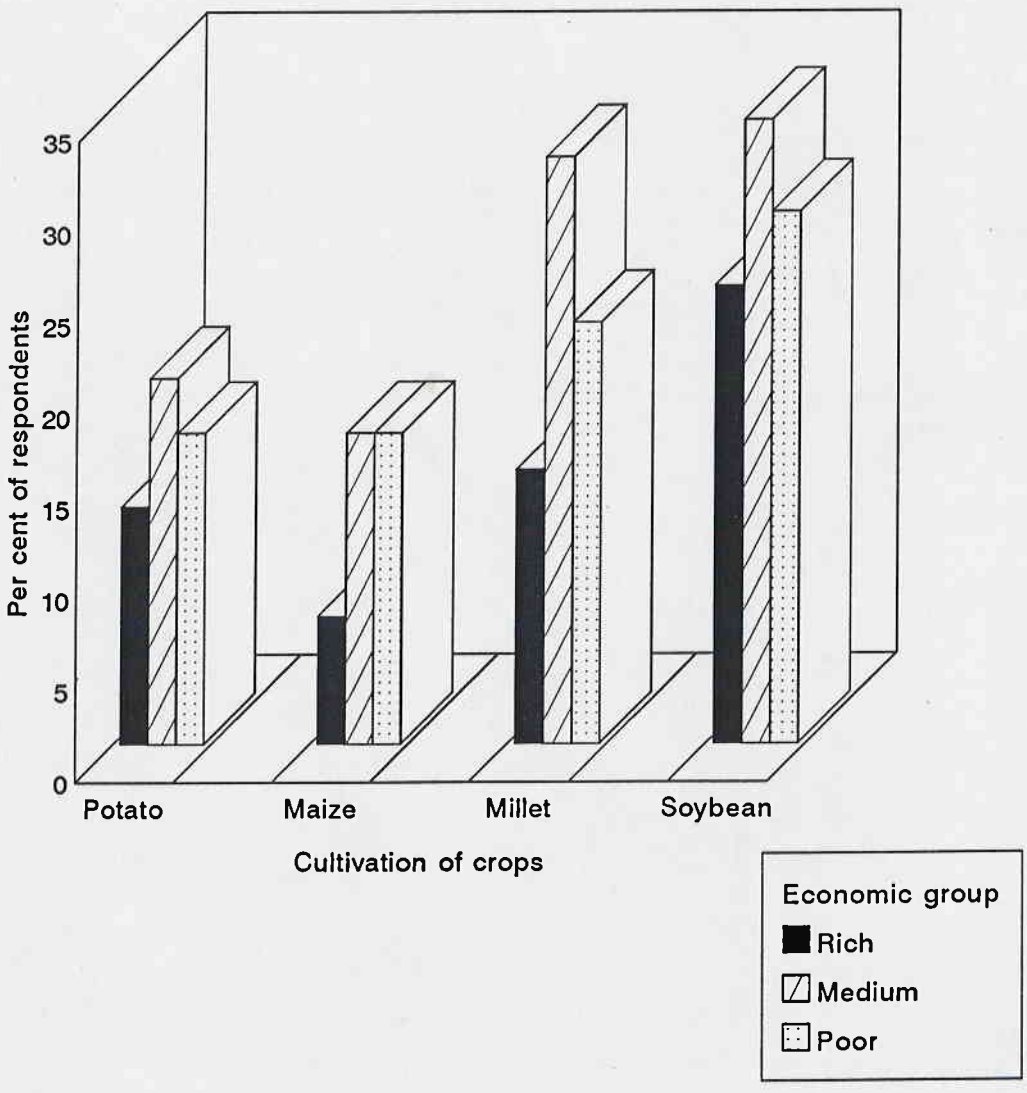


Figure 21 Womens' involvement in cultivation of different crops by economic status
Source: Survey, 1992

2) Livestock subsystem

Womens' involvement in livestock production is a longstanding tradition in Nepal where animals have been an integral part of farming systems. The livestock production patterns may differ widely in various ecological zones and social systems, but women play a major part in caring for animals in all systems from high hills to *terai.* It is necessary to prepare database on women's role in livestock production so as to assert that their contributions are critical to overall development of the sector. Because, without an adequate database, problems arise in knowing where to direct inputs to help women increase their productivity.

The results represented more female participation compared to male in various day to day livestock activities, i.e., preparing and feeding *khole*, feeding water, feeding thinned maize and rice straw, shed cleaning, compost making and making ghee, curd etc (Figure 22).

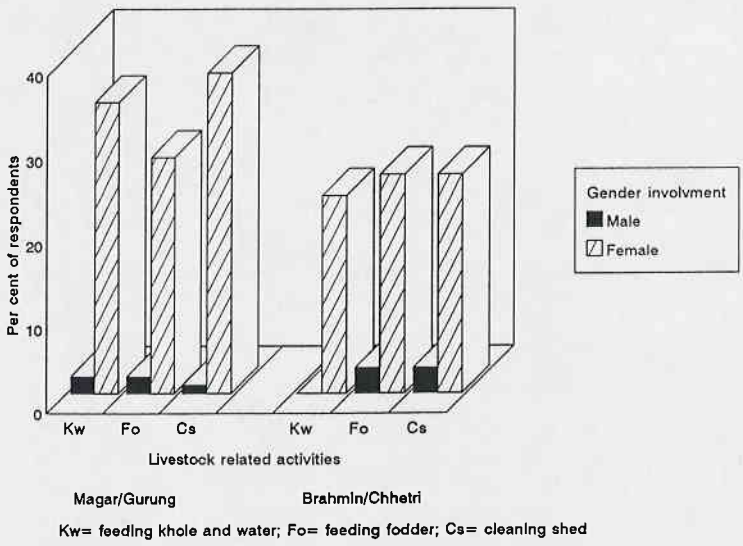
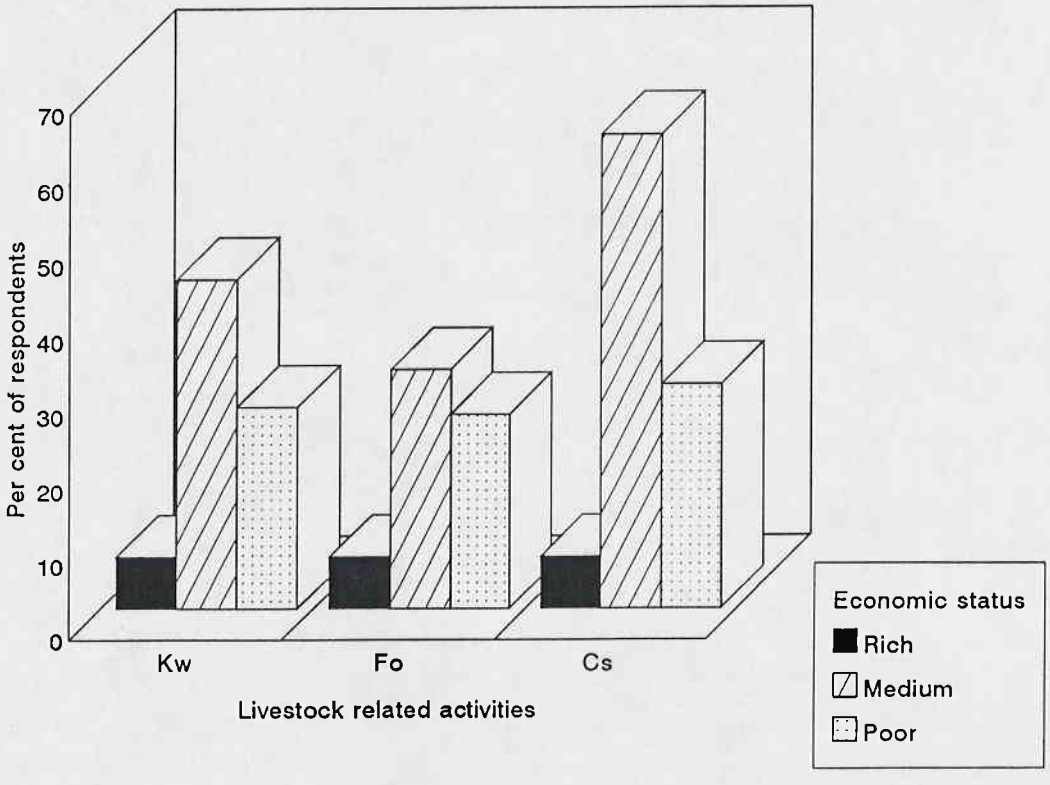


Figure 22 Gender participation in livestock activities by ethnic group
Source: Survey, 1992

The care of livestock is predominantly and sometimes completely womens' responsibility. This is supported by other researchers (Katuwal, 1990; Paris, 1992 and Timsina *et al.*, 1992). But disease management, selling/ buying livestock and livestock products are reported to be performed by male. Few percentage (14 per cent) of Magar, Gurung pointed involvement of women in milking, similarly, Brahmin/ Chhetri indicated more male involvement (26 per cent of the respondents) than female involvement (19 per cent of respondents).

The women in rich farm families are less involved in livestock activities. But the situation is reverse with medium and poor farm households (Table 23 and Figure 23).



Kw= feeding khole and water; Fo= feeding fodder; Cs= cleaning shed

Figure 23 Womens' participation in livestock activities by economic group
Source: Survey, 1992

The female of medium farm family are highly involved in livestock activities than poor female farmers. But some activities like disease management, selling/ buying livestock and livestock products are exclusively performed by male in all socioeconomic strata (Appendix Tables 3 and 4).

3) Tree subsystem

Considering the activities in tree subsystem, it was found that buying and searching of saplings were often carried out by male farmers. Furthermore, they were highly involved in logging and buying and selling of logs. Planting of saplings was done by both. Bedding materials and fuelwood collection in other hand, were mostly performed by female (Figure 24). Fodder collection was mostly done by female with occasional assistance of male (Appendix Tables 5 and 6).

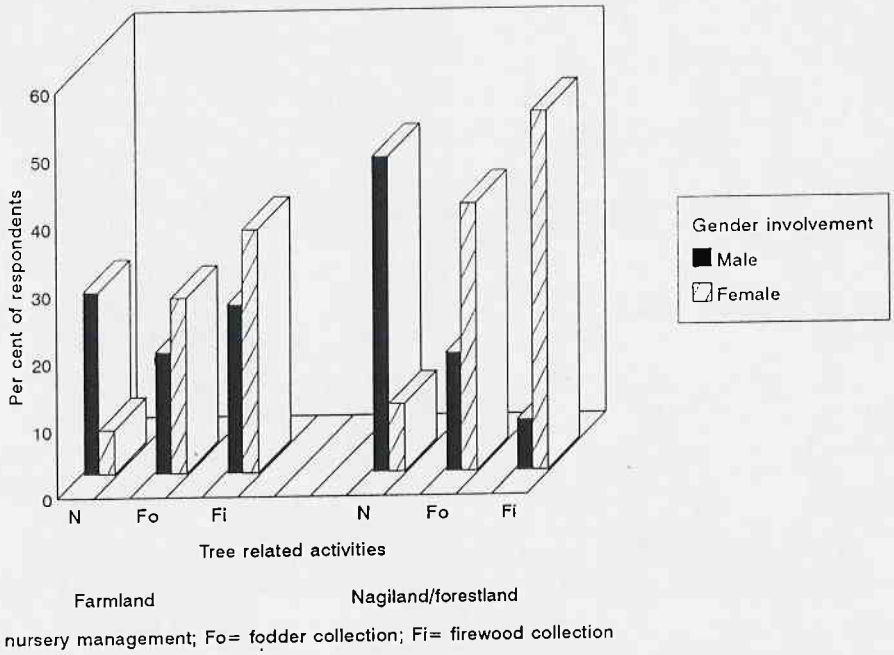


Figure 24 Gender involvement in tree activities
Source: Survey, 1992

When the analysis was carried out across two ethnic group, it was revealed almost equal participation of both Magar, Gurung and Brahmin, Chhetri men and women on farmland tree activities (Table 22 and Figure 25). But in case of forest/ *nagi*land trees, more participation of women than men of Magar, Gurung and also than Brahmin, Chhetri women was found because of comparatively low access of Brahmin, Chhetri to forest/ *nagi*land resources.

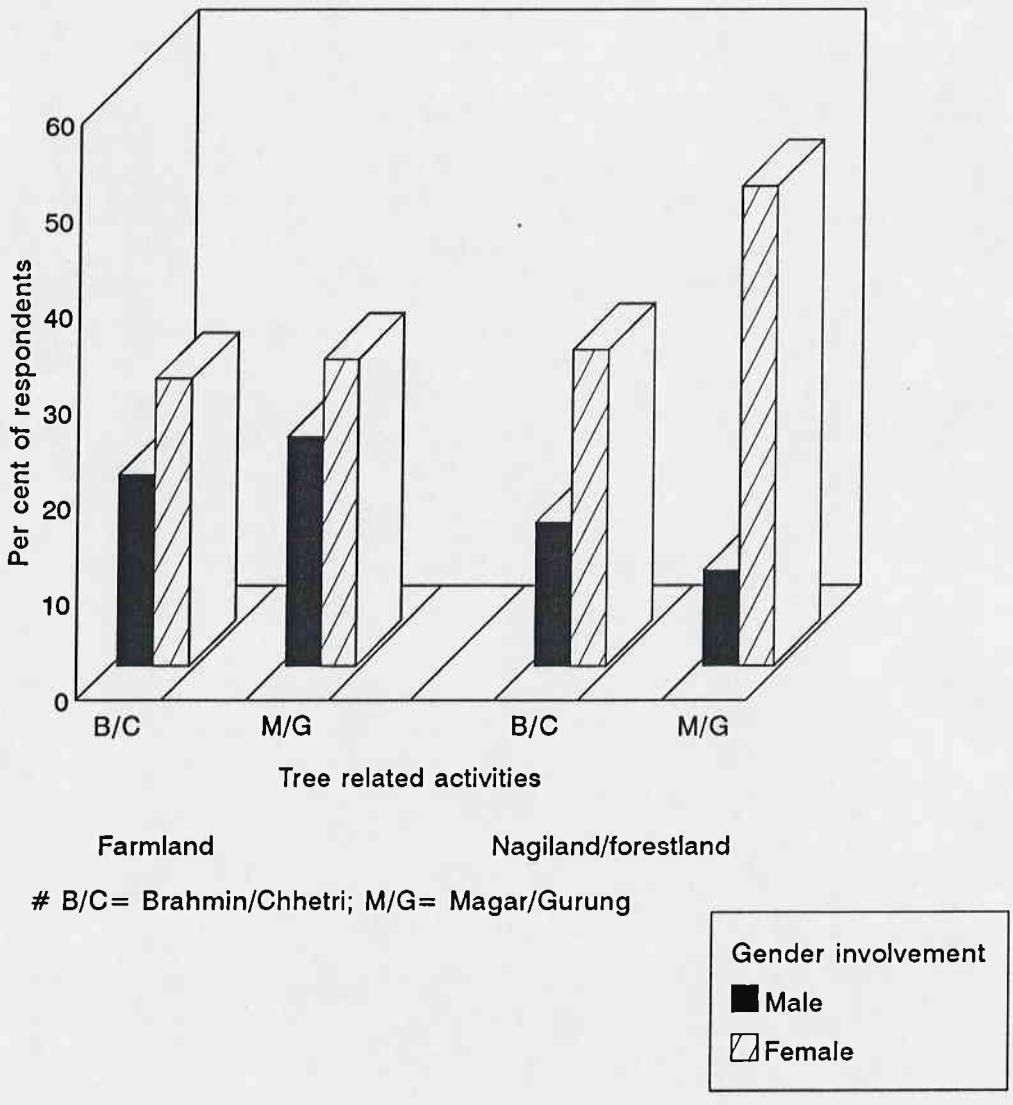


Figure 25 Gender involvement in tree activities by ethnic group
Source: Survey, 1992

However, comparison between male and female reflected a clear distinction in fodder and bedding material collection from forest/ *nagi*land (42 per cent of Magar, Gurung respondents mentioned it as women's activities as compared to only 13 per cent for mens', similarly, 37 per cent of Brahmin, Chhetri respondents reported women and 22 per cent men). Timsina *et al.*, (1992) also observed more involvement of Brahmin, Chhetri women than men in fodder collection from the forests in eastern Nepal.

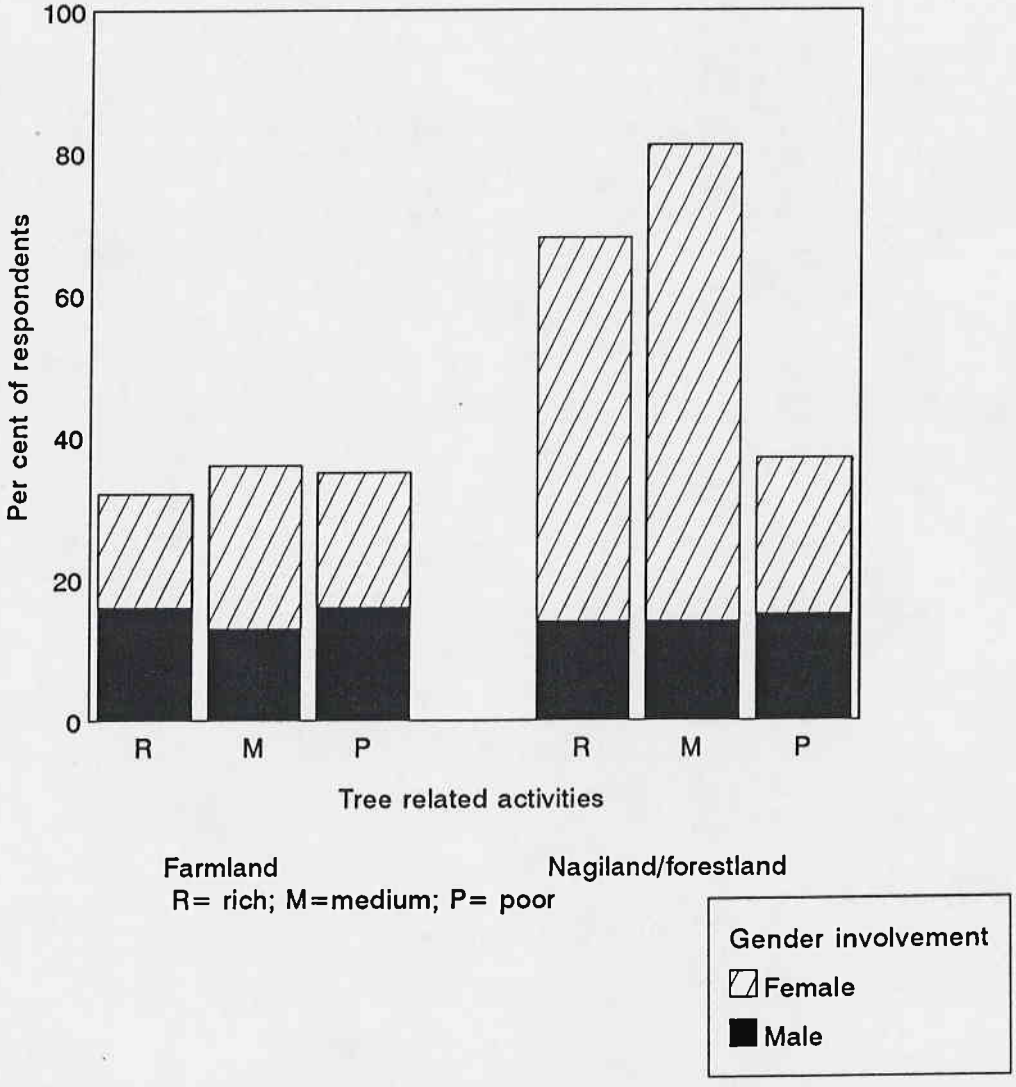


Figure 26 Gender participation in tree activities by economic status
Source: Survey, 1992

The close analysis with respect to different economic group indicated more participation of rich and medium women in tree activities compared that of poor women (Table 23 and Figure 26). Hence the extent of participation found to be directly related with access to land and tree resources.

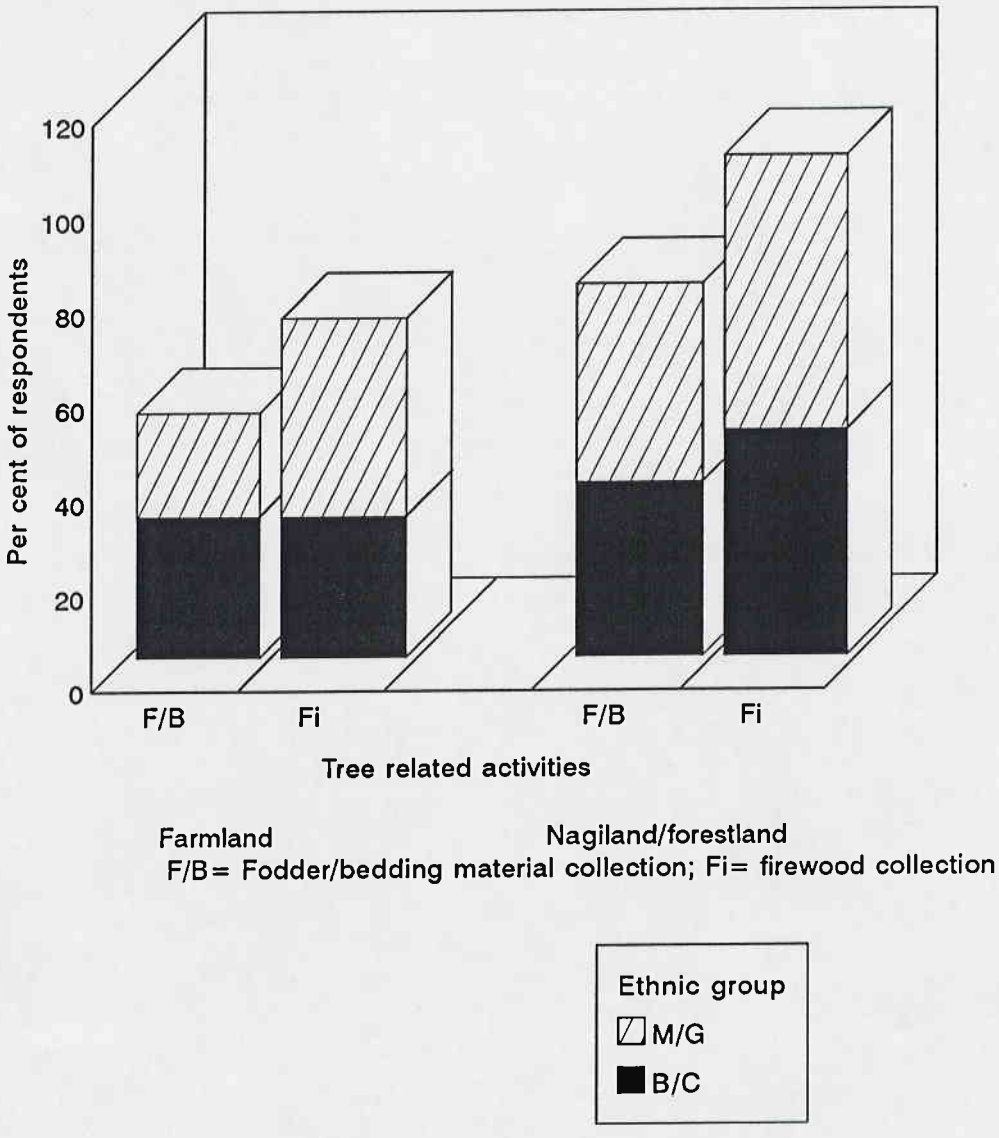


Figure 27 Womens' involvement in fodder/bedding material/fuelwood collection by ethnic group
Source: Survey, 1992

The poor farmers have to give first priority to food production rather than on tree growing as their farm produce is enough only for 6 to 8 months. Considering fodder and bedding material collection from *nagi*land/ forestland, more participation of women than men is revealed regardless of economic group. That is 50 per cent of rich, 56 per cent of medium and 20 per cent of poor respondents reported these activities done by women only (Figure 28). Same observation is also indicated by Paris (1992) in midhills of Nepal and Chauhan (1992) in India. However, around 20 per cent of rich, medium and poor respondents reported these are performed by men only. In fuelwood collection, women are relatively more involved than men as they are more responsible in cooking and feeding household members. This observation is also found by Timsina *et al.*, (1992).

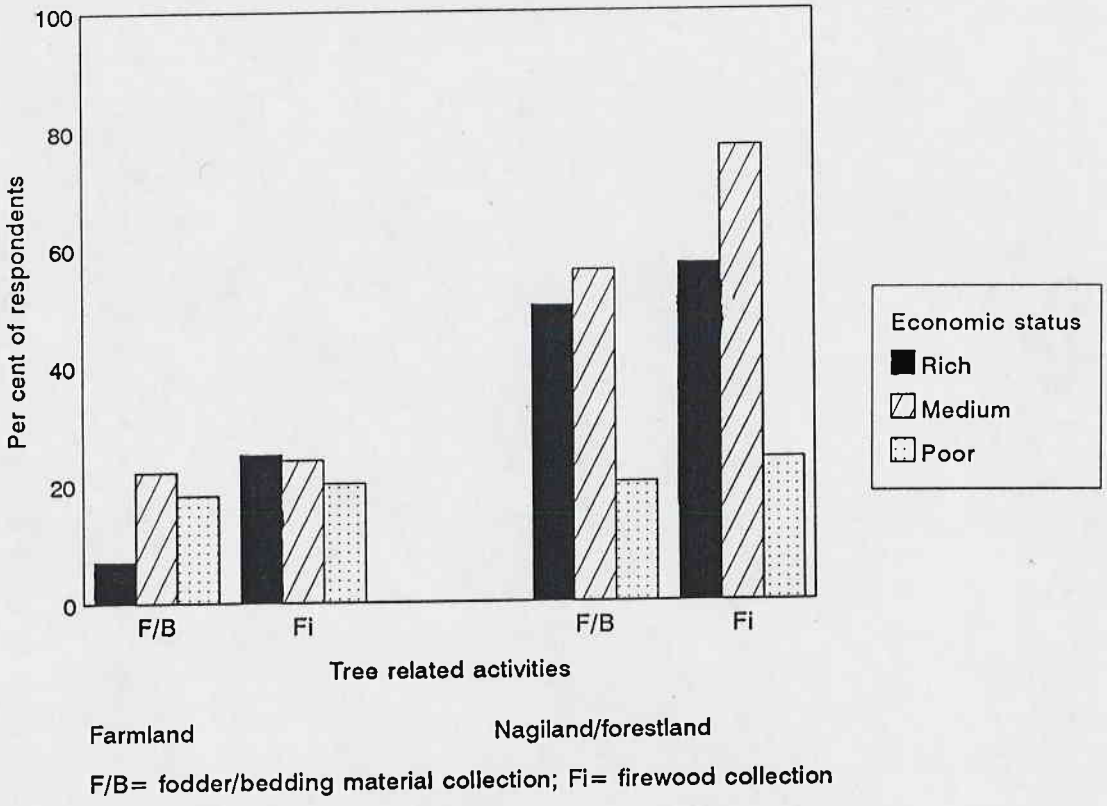


Figure 28 Womens' involvement in fodder/bedding material/fuelwood collection by economic group
Source: Survey, 1992

4.2.2 Labor use pattern on agroforestry activities by gender

In Nepalese subsistence economy of the hill farm household, study of labor use pattern is very useful, as time may be viewed as a scarce resource applicable for alternative uses and each member of the household allocate its scarce resource "time" in such a way that the household achieves its maximum welfare.

Rural women's workday is usually longer than that of men, so that time is a precious resource for women. Labor use studies are a useful tool to help identify women's needs and to plan for resource allocations.

T- test is followed as the statistical tool for showing significant differences ($p < 0.05$) in time spent for various agroforestry activities by gender and also with regard to socioeconomic group. At first, the t- test was carried out for the overall picture and then for detailed analysis, each related activities were tested for showing whether there is difference in time spent by gender, economic and also ethnic group.

1) Crop production

Labor use for different cropping activities by gender differs according to the nature of work, type of crop etc. (Tables 24- 28).

i) Potato

It is found that Magar/ Gurung women allocate a total of 31 days for sowing, weeding, digging/ harvesting and storage of potato while Brahmin/ Chhetri spent only 14 days for the same activities. These conditions are found significantly different through statistical t- test.

Table 24 Labor use pattern (days/ year) for crop production activities by rich Magar/ Gurung farmers (E1R) (n= 14)

Crops	Activities							
	Sowing		Weeding		Harvesting		Storage	
	M^1	F^2	M^1	F^2	M^1	F^2	M^1	F^2
Potato	3	3	14.6	10.9	3.2	6*	4.7	7*
Maize	3.1	4	7.7	7	4.6	4	4.1	4.7
Millet	2	3.8*	7	10.7*	7	9.6*	3	4*
Soybean	2.5	2.4	2	3.6*	5.7	6.9*	3.5	4.3*
Wheat	3.4	6.1*	4.8	5.8*	5.5	4.3	3.8	5.8*

Note: * significant difference at ($p< 0.05$).
1: male and 2: female
Source: Survey, 1992

However, figure represented to denote labor use does not include wage labor apart from household. This can also be supported by larger *bari* land area owned by Magar/ Gurung (average *bari* land is 1.33 ha) than that owned by Brahmin/ Chhetri (0.99 ha). When the comparison is made between male and female of same

ethnic group, no significant differences are found, as both men and women equally participate and allocate the same amount of time in potato growing and storage practices.

Table 25 Labor use pattern (days/ year) for crop production activities by medium Magar/ Gurung farmers (E1M) (n= 62)

Crops	Activities							
	Sowing		Weeding		Harvesting		Storage	
	M[1]	F[2]	M[1]	F[2]	M[1]	F[2]	M[1]	F[2]
Potato	14.6	12.9	10.6	9.1	11.9	11.9	3	3.5
Maize	7.4	6.4	13.2	9	7.4	6.1	5.2	6
Millet	12.5	13.3*	8.7	9.6*	7	7.5*	4.2	5.6*
Soybean	3.3	2.8	5.1	3.7	3	2.7	2	2.5
Wheat	2.2	3	3	2	2.3	2	4	2

Note: * significant difference at ($p<0.05$).
1: male and 2: female
Source: Survey, 1992

Comparison by economic group (rich, medium and poor) also indicates no significant difference on labor use for potato production by gender of all economic group. However, more close analysis reveals that in potato harvesting and storage, labor use by male and female of rich Magar, Gurung group is found significantly different indicating higher female participation (13 days per year) than male (7.9

days per year) in case of harvesting and storage. Poor Magar, Gurung women also spent significantly more time (5.9 days/ year) than men (4.5 days/ year) in potato storage.

Table 26 Labor use pattern (days/ year) for crop production activities by poor Magar/ Gurung farmers (E1P) (n= 42)

Crops	Activities							
	Sowing		Weeding		Harvesting		Storage	
	M[1]	F[2]	M[1]	F[2]	M[1]	F[2]	M[1]	F[2]
Potato	5.7	4.3	10.4	10	9.2	9.7	4.5	5.9*
Maize	4.7	3	8.1	10.8*	5.6	4.3	3.8	4.9*
Millet	6	6.6*	6.8	8.8*	9.6	10*	1	4*
Soybean	1.9	2.6*	5.9	6	3.5	5.6*	1.8	2.5*
Wheat	2	3*	2	4*	5	4	2	1.7

Note: * significant difference at ($p < 0.05$).
1: male and 2: female
Source: Survey, 1992

ii) Maize

The involvement of men and women in maize growing activities are not found different in all ethnic and economic group (average of 25 days/ year). But analysis across economic group indicated that labor use of medium group women (31 days/ year) is found significantly greater than that of poor women

(26 days/ year). In some activities like weeding, drying and storage, women involvement is significantly higher than men.

Table 27 Labor use pattern (days/ year) for crop production activities by medium Brahmin/ Chhetri farmers (E2M) (n= 18)

Crops	Activities							
	Sowing		Weeding		Harvesting		Storage	
	M^1	F^2	M^1	F^2	M^1	F^2	M^1	F^2
Potato	2.2	2.1	4.7	4	5.1	5.8	4.5	5.7*
Maize	5.3	3.7	6.6	6.8	4.8	4.2	5.7	6.2*
Millet	6.1	7*	4.6	5.6*	8	8.4*	6.1	8.2*
Soybean	2.2	2.4	2.2	2.2	3	3.2	2	2.2
Wheat	4	3.6	2.6	1	2.3	2	2.5	2

Note: * significant difference at ($p < 0.05$).
1: male and 2: female
Source: Survey, 1992

iii) Millet

There is found significant difference between time spent for millet sowing, transplanting, weeding, harvesting, threshing, drying and storage by male and female of both ethnic group and also of medium and poor economic group owing higher involvement of female. Magar, Gurung women work 31 days/ year as

compared to men working 25 days/ year while Brahmin, Chhetri women use 29 days/ year as compared to men using 24 days/ year.

Table 28 Labor use pattern (days/ year) for crop production activities by poor Brahmin/ Chhetri farmers (E2P) (n= 9)

Crops	Activities							
	Sowing		Weeding		Harvesting		Storage	
	M^1	F^2	M^1	F^2	M^1	F^2	M^1	F^2
Potato	5	5.7	4.7	4	5.1	5.8	4.5	4.7*
Maize	9.4	10.8*	6.6	6.8	4.8	4.2	5.7	6.2*
Millet	5.4	6.2*	4.6	5.7*	8	8.4*	6.1	8.2*
Soybean	3	3.5	2.2	2.2	3	3.2	2	2.2
Wheat	6	4.3	2.6	1	2.3	2	1.3	1.8

Note: * significant difference at ($p< 0.05$).
1: male and 2: female
Source: Survey, 1992

iv) Soybean

Soybean may also be regarded as female's crop to perform all production activities in rich and poor Magar, Gurung . But in the rest of socioeconomic groups, nearly equal participation of male and female is observed. There exists significant difference between female of Magar, Gurung and Brahmin,

Chhetri ethnic group showing more involvement of Magar, Gurung (15.2 days) in sowing, weeding, harvesting, drying and storage of soybean than that of Brahmin, Chhetri (10.61 days).

Table 29 Labor use pattern (days/ year) for crop production activities by ethnic group

Crops	Magar/ Gurung		Brahmin/ Chhetri	
	Male	Female	Male	Female
Potato	32	31	15	14
Maize	25	23	25	25
Millet	25	31	25	29
Soybean	13	15	10	11
Wheat	14	15	11	9
	(n = 118)		(n = 27)	

Source: Survey, 1992

v) Wheat

There seems no significant difference on gender activities among different socioeconomic group except rich and poor Magar, Gurung group in which male and females' labor use in sowing and intercultural operation of wheat crop are significantly different. In both group, female spent more time than male. Similar situation is also observed for postharvest activities in wheat in case of rich Magar, Gurung (Table 24).

Table 30 Labor use pattern (days/ year) in crop production activities by women of different economic status group

Crops	Rich	Medium	Poor
Potato	27	31	26
Maize	20	25	26
Millet	28	33	29
Soybean	17	11	12
Wheat	22	9	11
	(n = 14)	(n = 81)	(n = 50)

Source: Survey, 1992

2) Animal husbandry

Both male and female farmers participate in animal husbandry. Women spend 25 - 30 per cent of the total daily working time in major livestock activities. Time spent daily by women in Salle village shows quite more than that reported by Acharya and Bennett (1983) as 3.71 hours per day by a woman in farming and animal husbandry work. But, this is less as compared to 6.5 working hours of Pakistani women in livestock activities (Adapted from Paris, 1992). Further, Katuwal (1990) reported that women in eastern hill of Nepal spend more than 6 hours each day on these activities.

Female spend more time on the livestock activities than their male counterparts regardless of ethnic group. Paris (1992) indicated higher participation of women than men in midhills of Nepal. Shrestha *et al.*, (1992)

reported that women spend on an average 23 per cent of total daily working hours on livestock activities; comparing this involvement with input of men, 21 per cent per day with livestock, it appears that women devote more time to livestock activities, however, the difference was not significant. And also in Bangladesh, the author indicated higher women participation in all livestock activities and in all farm size holdings. But in Salle village, this case is revealed significantly only in case of Magar, Gurung. Even though Brahmin, Chhetri women spend less time regarding these activities (5.6 months/ year) than Magar, Gurung (6.07 months /year), it does not show significant differences. However, this result can be compared with the finding of Shrestha *et al.*, (1992). According to the authors, average daily working hours of women in livestock activities found to be greater in Brahmin, Chhetri (5.25 hours/ day) than in Magar, Gurung (4.5 hours/ day) in midhills, however, this is greater in Magar, Gurung (4.75 hours/ day) than in Brahmin, Chhetri (3.9 hours) in high hills situation. Both high and mid hills are covered in Salle observation.

It is found that women's labor use for livestock activities in every socioeconomic strata, is more than that of men but not significantly different. However, detailed analysis on each activity shows interesting result. In feeding, shed cleaning and compost making processes, women of medium and poor Magar, Gurung and Poor Brahmin, Chhetri socioeconomic group allocate significantly greater time than men. Similar case occurs in case of feeding water to livestock with only rich and medium Magar, Gurung and in case of preparing and feeding *khole* with only medium and poor Magar, Gurung. The findings of more women involvement than

men for such activities are also reported by Timsina *et al.*, (1989). Feeding management and shed cleaning are important routine jobs performed by women.

In another aspect of animal husbandry like milking, disease management, selling and buying of livestock and livestock products (*ghee*, curd etc), labor use of men is greater than that of women regardless of socioeconomic strata. Women provide about 37 per cent and men provide 54 per cent of the labor required for milking. Time allocated by women in milking shows direct relationship with economic status, indicating higher involvement in rich and lower in poor. It may be due to large stock in rich farm families and women in rich households are often busy with only household works since they can have wage labor for farming activities.

Table 31 Labor use pattern (days/year) for livestock activities by socioeconomic group

Activities	Rich Magar, Gurung		Medium Magar, Gurung		Poor Magar, Gurung		Medium Brahmin, Chhetri		Poor Brahmin, Chhetri	
	M[1]	F[2]	M[1]	F[2]	M[1]	F[2]	M[1]	F[2]	M[1]	F[2]
Preparing & feeding *khole.*	40	45	43	48*	31	37*	42	42	34	45
Feeding water	34	45*	43	47*	33	34	39	40	38	45
Feeding fodder, forage, straw.	34	38*	36	37*	30	32*	25	26	31	45*
Shed cleaning and compost making.	42	45	34	44*	32	36*	41	45	27	45*
Making *ghee, curd* etc.	2	2.3	6.7	7	9	10	17	23	4	8
Milking	67	60	41	29	30	22	39	24	21	16
Disease management.	7	5	2	1	5	2	3	3.3	4	1
Selling & buying of livestock.	3	2.6	5	1	3	2.5	4	3.6	4	2
Selling *ghee, curd*	15	12	-	-	7	3	14	8	5	4
	n = 14		n = 62		n = 42		n = 18		n = 9	

Note: * significant difference at ($p < 0.05$).
1: male and 2: female

Source: Survey, 1992

3) Tree activities

Rural women are among the most frequent and most important forest users in Nepal. They are the ones who suffer most due to inadequate sources of fodder and fuelwood in their locality. As the forests accessible to them are nowadays declining, dependence is increasing towards multipurpose trees on farmland.

Analysis shows that labor use by women in farmland tree activities is significantly greater than by men in Magar, Gurung ethnic group. However, there is no significant difference in case of Brahmin, Chhetri and also between women of these ethnic group. As Brahmin, Chhetri do not own *nagi*land, only Magar, Gurung women are involved more than men in case of *nagi*land tree activities. With regard to economic group, almost same amount of time is allocated by medium and poor women. In case of medium group, labor use by women is found significantly greater than that by men only in farmland tree activities but such case is not found in forest/ *nagi*land tree activities. No significant difference is noted among socioeconomic strata.

Fodder collection is most time consuming job and women perform 84 per cent of this work. Women on an average spend almost 26 days per year gathering fodder and bedding material as compared to 21 days per year devoted by men. Between socioeconomic strata except medium and poor Brahmin, Chhetri, there

exists also a greater variation indicating significantly higher time allocated by women than by men. Similar results are indicated by Timsina (1992). The involvement of women in fuelwood collection is more (12 days/ year) than men (10 days/ year) because they have more responsibility in cooking and feeding household members.

Table 32 Labor use pattern (days/ year) for forestry/ tree related activities by socioeconomic group

Activities	Rich Magar, Gurung		Medium Magar, Gurung		Poor Magar, Gurung		Medium Brahmin, Chhetri		Poor Brahmin, Chhetri	
	M[1]	F[2]	M[1]	F[2]	M[1]	F[2]	M[1]	F[2]	M[1]	F[2]
Farmland: Nursery related activities.	3.7	3.3	2.8	2	1.7	1.4	2.3	1.8	2.9	1
Fodder collection.	18	23*	21	30*	24	29*	20	25	21	26
Firewood collection.	8	7	12	11	19	14	12	13	11	13
Logging	0	6	1	9	3	11	1	10	2	12
Forest/ nagi land: Nursery related activities.	3	3.5	2.6	2.2	1.5	2.2	1	1	NA#	
Fodder & bedding material collection.	23	27	26	33*	18	23*	25	24	20	28
Firewood collection.	7	6	9	9.5	6.5	9.4*	5.9	5	8.5	9
Logging	0	7	1	9	2	10	1	10	2	11
	n = 14		n = 62		n = 42		n = 18		n = 9	

Note: * significant difference at ($p < 0.05$); # not available.
1: male and 2: female
Source: Survey, 1992

Table 33 Results of t- test ($p < 0.05$) for labor use pattern

Activities	By gender	By economic status	By ethnic group
Crop Production:			
Potato	NS	NS	S
Maize	NS	S	S
Millet	S	S	S
Wheat	NS	NS	NS
Soybean	S	S	S
Livestock Production:	S	NS	NS
Tree Management:			
Farmland	S	S	S
Forest/ *Nagi*	S	S	S

Despite the fact that females dominate in fodder and fuelwood collection and in their overall contribution to tree activities, observations show that males do put in more time than women in other subcategories such as all nursery related activities, chopping logs, cutting trees for timber etc.

4.2.3 Time allocation pattern for daily activities by gender

The daily work routine of gender was prepared through various PRA approaches like "Activity Profiles", "Daily Routines" and "Participant Observations".

The monthly distribution of activities (Table 34), on which both men and women were involved, were useful to be described before explaining about daily

chores. The extent of involvement by gender was already clear from the involvement observation and labor use pattern.

Table 34 Schematic display of activities by month

Months	Major activities
January	Potato sowing, firewood collection, vegetable cultivation
February	Potato sowing, firewood collection
March	Land preparation, maize sowing and wheat sowing
April	Land preparation, maize sowing, soybean sowing, wheat harvesting
May	Maize hoeing/ weeding, potato harvesting, potato storage and seedbed preparation for rice
June	Soybean weeding, land preparation for rice and rice transplanting
July	Weeding in rice field, tree plantation and earthing up in maize
August	Land preparation and sowing millet and weeding in rice field
September	Maize harvesting
October	Weeding millet and harvesting rice and soybean
November	Land preparation for wheat
December	Land preparation for potato, firewood collection, millet harvesting, wheat sowing

Source: PRA and RRA, 1992

Table 35 Daily work routine of gender by detail activities during winter season* (average of 3 women, 4 men)

Activities	Time taken	
	Women	Men
Grinding of maize and making fire in *chulo*	2 hrs	-
Sweeping and cleaning the house	10 min	-
Bringing water from the spring (1st)	20 min	-
Feeding grasses,tree leaves & straw to livestock (1st)	10 min	15 min
Feeding grasses, twigs to goats (1st)	10 min	10 min
Cooking lunch	25 min	-
Firewood gathering at around farmland	25 min	15 min
Giving feed to chicken/ pigs (1st)	15 min	-
Cleaning utensils	15 min	-
Cooking *Khole* for livestock[1]	20 min	10 min
Working in the field	2 hrs	4 hrs
Eating lunch and cleaning the kitchen wares	25 min	10 min
Cleaning shed (day time 1st)	30 min	20 min
Feeding *Khole* to livestock (1st)	10 min	10 min
Feeding tree leaves, straw & water to livestock (2nd)	10 min	10 min
Giving feed, water to goats (1st)	15 min	-
Cleaning shed (2nd)	35 min	30 min
Bringing water from spring (2nd)	25 min	-
Giving feed to chicken/ pigs (2nd)	10 min	-
Discussion with neighbors	15 min	1 hr
Preparing snacks for laborers	20 min	-
Feeding tree leaves & straw to livestock (3rd)	10 min	-
Feeding grasses, tree leaves to goats (2nd)	10 min	5 min
Feeding water to livestock	20 min	10 min
Cooking dinner and cleaning utensils	1 hrs	-
Total	11 hrs & 25 min	7 hrs & 30 min

Note: 1 : Livestock here indicates only cows, buffaloes and oxes.
* The interview was done during November and December and farmers were asked about the whole winter season.

Source: PRA, 1992

The detail of daily work routine is influenced by the household size, socioeconomic status and physiographic conditions. Shrestha *et al.*, (1992) stated

that the daily work carried out by women at different altitudes and in different ethnic group was considered different (but not statistically significant). The daily work routine by detail activities for monsoon and winter season are shown in Tables 35 and 36 respectively. In Salle, the total working hours per day spent on household, livestock, tree and field activities were observed higher in female (12 hours 49 minutes) than in male (8 hours 5 minutes) (Tables 37 and 38). Siwi (1990) revealed that Indonesian women work more than 10 hours per day as compared to less than 10 hours for men. It was also found different for different seasons (Tables 35 and 36) indicating more time spent in monsoon than in winter. The daily working hour of Nepalese women found to be little bit less than that of Indian women who spend 14 to 16 hours per day during crop season (Chauhan, 1992). The Salle observation for monsoon is higher than that shown by Acharya and Bennett (1983) as 11 hours 21 minutes per day. Women contribute substantially more to domestic tasks than men. On average, 4.07 hours per day is spent on cooking and cleaning by women whereas men spent only 10 minutes (Figures 29 and 30). Acharya and Bennett (1983) indicated 4.04 hours spent by women on cooking, cleaning, doing laundry and caring for children. They also reported that women do 70 per cent more work in the house and subsistence agricultural production than men. Similarly, Stephens (1992) showed that women have to work 2 to 3 hours longer each day than men. The total time spent in all crop and household activities is higher for women (59 per cent) than men (41 per cent) in Thailand (Shinawatra *et al.*, 1987). Their time throughout the day is very fragmented due to their multiple economic and domestic responsibilities and there is little time for any leisure.

The daily work routine of women in the Salle village can be described like this. They start housework at about 4 a.m and finish at 9 p.m. In early morning, they grind corn and clean the house. Men get up later than women.

Table 36 Daily work routine of gender by detail activities during monsoon season* (average of 3 women, 3 men)

Activities	Time taken	
	Women	Men
Grinding of maize and making fire in *chulo*	2 hrs	-
Sweeping and cleaning the house	10 min	-
Bringing water from the spring (1st)	20 min	-
Feeding grasses,tree leaves & twigs to livestock (1st)	15 min	10 min
Feeding grasses, twigs to goats (1st)	20 min	10 min
Cooking lunch	30 min	-
Firewood gathering at around farmland	15 min	15 min
Giving feed to chicken/ pigs (1st)	15 min	-
Cleaning utensils	15 min	-
Cooking *Khole* for livestock[1]	15 min	10 min
Working in the field	3 hrs	5 hrs
Eating lunch and cleaning the kitchen wares	30 min	10 min
Giving tea snacks to guests	15 min	-
Cleaning shed (day time 1st)	30 min	25 min
Feeding *Khole* to livestock (1st)	10 min	10 min
Feeding tree leaves,twigs & water to livestock (2nd)	15 min	10 min
Giving feed, water to goats (1st)	15 min	-
Cleaning shed (2nd)	35 min	30 min
Bringing water from spring (2nd)	20 min	-
Giving feed to chicken/pigs (2nd)	10 min	-
Discussion with neighbors	10 min	40 min
Preparing snacks for laborers	35 min	-
Feeding grasses, tree leaves to livestock (3rd)	15 min	10 min
Feeding grasses, tree leaves to goats (2nd)	20 min	10 min
Giving snacks to laborer	10 min	-
Feeding water to livestock	30 min	10 min
Cooking dinner and cleaning utensils	1 hr	-
Total	13 hrs & 35 min	8 hrs & 40 min

Note: 1 : Livestock here indicates only cows, buffaloes and oxes.
* The interview was done in April and farmers were asked about the whole monsoon season.
Source: PRA, 1992

Women do the cooking in all households and they spent about 4 hours in this activity. If a family has only one woman, the man sometimes does the cooking if the woman is sick. Food is cooked three times a day; lunch is eaten in the late morning, a snack in the afternoon and dinner in the evening. The main staple food for poor families is maize and also sometimes boiled potatoes, the richer people eat rice.

Table 37 Daily work routine of gender by group of activities during winter season (average of 3 women, 4 men)

Activities	Time taken			
	Women		Men	
	Hour	Min	Hour	Min
Cooking food	3	15	-	-
Cleaning the house and utensils	1	5	-	10
Bringing water from the spring	1	-	-	-
Feeding ruminants	1	45	1	5
Feeding chicken/ pigs	-	35	-	-
Firewood gathering at around farmland	-	25	-	15
Working in the field	2	-	4	-
Cleaning shed	1	5	-	55
Discussion with neighbors	-	20	1	5
Total	11	25	7	30

Source: Time allocation study, 1992

Table 38 Daily work routine of gender by group of activities during monsoon season (average of 3 women, 3 men)

Activities	Time taken			
	Women		Men	
	Hour	Min	Hour	Min
Cooking food	4	5	-	-
Cleaning the house and utensils	1	-	-	10
Bringing water from the spring	-	45	-	-
Feeding ruminant	2	30	1	10
Feeding chicken/ pigs	-	35	-	-
Firewood gathering at around farmland	-	15	-	15
Working in the field	3	-	5	-
Cleaning shed	1	15	1	5
Discussion with neighbors	-	10	1	-
Total	13	35	8	40

Source: Time allocation study, 1992

Roasted maize and soybeans are most popular snacks. Women normally bring water from the *Pandera*. However, if the water source is near, children also help with this task. Fetching one load of water takes 10 minutes to half an hour depending upon distance of spring from house and quantity of water output from the spring. Women have to collect water five or six times a day for drinking, cooking, cleaning kitchen wares and preparing animal feed, depending upon the size of the family, number of livestock and use of water.

Magar , Gurung women also prepare alcoholic drink (*Jand*) from maize and millet by themselves. Every Magar, Gurung households, despite poor or rich have *Jand* and they offer especially this drink to the guests.

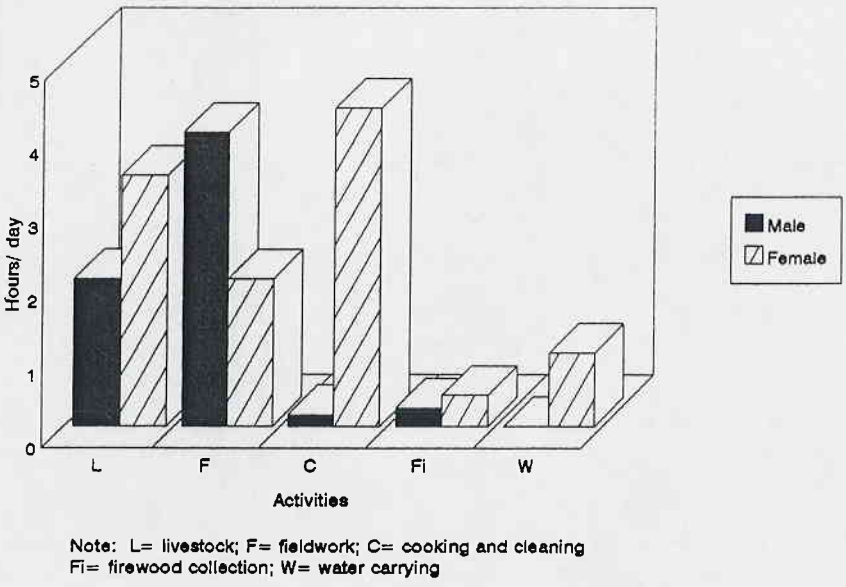


Figure 29 Time spent by gender on agroforestry and household activities in winter season
Source: PRA, 1992

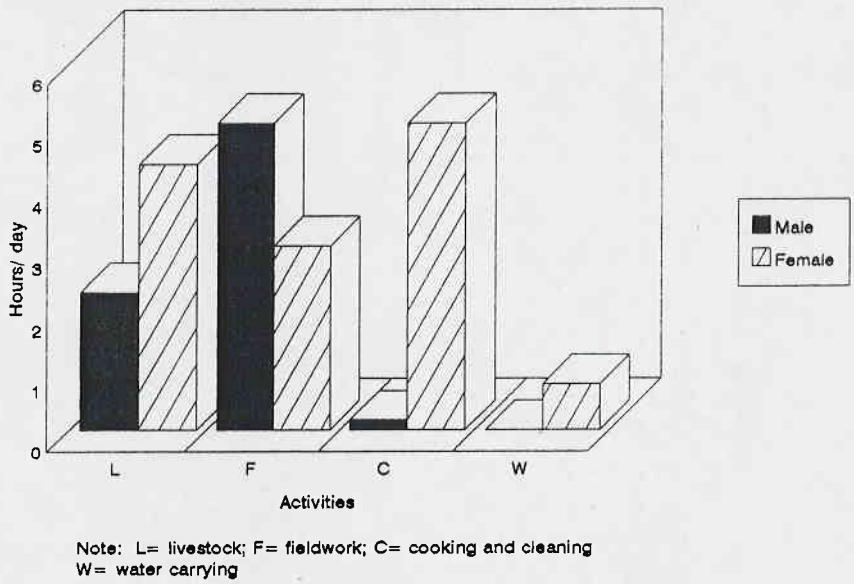


Figure 30 Time spent by gender on agroforestry and household activities in monsoon season
Source: PRA, 1992

4.2.4 Decision making

The whole process of decision making in the household is a complex one, and it is difficult to pinpoint which of the members has made a particular decision. Although men are culturally accepted as the decision maker in the household, the decisions that they make are usually suggested by other members of the household, particularly by the wives. The information are not easily obtainable from a questionnaire survey, and a participant observation method is useful for finding the less obvious factors. For example, when asked directly a question such as "who made this decision?" the answer was invariably the husband or the head of the family. But in actual practice the women of the house, particularly, the wives exercised a great deal of influence. The husbands of this community almost always consult their wives informally before taking a major decision.

To examine the degree to which women make decisions in areas important in the household, four main areas of decision making have been distinguished: crop production, livestock, tree management and household activities.

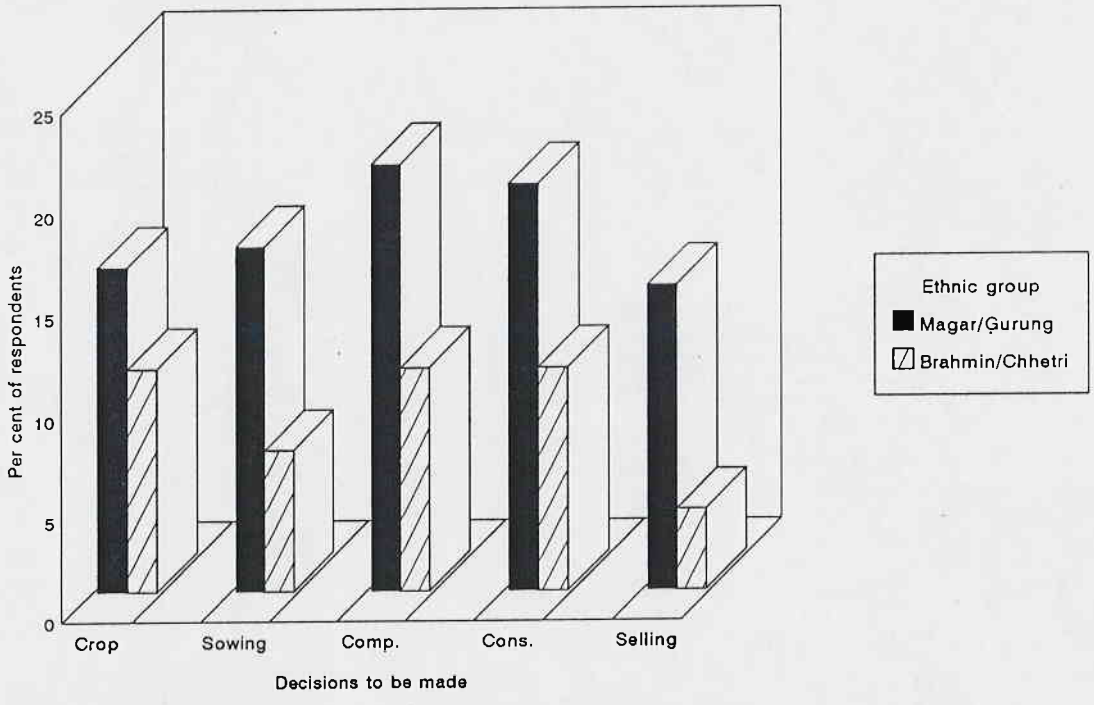
1) Role of gender on decision making of various agroforestry activities

A role of gender on decision making should have been studied with respect to men as well as women in further detail. Finding of such type results would be rather more informative to understand the assess on decision making relating to the various agroforestry activities. However, time requirement as well as

the financial constraint were the main lacuna to perform the detail study. In this study, womens' activities were considered in detail since they are invisible and unseen to the most of activities concerning to collection of facts and findings.

i) Crop Production

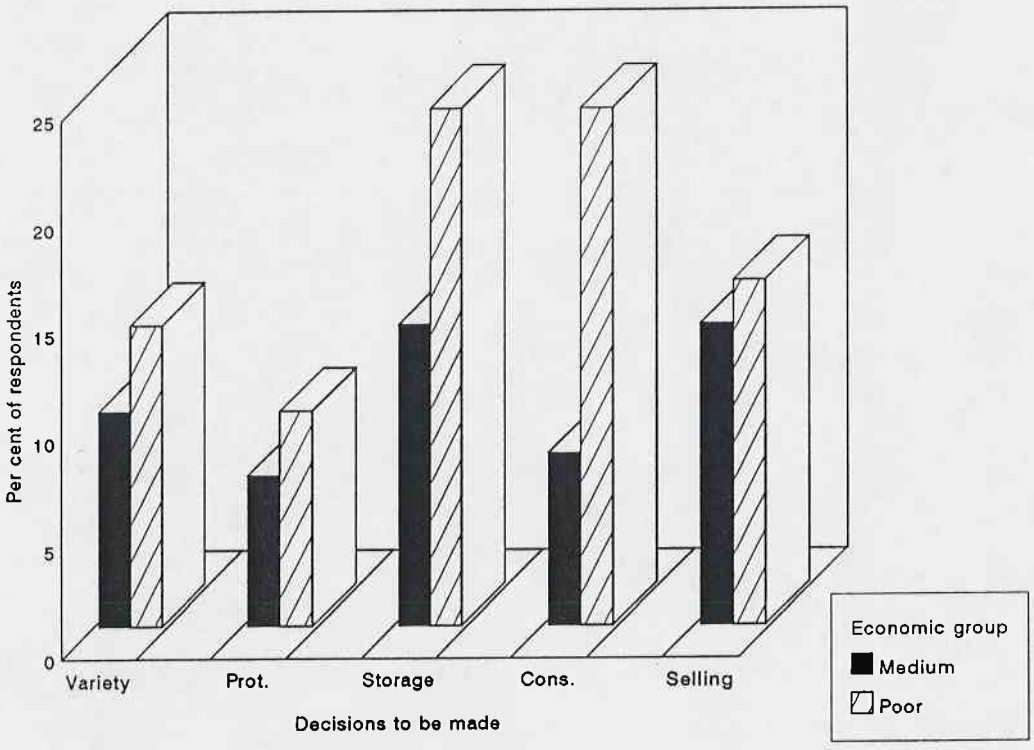
In almost all cases of different operations directly related to crop production (choice of area/ land for different crops, cropping pattern, planting time, harvesting time, adoption of plant protection measures etc), half of decisions are made by both sexes with common understanding (Appendix Tables 7 and 8).



Comp. = Use of compost; Cons.= Household consumption of grain

Figure 31 Womens' decision making role regarding crop production by ethnic group
Source: Survey, 1992

Rest of the decisions are generally made either by men or women alone. In the activities like amount of compost to be applied, time of weeding and amount of grain for the whole year consumption, women have comparatively better role. Same observations were also revealed by Timsina *et al.*, (1990). The extent of overall decision regarding crop production activities is found to be affected by ethnicity. Magar, Gurung women have better role as compared to Brahmin, Chhetri (Table 39 and Figure 31). But the comparison among three economic status group reveals that women of resource poor families have strong role in decision making as compared to women of resource rich and medium families (Table 40 and Figure 32).

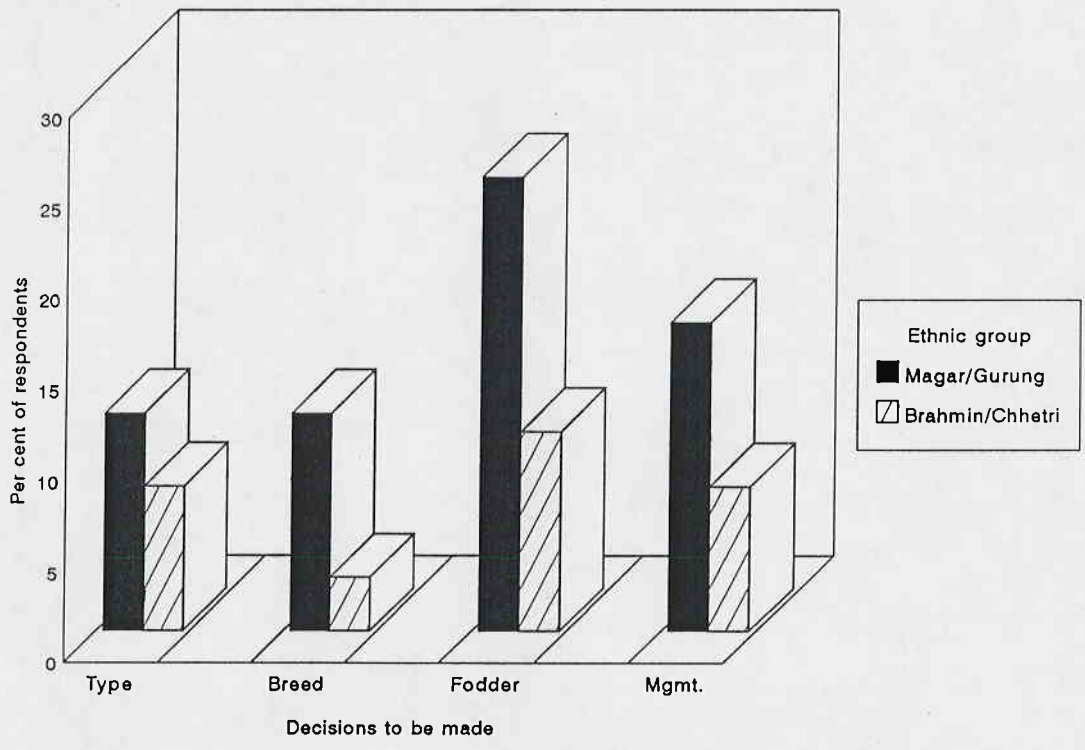


Prot. = Plant protection; Cons.= Household consumption of grain

Figure 32 Womens' decision making role regarding crop production by economic group
Source: Survey, 1992

ii) Livestock management

In practices relating to livestock, male heads of families take almost half of decisions jointly with their wives. However, in certain decisions on choice of area and person for fodder collection and feeding management in dry season, involvement of women is greater (about 19 per cent) (Appendix Tables 9 and 10). Thangavelu (1992) cited that decision making on animal management and husbandry is more by the women than by men in Malaysia. Timsina *et al.*, (1990) also showed that Nepalese women's decisions become critical in animal production activities. Animal purchase is mostly decided by men.



Mgmt.= Feeding management; Fodder= Fodder collection; Breed= Selection of breed

Figure 33 Womens' decision making role regarding livestock production by ethnic group
Source: Survey, 1992

Table 39 Gender related decision making processes concerning agroforestry production by ethnic group

Activities	Per cent of respondents					
	Magar/Gurung			Brahmin/Chhetri		
	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]
Crop production	36	16	48	49	8	43
Livestock management	43	14	43	49	8	43
Tree management	58	11	32	61	7	35
HH & other activities	51	14	35	65	18	27
	n = 118			n = 27		

Note: 1: male, 2: female, 3: both
Source: Survey, 1992

Participation of farm women in decision making is associated with caste. Women of Magar, Gurung caste has stronger decision making role as compared to that of Brahmin, Chhetri (Table 39 and Figure 33). But status of economy is observed to be negatively correlated with involvement of farm women in decision making (Table 40 and Figure 34).

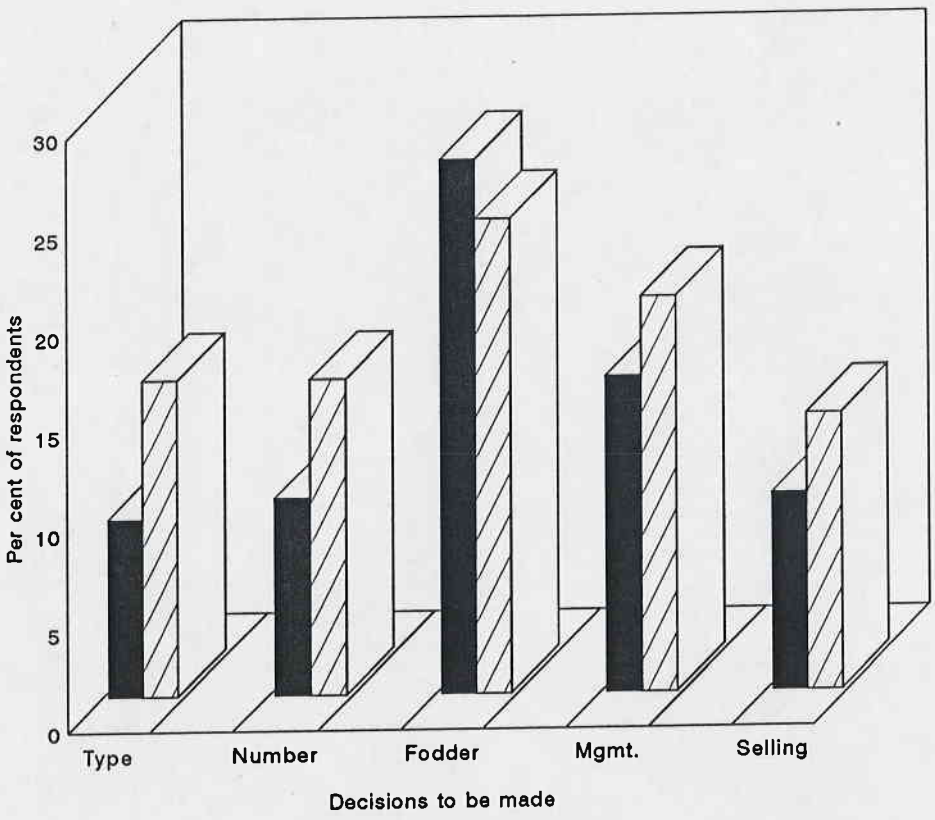


Figure 34 Womens' decision making role regarding livestock production by economic group
Source: Survey, 1992

Therefore, farm women in higher socioeconomic status do not enjoy as much of involvement in decision making process regarding livestock husbandry and management, as those of middle or lower socioeconomic status families.

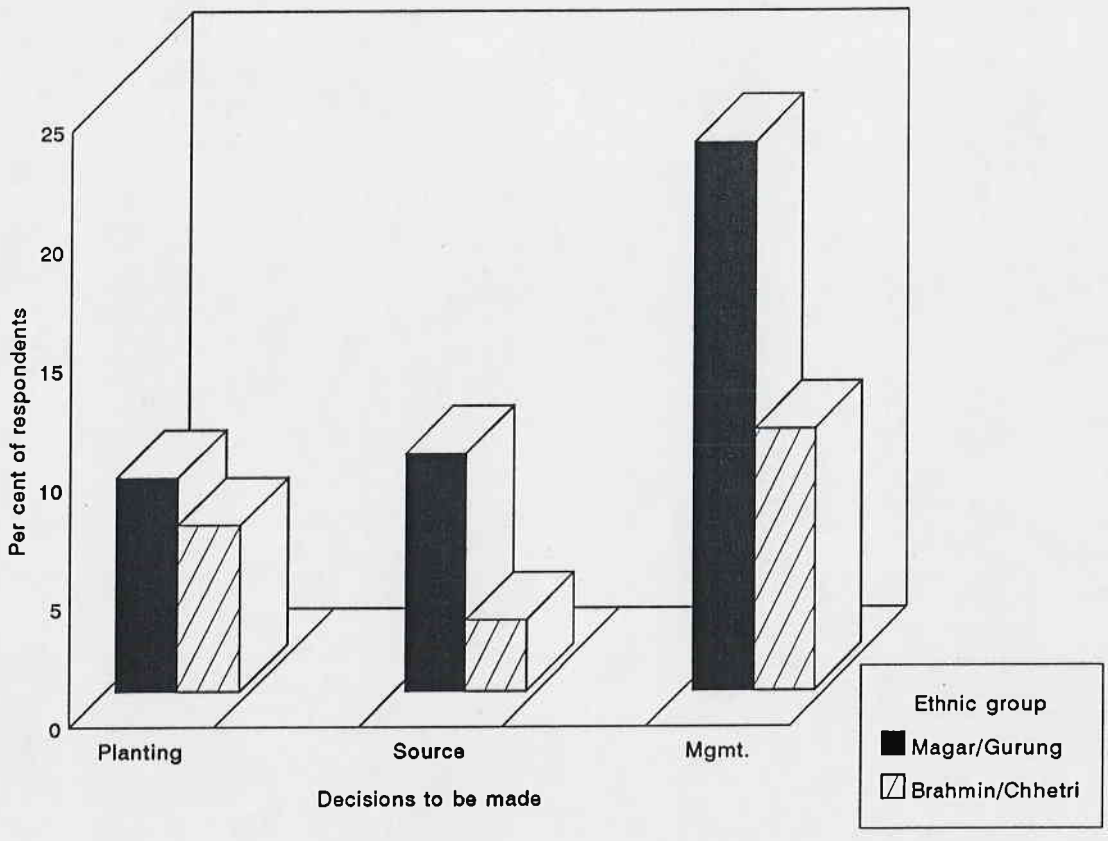
Table 40 Gender related decision making processes concerning agroforestry production by economic group

Activities	Per cent of respondents								
	Rich			Medium			Poor		
	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]
Crop production	55	7	38	31	14	55	46	18	36
Livestock management	56	7	37	40	13	47	50	18	32
Tree management	70	15	29	63	7	30	65	15	20
HH & other activities	32	8	57	48	11	41	68	17	15
	n = 14			n = 81			n = 50		

Note: 1: male, 2: female, 3: both
Source: Survey, 1992

iii) Forestry management

Sixty five per cent respondents reported decision regarding tree activities are generally made by men. For the majority of remaining, decisions are taken equally with the consultation of women (Appendix Tables 11 and 12). Magar, Gurung women are comparatively participating more in decisions related to tree planting and management than those belonging to Brahmin, Chhetri (Table 39 and Figure 35). The extent of decision making role on time and place of fuelwood collection is found to be indirectly related with economic status (Table 40 and Figure 36).



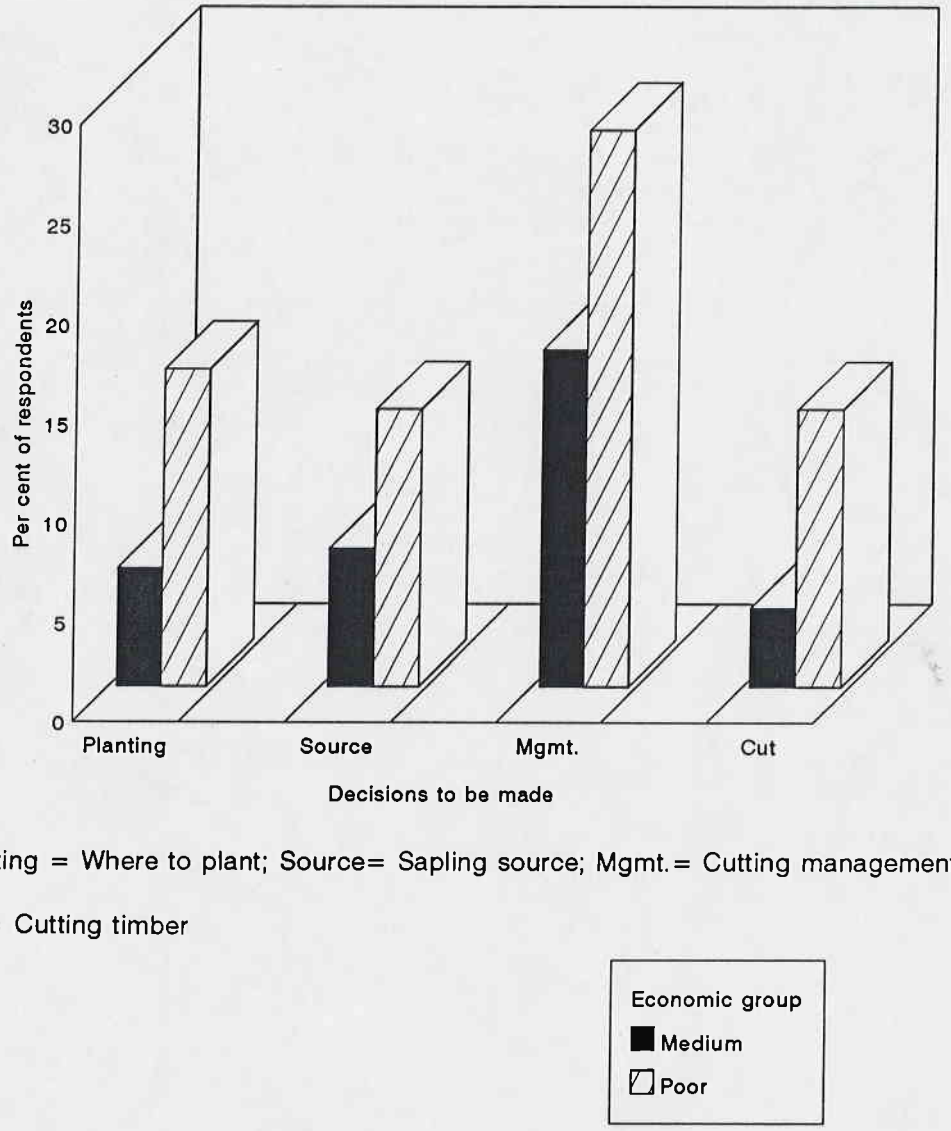
Planting = Where to plant; Source= Sapling source; Mgmt.= Cutting management

Figure 35 Womens' decision making role regarding tree management by ethnic group
Source: Survey, 1992

iv) Household and other activities

Decision making concerning the internal household activities in the rural families are mostly found to be taking principal role by women. Regarding expenditures on household use, about 1/3 rd of the decisions are made by women.

However, the extent is negatively correlated with socioeconomic status (Tables 39, 40). But buying and selling of land/ house and sending children to school are often decided by men. It is found that women's involvement is meager in decision making on participation of village meetings and training activities (Appendix Tables 13 and 14).



Planting = Where to plant; Source= Sapling source; Mgmt.= Cutting management; Cut= Cutting timber

Figure 36 Womens' decision making role regarding tree management by economic group
Source: Survey, 1992

2) Access and control of resources

One of the several keys that need to be considered is control over and access to resources and benefits contributing to family welfare and agricultural productivity (Tisch, 1992). The relationships between and division of labor with gender affect how household and local resources are allocated. The management and control of these resources are important to sustainable agroforestry system. Who has access to the resources used for agricultural activities, in tree growing and animal production is also critical. Some of the main local resources include land, forests, water etc.

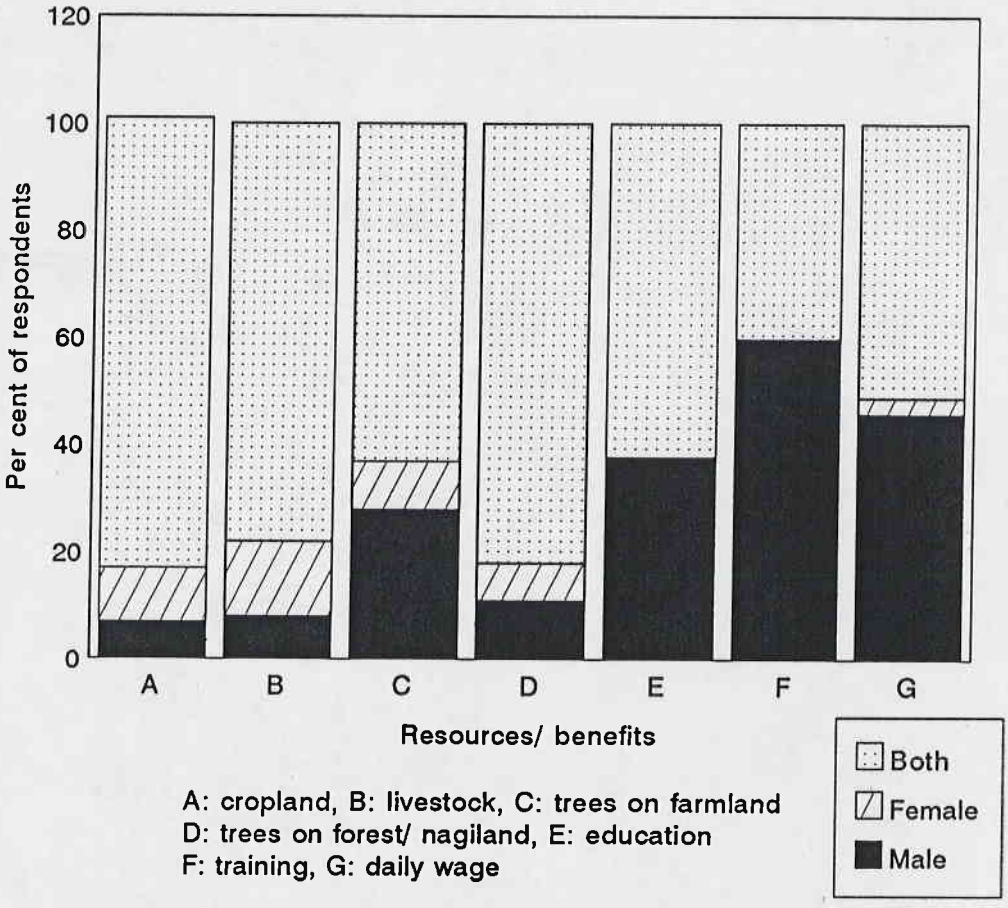


Figure 37 Access of resources by gender in Magar/Gurung
Source: Survey, 1992

The issue of intra-family equity arises because of implementation of new forms of control over resources e.g. *nagi*land, introduction of new tree species and availability of technical help and training for management. In this study, equity issues of gender and socioeconomic status are considered.

However, equity issues differ with ethnicity, religion, class, age and gender. Decisions regarding management of household along with farm, tree and livestock production are affected by the control of resources. Analysis of resource control indicates degree of decision making, concerning particular aspects of agroforestry system. For instance, access to and control over *nagi*land may be critical factor in convincing a farmer to plant new tree species. Planting new multipurpose tree species on the edge of terrace of farmland with crops may seem sensible to the researcher and project planner, but first it must be understood who in the family is seen as responsible for farmland.

It is observed that even though women have access to resources e.g. cropland, livestock, trees, daily wage etc., they have very little control over them. This also differs with ethnicity as mentioned above; indicating Magar, Gurung have comparatively more access and control over these resources.

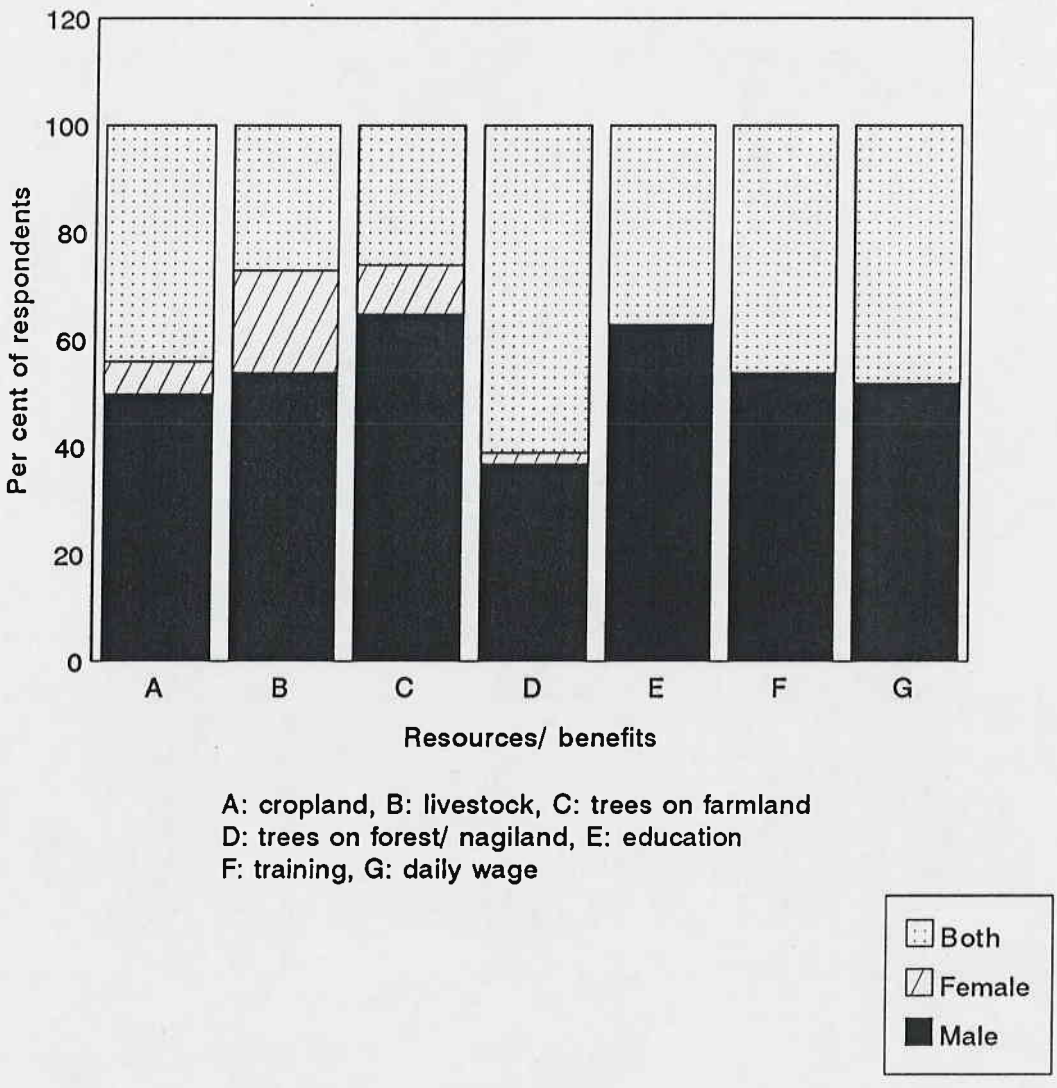


Figure 38 Control of resources by gender in Magar/Gurung
Source: Survey, 1992

Furthermore, the control and responsibility over resources shifts with location. Women are mostly involved in care and management of trees near the homestead or farmland whereas for trees on *nagi*land, men are responsible (Figures 37 and 38). Most of the respondents indicated no or negligible access and control over education, training activities etc.

4.2.5 Perception about resource situation in the village by gender

Sustainability depends on information about local resources. These resources are controlled differently by men and women. There are many agricultural and resource management areas where men and women's knowledge differ. The degree of gender differentiation in knowledge base shapes problem identification and technology adoption within the household.

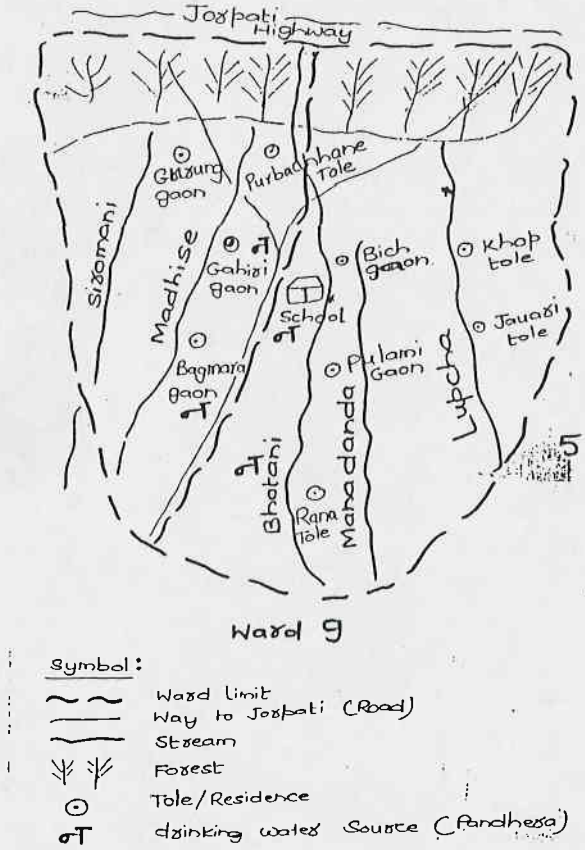


Figure 39 Resource map drawn by male farmers
Source: Survey, 1992

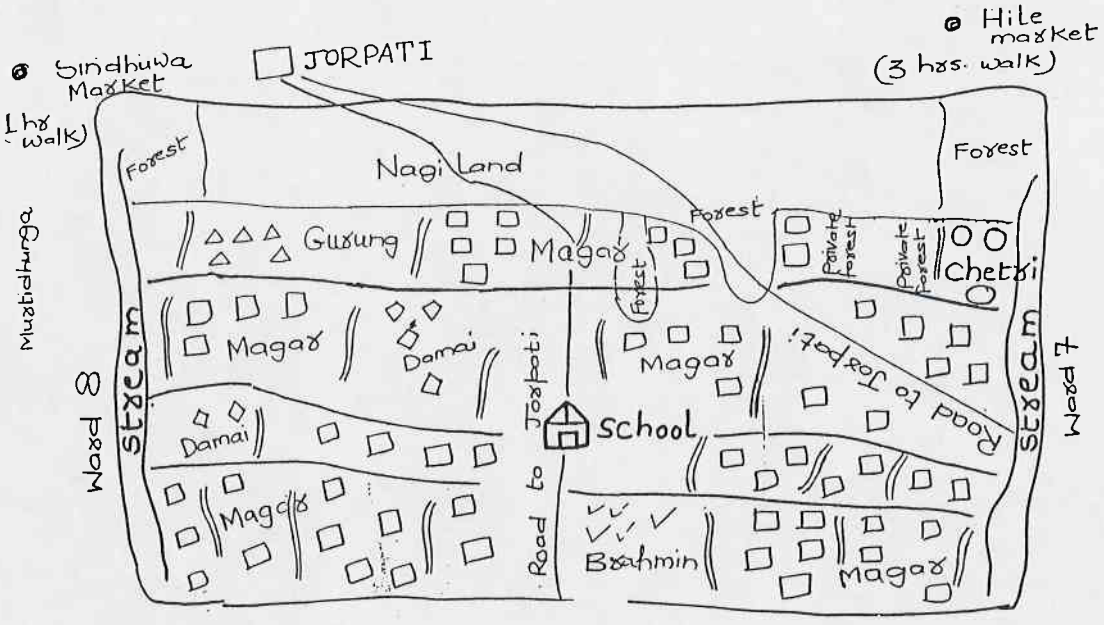


Figure 40 Resource map drawn by female farmers
Source: Survey, 1992

The agroecosystem resource mapping by PRA Techniques revealed different perceptions, views and thinking of male and female farmers about their resource situation in the village. This also provided an opportunity of people to show a group of outsiders a version of their area which needed certain emphases and areas for intervention. The villagers, particularly male, expected the researchers to be capable of offering assistance of some form no matter how the exercise was introduced. In this situation, they wished to prompt certain conclusions and make certain points. Female, on the other hand, had none of the expectations and wished just to show an accurate version of their area. The maps drawn by male and female are different and

are presented in figures 39 and 40. The male farmers considered political/ administrative boundary of the village and draw a more accurate map in this aspect. They showed the whole area with location of households of different social groups, grassland/ forest, and major streams and drinking water resources. Discussions with men were centred on the lack of sufficient forest/ fodder for maintaining their livelihood. The women, on the other hand, were not familiar with the administrative boundary so they fixed their own boundary covering the village. But the maps drawn by women farmers seem more detail and convey descriptive information about resources; for example, regarding water resources i.e., springs, they not only consider location but also the point source and distance from house. These different perceptions may be due to the fact that women mostly work around the homestead and so they are more concerned about these situations. As men have more access to the world outside the village and to politics, training, meeting and discussions, so they have different perception from women. Figures 39 and 40 indicated that as compared to men, women had detailed perception about the village with regard to household situation which also directly showed the access of women to resources necessary for household activities. Women located from small private forests to the springs in the map, which indicated that they had access to these resources.

CHAPTER V

PRIVATE TREE PLANTING PROGRAM OF PAC AND ITS EVALUATION

The role of tree subsystem as an important component of household inter-relationships has been described earlier (Chapter IV). Due to the prominent interactive effect, each component may be spectacular more or less depending on the bio-physical as well as socioeconomic structure of the area. Status of tree component is directly related with the livestock, which varied among different ethnic groups. The tree plantation program launched by the PAC on some of the private barren as well as cultivated land has developed a new consequences of system interaction, which is obvious with respect to gender differentiation and the agroforestry system.

5.1 Private tree planting program of PAC

PAC is the multidisciplinary semi-governmental project, whose objectives and approaches emerge from the strongly felt need for arresting declining trends in productivity and maintaining sustainability of hills resources. The workable solutions to the problems of hill agriculture that PAC's hope, can be found through an

integrated and multidisciplinary based development approach. PAC's one of the pioneer project which has emphasized a private tree planting program in a relatively structured manner.

The methods and approaches the centre has chosen to promote this program are more than just distribution of seedlings. PAC's innovation has also been to involve farmers in forestry activities.

5.1.1 Introduction of PAC's tree planting program

The PAC's forestry program was initiated at a time when all the forest public land belonged to government, following to the nationalization of forest in 1957 and the forest act of 1961. The program was therefore started before the present community forestry program, during the late 1970s by the deliberate policy of the centre to focus on private tree planting. Two things are reported by Malla (1988), from the analysis of the existing forestry situation in the Pakhribas area. First, as a result of deforestation there is very little public forest left and farmers' dependency on private land for fodder and firewood are increasing. Second, there is still uncultivated land available in such forms as marginal land, farm boundaries, gullies, streambanks and odd corners which, at present are underutilized. The proper utilization of such lands, particularly through planting trees and grasses, has tremendous potential for raising overall production.

The Private Tree Planting Program has following objectives;

1. To provide farmers with trees and technical suggestions for scattered planting.
2. To establish block plantations of fodder and fuelwood trees on those private land sufficient for at least fifty trees.

The field staff visit the sites and decide jointly with the farmers which tree species are to be planted. At the time of planting, they go and provide technical support to farmers for planting trees and in the following winter they make follow up visits and suggest farmers to protect, weed, mulch and if possible manure the trees.

In the last ten years, the centre has distributed over 200,000 saplings and established some 500 fodder and fuelwood blocks on private farmland. In the early stage of the program, no charge was made for the trees distributed, but a record was kept which enabled the forestry staff to make follow up visits in the following winter. In the subsequent year, the decision was made to charge a nominal price for the saplings. The tree planting was extended within Forestry Section's command area in four Koshi hill districts. In Hattikharka Village Development Committee of Dhankuta district, altogether 725 households were provided with saplings and necessary technical supports. In case of Salle village, 21 per cent of total households responded of participating in private tree planting program.

5.1.2 Initiation of tree planting program in Salle village

In the late 1987, a group of farmers from Salle village contacted the Forestry section at PAC seeking advice and help for planting trees on 30 ha of *nagi*land (grassland) previously used for open grazing but privately owned by 68 households. Following a request from the villagers, a program of home farm visits to meet individual farmers and to identify their needs and opportunities was launched by the staff of the Forestry Section. There was equal participation by both *nagi*-owners and non-*nagi*-owners in a series of village on site meetings. The community self help group with 54 members was formed which resulted in the formation of Salle community tree plantation scheme. An executive committee was formed with 6 members, including two women farmers, by the villagers. The members included farmers both with and without access to *nagi*land. Several meetings were organized by the committee to discuss and to agree upon the future program. The main points agreed between the committee and the villagers were;

1. Development of village level program such as the construction of nursery particularly labor from each household.
2. Fixing a nominal charge for seedlings.
3. Preparation of a simple plan for the plantation.
4. Development of local rules and regulations for protection and management of the plantation area.
5. Holding meetings on the first saturday of every month.

PAC provided nursery training to one person selected by the committee to work as a nurseryman. Back in the village, the man with the help of other villagers constructed the village nursery on his private land. Labor required in construction, soil collection etc. and construction materials such as bamboos, shade etc. were contributed by the villagers. PAC provided the nursery polypots and polythene pipes for irrigation. A total of 18,000 saplings (8,000 in 1988 and 10,000 in 1989) have been produced in the nursery. PAC provided an additional 42,000 saplings during the first 2 years to meet the local demands. All collection, transportation, distribution and planting activities were organized by the committee and carried out by the participants themselves. As agreed previously, farmers were charged 15 paisa[1] per fodder tree seedling and 10 paisa for other species. The amount collected was set aside in a community fund which was deposited at the bank in a joint account with the committee chairman and two other committee members as signatories.

5.1.3 Management aspect of tree planting program

For the protection of unfenced plantation area against grazing and vandalization, the committee in consultation with other villagers, developed its own rules and regulations. A summary of these rules and regulations extracted from the

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[1]100 paisa= Rupees 1.0 and Rupees 50= US $ 1

meeting minutes, maintained by the committee over the period of two years, is as follows,

1. Each household is to practise a stall feeding system.
2. A *Kanzihouse* (animal pound) is to be constructed with labor contribution from each household.
3. Animals found grazing on the plantation area are to be brought and kept in *Kanzihouse*. The owners are then charged depending on types of animals and the severity of damage done by animals.
4. Non *nagi*-owners may cut grasses from *nagi*land with permission of owners. However, anyone found guilty of stealing grasses from the plantation area is to be fined 10 ruppees per load.
5. All *nagi*-owners must provide a watchman in turn.
6. All owners of *nagi*land have to contribute labor for the construction of firelines at the start of the dry season.
7. Anyone found guilty of setting fire to the plantation area is to be fined Rs. 500.

Most of these rules found effective, however, some of the farmers reported that, rules like the provision of watchman and contribution of labor for the construction of firelines are difficult to approach at practical level.

5.1.4 Involvement of gender

The successful management of the *nagi*land/ forest depends upon the active participation of women, as they are responsible for collecting most of the fuelwood, fodder, leaf composting and bedding as well as controlling grazing. They also provide much of the labor for nurseries and tree planting. The men, on the other hand, generally take care of cutting and selling timber and with administrative decisions about the forests.

It is generally known that women farmers are highly involved in tree planting and management activities. However, buying and carrying of saplings from nurseries or the project are largely done by men, the planting, caring and management of saplings are reported to be mostly performed by women. From the beginning, two women farmers voluntarily agreed to work as committee members in assisting the execution of private tree planting program in the Salle village. Their participation in meetings and discussions were negligible as compared to men. Through informal interview, it was found that, even though they are interested in the issues discussed in the meetings many times they cannot be bold enough to express in the group as they are illiterate and lack the confidence and also lack awareness in various other programs executed by the project and government. Another reason is of course the lower societal status of rural women. Some indicated that it was rooted in the male dominated structure of Nepalese society whereby women were supposed to be secluded within the household with a minimal role in decision making. Siddiqi (1989) reported that when women members didn't show up for a

Forest Management Committee, it was assumed that they were not interested in forestry. In fact, women did not show up because the timing of the said meetings were inappropriate for them. Some farmers also responded that it was meaningless to join a group with five times as many men as women, where men would dominate all discussions and decision making. Some women also felt that it was a waste of time because important matters such as identification of actual user group and subsistence needs were never brought up at such meetings. The women sometimes opt for such limited exposure also because they do not wish to be bothered as it would mean addition to their regular workload. They are generally quite heavily occupied in the field and do not have much leisure time to participate in activities other than households and field. Participation of women is supposed to be possible only through a slow extension process which emphasizes the importance of user groups (Siddiqi, 1989). Over time this is expected to lead to the inclusion of women, as primary users, in forestry development activities (Fisher and Malla, 1987). In the Salle case, even though, during discussions with the project staff about problems and potentials in tree resources in the village, female farmers particularly are being encouraged to participate, their participation still seem to be below target. Hence, any of the situations for making women interest in participation on discussions/ meetings and realizing them the necessity of their role in successful execution of any forestry programs, should be followed.

5.2 Evaluation of PAC'S private tree planting program

The tree planting program was implemented through a community self help group which agreed through member discussion, on a no- grazing policy in the planted area. The *nagi*land which has been planted, was formerly used for livestock grazing by both the private owners and also non-owners living in the vicinity. Fourty four sampled households (Table 41) who own the *nagi*land and participated in program were mostly Magar and Gurung. The rules of the planting scheme committee mean that no one is now allowed to graze the area, although grass is cut mainly by the *nagi*-owners. As there is no alternative area for grazing, households who used to graze their livestocks on *nagi*land are now practicing stall feeding. Even though the non-*nagi*-owners are not directly participating in tree program, are affected in one way or another.

The Salle scheme is a planting program on private land but its implementation is organized through a community group. Both *nagi*land and cultivated *bari*land is planted with trees and some of the less well off members of the community are involved in this scheme. Non-*nagi*-owners planted tree saplings especially on *bari*land (Thapa *et al.,* 1990).

There has been observed changes in labor requirement and division for agroforestry systems particularly livestock production after the planting scheme was introduced. It is known that contribution of women is major in livestock production.

Therefore, it is important to make evaluation of the effect of program on household and women's situation in addition to its effects on non-*nagi*-owners who used to use *nagi*land, what was in effect a common grazing source. The effect can be observed in terms of livestock rearing practice, livestock holding, awareness and interest in planting new tree species, availability of fodder/ bedding material and labor especially with reference to working women.

Table 41 Farmers owning *nagi*land in Salle village

Ownership on *nagi*land	No. of HH*	Per cent of HH	No.of respondent
Nagi-owners	44	43	55
Non-*nagi*-owners	59	57	90
Total	103 (n = 103)	100	145 (n = 145)

* HH indicates household
Source: Survey, 1992

5.2.1 Overall impact of the program at village level

1) Changes in livestock rearing practice from grazing to stall feeding

The greatest impact of the planting scheme at village level has been the change in practices of grazing to stall feeding. There are trade offs in this situation, as stall feeding system has both advantages and disadvantages. The advantages and disadvantages mentioned by farmers are discussed below:

i) Advantages of stall feeding

a) Increased manure collection for application to cultivated land, rather than it being dispersed on pasture land.

b) Improved livestock disease control, especially of internal parasite burdens by breaking the life cycle.

c) Greater control over protection of crops and tree seedlings allowing regeneration of desirable species and establishment of new plantings and prevention of palatable species being grazed out.

d) Erosion control on pasture land by decreasing overgrazing.

e) Increased energy efficiency with protection against climatic stress and decreased energy expenditure in searching for fodder.

The PRA results indicated that most of the farmers responded first two advantages. In addition to this, they also affirmed in increasing number of children attending school since the adoption of stall feeding (Figure 41). These children were previously engaged in herding animals. The adoption of stall feeding has eliminated this need which in turn has encouraged parents to send their children to school.

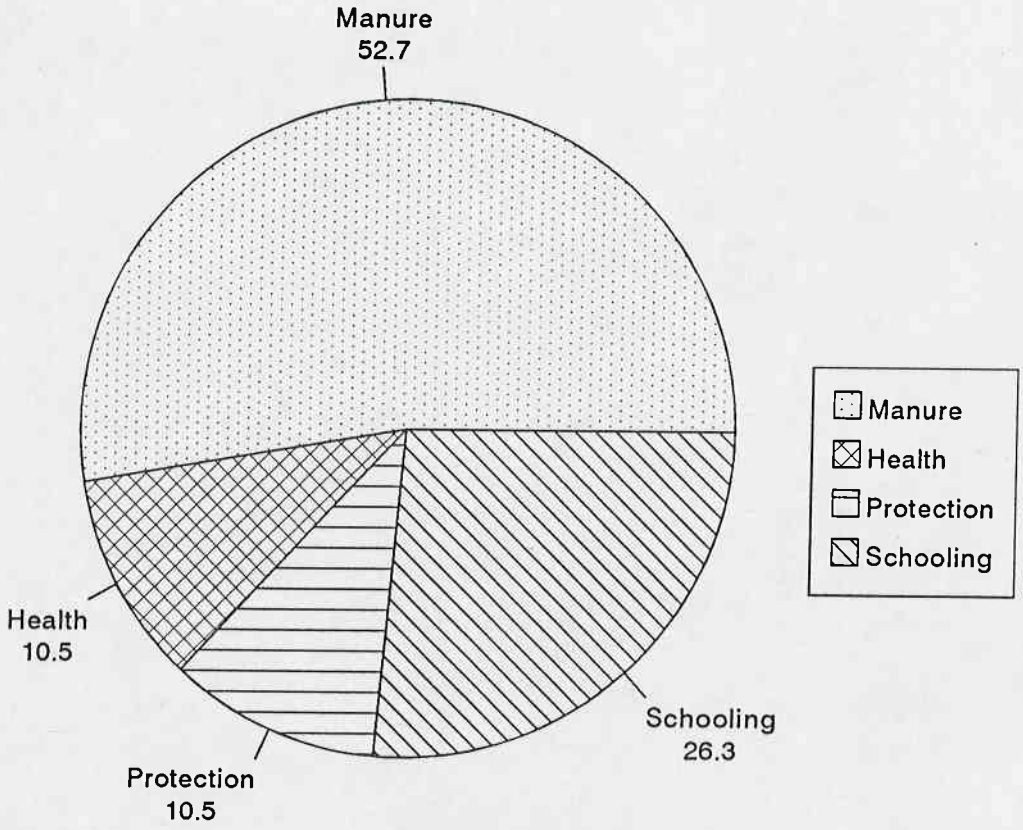

Figure 41 Farmers' response on advantages of stall feeding
Source: Survey, 1992

Some farmers also reported that there is efficient use of labor now. In previous free grazing system, at least one member of the family had to be engaged in herding animals full time, which was regarded as an inefficient use of labor. Currently, children collect fodder during the morning before they go to school and women do so either during morning or afternoon. This type of observed results contradicts the commonly held belief that more labor is required for stall feeding. However, the statement could be justified due to the reduction in livestock population which enabled them to manage their animals in the stall feeding system.

ii) Disadvantages of stall feeding

Some of the disadvantages of stall feeding system are mentioned as higher requirement of fodder, bedding material and labor needed for management which forced them to reduce their herd size (Figure 42).

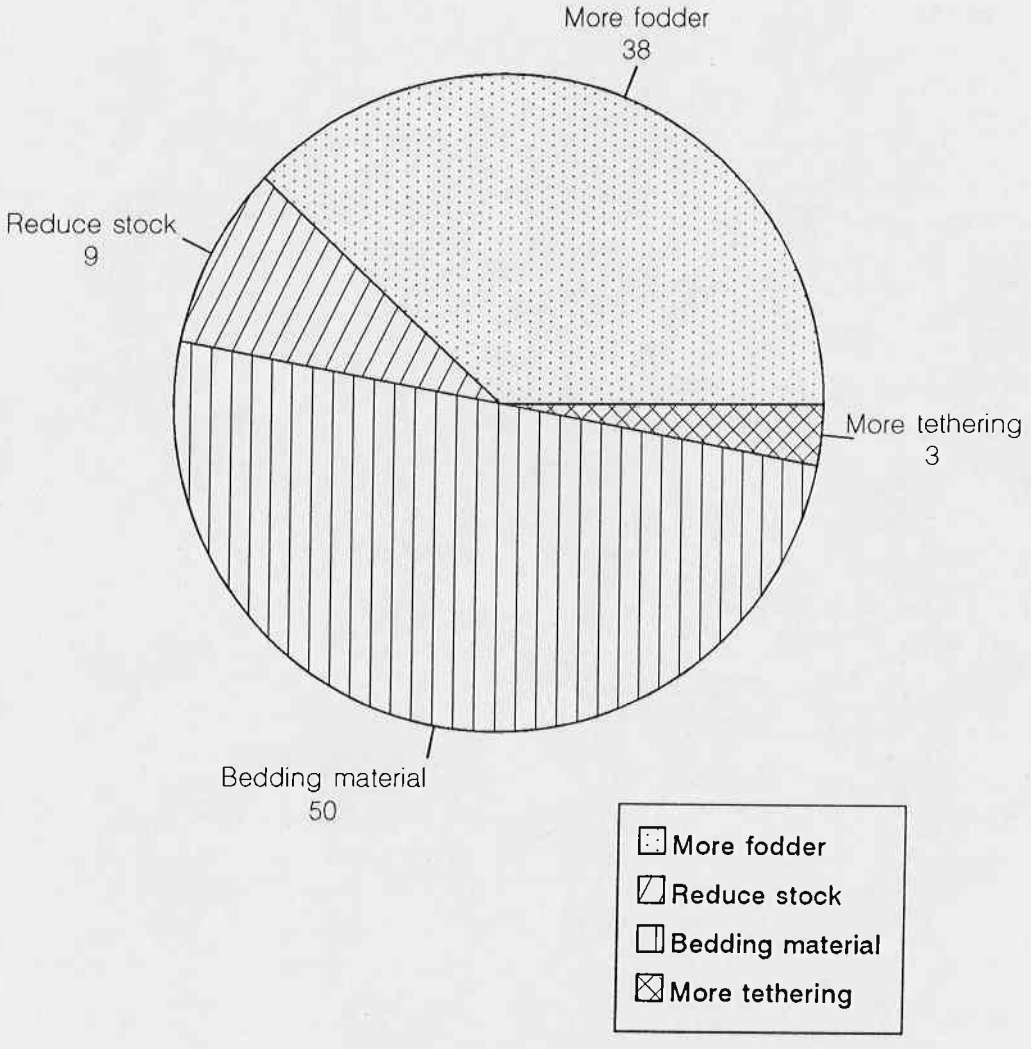

Figure 42 Farmers' response on disadvantages of stall feeding
Source: Survey, 1992

2) Changes in livestock holding

There has been an overall decrease in number of livestocks owned by households. The percentage decrease is almost the same within each ethnic group regardless of economic status but it is comparatively higher in Brahmin, Chhetri than in Magar, Gurung. The reason for this can be unavailability of *nagi*land and also less number of trees on private forestland and farmland of Brahmin, Chhetri farmers. From these observations it is also clear that most of non-*nagi*-owners reduced more number of livestock than *nagi*-owners. The small animals like goat, sheep and pig showed greatest decrease in all socioeconomic groups. Sheep and goat raising requires grazing land. As there is no more grazing allowed, it is believable in decrease of sheep herd size. Only medium Brahmin, Chhetri socio-economic group showed greatest decrease in large animals like cattle and buffaloes (Table 42).

It has been reported by different researchers that farmers in the eastern hills with large farms (> 1 ha) have more fodder trees per LSU (Livestock Unit) than those with small farms (< 0.5 ha) (Dutt, 1979; Hopkins, 1985), implying that smaller farms are more reliant on common property resources for fodder and bedding material supply. Conlin and Falk (1979) concluded that livestock population are more dense on small farms (< 0.5 ha) and that although they own smaller numbers of stock, these farmers as a group are more dependent on livestock for their livelihood. But due to insufficient feed and fodder, they are forced to decrease livestock, that is why the percentage decrease is more in such cases. The decreased

stock holdings have had a greater impact on livelihood for poor farmers. These relationships are pictured out during informal survey to some extent. As the livestock is kept for cash whenever needed regarding as major source of income, the decrease of livestock number affected adversely in their income.

Table 42 Change in livestock holding by socioeconomic group

SES	Average livestock holding per household											
	Before project			After project			Av. change			RDLH (Per cent)		
	LA	SA	T	LA	SA	T	LA	SA	T	LA	SA	T
E1R	7.0	16.0	23.0	5.6	10.0	15.6	**-1.4**	**-6.0**	**-7.4**	20	38	32
E1M	4.6	8.7	13.3	4.3	4.6	8.9	**-0.3**	**-4.1**	**-4.4**	6.5	47	33
E1P	3.1	3.9	7	2.8	2.1	4.9	**-0.3**	**-1.8**	**-2.1**	9.7	46	30
E2M	6.4	8.3	14.7	3.6	3.9	7.5	**-2.8**	**-4.4**	**-7.2**	43.8	53	49
E2P	3.3	9.3	12.6	2.8	3.4	6.5	**-0.5**	**-5.9**	**-6.1**	15	63	49
Mean	4.9	9.2	14.1	3.8	4.8	8.7	**-1.06**	**-4.4**	**-5.44**	21.6	47.8	39

Source: Survey, 1992

Note: RDLH = Relative decrease in livestock holding
LA = Large animals for e.g., cow, buffalo, ox etc.
SA = Small animals for e.g., goat and sheep
T = Total number of livestock
SES = Socioeconomic group

Besides land and tree holding, the causes for reduction in livestock holding are sought for in order to explain and make understand about this relationship. Farmers have adjusted to a new situation and altered their resource use pattern. There is likely to be a similar trend for other communities where there is a move towards stall feeding due to pressure on land resources (Campbell *et al.*, 1990).

As the existing fodder resources in the village were not enough and also with the purpose of maintaining quality of livestock, the farmers in the Salle village decreased the number of livestock (Campbell *et al.*, 1990). Thus, fodder shortage followed by labor shortage and lack of grazing land were main limitations to the number of livestock kept per household. Leaf litter shortage and no capital to buy more stock were also the causes for this situation. The non-*nagi*-owners expressed the grazing limitation as the main reason for decreasing livestock number. These reasons are justified by the farmers' responses in a survey in Lamjung District (Gajurel *et al.*, 1987). The most serious problem in livestock raising was feed supply.

These decreases in livestock holdings could be seen in a positive light as they mean a decrease in pressure on fodder resources. Despite the lower number of stock, the farmers are still not in a position to supply enough quantity of feed.

3) Introduction of new tree species

The tree planting program not only introduced tree species plantation on *nagi*land but also encouraged farmers to plant on the farmland. Hence, the evaluation of this program should also be done with regard to effect on farmland trees in addition to *nagi*land.

The tree species distributed by PAC to Salle private plantation scheme are given in table 43. Mostly fuelwood/ timber trees were distributed. However, some fodder tree local nurseries were established which helped to improve the status of fodder trees in the village.

Table 43 The tree species distributed from PAC to Salle private plantation scheme

Tree species (Local names)	Purpose
Utis	Timber, fuelwood, bedding material
Gobre salla	Timber, fuelwood
Patulo salla	Timber
Falant	Timber, fuelwood and fodder
Katus	Timber, fuelwood, fruit
Okhar	Timber, fruit, fodder
Champ	Timber

Source: Forestry Section (PAC), 1992

The existing trees on *nagi*land as reported by *nagi*-owners are *Utis, Salla, Masala, Nevaro, Falant* (Table 44). Most of them owned *Utis* and only few of them had *Nevaro.* But some farmers reported that they had also planted *Katus, Okhar* and *Champ* which are slow growing and taking long time for establishment. Matrix scoring and formal survey results indicated farmers' tree preferences. They seem to be more concerned about fodder trees as they have to face the problem of fodder scarcity. Fodder problem is prioritized as the major one although they equally have the problem of fuelwood insufficiency. It was found that farmers preferred *Nevaro, Dudhilo* and *Gogan* for fodder and *Utis, Phusre* and *Patle* for timber and fuelwood.

It was known that fodder species they preferred were considered highly nutritious, more milk giving, and some are evergreen in nature (Chapter IV). Timely unavailability of preferred tree saplings is the major constraint of the programs realized by most of the farmers.

Table 44 Trees planted on *nagi*land

Tree species (local names)	Av. no. of trees per farm	Range	Per cent of *nagi*-owners with species
Utis	882.0	0-2625	80
Salla	97.0	0-156	57
Masala	44.0	0-45	35
Nevaro	13.8	0-20	25
Falant	53.0	0-60	30

Source: Survey, 1992

Analysis regarding availability of farmland trees and shrubs before and after the scheme showed that there had been plantation of new tree species on farmland. Comparison between the changes in number of tree species before and after plantation program are presented in tables 45 and 46.

Table 45 Common farmland trees and shrubs before the scheme

Tree species (local names)	Av. no. of trees per farm	Range	Per cent of farmers with species
Utis	258.2	10- 500	100
Dudhilo	31.6	4- 70	100
Ghurmiso	15.4	7- 40	100
Painyu	15.1	2- 30	100
Gogan	6.2	0- 25	92
Nevaro	4.3	0- 15	85
Bans	2.0	0- 5	74

Source: Thapa *et al.*, 1990

Utis, Ghurmiso, Dudhilo, Painyu etc were observed on the farmland before the scheme too. Some tree species like *Bains, Khanyu* and *Dhupi* were planted after the scheme, however, all these were not available from the nursery. The average number of some tree species like *Utis, Nevaro, Gogan* etc were found increasing. This might directly be due to the impact of the plantation program.

Table 46 Common farmland trees and shrubs after the scheme

Tree species (local names)	Av. no. of trees per farm	Range	Per cent of farmers with species
Utis	300.0	20- 500	100
Dudhilo	24.5	6- 40	100
Ghurmiso	18.4	8- 45	100
Painyu	11.0	10- 20	100
Gogan	27.4	8- 43	100
Nevaro	28.5	6- 72	100
Bans	6.0	0- 6	76
Bains	4.8	0- 7	79
Khanyu	25.0	0- 44	80
Dhupi	12.0	0- 24	70

Source: Survey, 1992

5.2.2 Impact of the program at household level

To discuss the effect of program at household level, both *nagi*-owners and non-*nagi*-owners are considered along with comparing between them. The farmers indicated positive and negative effects of program. The beneficiaries of the *nagi*land plantation program were the *nagi*-owners, since most of them responded positive effect however, most of the non-*nagi*-owners indicated no effect (Table 47).

Table 47 Impacts of the program on household situation

Impacts	*Nagi*-owners		Non-*nagi*-owners		Total	
	No. of HH	Per cent	No. of HH	Per cent	No. of HH	Per cent
Positive	22	50	16	27	38	37
Negative	4	9	8	14	12	12
Positive and negative	15	34	10	17	25	24
No Effect	3	7	25	42	28	27
Total	44	100	59	100	103	100
	n = 44		n = 59		n = 103	

Source: Survey, 1992

1) Positive impact

The positive impacts as mentioned by farmers are listed in table 48. The responses of *nagi*-owners and non-*nagi*-owners are observed similar. Increase in availability of grasses, fuelwood and bedding material from *nagi*land as well as other private land and decrease in time for fodder/ bedding material collection were the main positive effects. Some other positive effects, e.g., increase in interest of planting trees, more number of children can go to school and increase in manure were also mentioned.

Table 48 Positive impacts of the program (farmers' response, n= 38)

Positive impacts	*Nagi*-owners		Non-*nagi*-owners		Total	
	No. of HH	Per cent	No. of HH	Per cent	No. of HH	Per cent
Grass[1]	5	22.7	6	37.5	11	28.9
Time[2]	8	36.4	4	25.0	12	31.6
Int[3] & Com[4]	3	13.6	2	12.5	5	13.2
Children[5]	1	4.5	3	18.8	4	10.5
Environment[6]	3	13.6	-	-	3	7.9
Time & children	2	9.2	1	6.2	3	7.9
Total	22	100	16	100	38	100
	n = 22		n = 16		n = 38	

Note:

1. Increase in grass, bedding material and fuelwood availability from *nagi*land and / or forestland.
2. Decrease in time of fodder/ bedding material collection.
3. Increase interest in planting trees
4. Make strong feeling of community and preservation of community resources.
5. More number of children can go to school as they donot have to spend time for animal grazing.
6. Increase in manure, forest and good environment.

Source: Survey, 1992

2) Negative impact

Only 12 respondents argued for negative impact of the program. The major negative impact reported by both *nagi*-owners and non- *nagi*-owners is a decrease in livestock number. More time is needed for care and feeding management of livestock in stocking system as compared to grazing system practiced before scheme. And as there is a shortage of labor, they have to decrease livestock number (Table 49).

Table 49 Negative impacts of the program on household situation (farmers' response, n= 12)

Negative impacts	*Nagi*-owners		Non-*nagi*-owners		Total	
	No. of HH	Per cent	No.of HH	Per cent	No.of HH	Per cent
More time spent in livestock care in stocking system	-	-	3	37.5	3	25
Have to decrease livestock number	2	50	2	25.0	4	33
Scarcity of labor for caring livestock so decrease in livestock number	2	50	3	37.55	5	42
Total	4	100	8	100	12	100
	n = 4		n = 8		n = 12	

Source: Survey, 1992

3) Impact on fodder, bedding material and fuelwood supply

It is true that as no grazing is allowed on *nagi*land, the grasses and also tree seedlings can grow well (Hopkins, 1985). Thus availability of grasses used as livestock feed would be increased. When the farmers were asked whether the scheme has solved their fodder scarcity problem, only 26 per cent of *nagi*-owners and 16 per cent of non-*nagi*-owners gave positive response (Table 50).

Table 50 Farmers' response on solving fodder scarcity problems by tree planting program

Type of response	*Nagi*-owners		Non-*nagi*-owners	
	No. of respondent	Per cent	No. of respondent	Per cent
Yes	15	26	14	16
No	42	74	74	84
Total	57	100	88	100
	n = 57		n = 88	

Source: Survey, 1992

Rest of the respondents argued for negative by giving several reasons. Twenty seven per cent of respondents said that trees planted on *nagi*land are mostly fuelwood/ timber and 20 per cent reported three reasons simultaneously, i.e, 1) trees planted on *nagi*land are still small; 2) decrease in pastureland and so need to buy more straw for feeding the livestock ; and 3) trees planted on *nagi*land are mostly fuelwood/ timber (Table 51).

Table 51 Reasons for the negative impact of tree planting program

Reasons	Farmers' response	
	No. of Respondent	Per cent
Tree[1]	12	16
Land[2]	8	11
Timber[3]	20	27
House[4]	4	5
Tree & Land	10	14
Tree & Timber	2	3
Tree & House	1	1
Land & Timber	2	3
Tree, Land & Timber	15	20
Total	74	100

n = 74

Note:

1 : Trees are still small.
2 : Decrease in pastureland by plantation program so need to buy more straw for feeding the livestock.
3 : Trees planted on *nagi*land are mostly fuelwood/ timber.
4 : *Nagi*land is far away from the house.

Source: Survey, 1992

Bedding material is mostly collected from forest and farmland. Most of the *nagi*owners and some non-*nagi*-owners with approval from the owners, collect from *nagi*land. About 40 per cent of *nagi*-owners and 30 per cent non-*nagi*-owners reported that grasses and tree leaves from *nagi*land has solved the problem of insufficiency of bedding material required in large amount for stocking system. However, because of far distance to *nagi*land from house and trees are still small, 34 per cent *nagi*-owners did not support this statement. A strong community feeling and unity among the villagers can be noticed from the PRA results. That is why even the villagers who do not own *nagi*land, are also sharing the tree products and

grasses from the *nagi*land. Another important aspect is about time needed for tree product collection on *nagi*land. Even though there is accessibility, the villagers do not prefer to go far distance as it is time consuming.

Reliance on farmland as the source of fuelwood is greatest. Other sources include private forest, public forest and multiple sources including *nagi*, farmland, forest, streambank and bought. Most of the trees on *nagi*land are for fuelwood/ timber, but they are still in growing stage and fuelwood requirement is not fulfilled by the trees planted on *nagi*land. Campbell *et al.,* (1990) pointed fuelwood shortage as main problem in the vicinity. Most of the farmers hoped that there will be increased availability and the possibility to buy fuelwood in the future. Thapa *et al.,* (1990) identified this as a major motivation for planting on the *nagi*land.

Hence, the majority of farmers are hopeful that they will have plenty of fodder, grass, fuelwood and timber in near future.

5.2.3 Change in labor use and labor division specially referring to women

In the grazing system, the physically weak members of the family, children and old people, shared a greater proportion of the total livestock work load. The stall feeding system has often moved the workload to the mature members of the household, i.e., the women and men. Although this indicated the advantages of releasing children for school attendance, adults already bear the major burden of the

agricultural workload. Increased responsibilities in livestock care causes either reallocation of their labor from other areas of the farming system or they have to work harder. This has the future implication for other technology development that labor constraints must be scrutinized otherwise non adoption of recommended practices may result.

Involvement in agroforestry activities, time allocation study, activity profile and participant observation indicated greater role of women in livestock tasks, e.g., fodder and bedding material collection and also care and management of livestock. As women are mainly responsibile for livestock care, it is expected that they have to bear additional workload.

The time requirement for the care and management of livestock varies with the season. The average time spent on livestock tasks per household by women is 3.92 hrs/ day in monsoon and 3.42 hrs/ day in winter for stall feeding system (Chapter IV). However, the time spent ranges from 25- 30 per cent of total working hours in a day but it varies with the economic status and size of livestock holding of the household. The observations from PRA revealed increase in time spent as economic status decreased. In terms of livestock holding, only households having medium numbers of livestock spent more time since most of the households owning large number of livestock are rich and they can use hired labor for care and management of the animals. Campbell *et al.*, (1990) in their study, indicated a decrease in labor requirement for stall feeding as compared to grazing as a large number of stock can be managed by a few labor provided that there is availability

of pasture. The average time spent on livestock task per household at the time of grazing practice was 7.4 hrs/ day compared to 7 hrs/ day in monsoon and 4.6 hrs/ day in winter for stocking system. Daily livestock tasks were also monitored in Sindhu Palchok District and an average of 7.57 hrs/ day was calculated for tasks including fodder collection, grazing and looking after stock at home (Shrestha and Evans, 1984). This is greater than the average time spent during monsoon in Salle. The study in Sindhu Palchok was conducted during winter when fodder is relatively scarce. It was questioned whether a lower labor input would be expected in the monsoon, when there is abundant fodder and less trips to the forests, or whether labor inputs would be greater as livestock exist in a mal-nourished condition in the winter and possibly more fodder is collected and fed in the monsoon. The latter case happened in Salle. Greater volume of fodder is collected in the monsoon compared to winter. Fodder collection in the monsoon and specially of grass, is a major time consuming activity. As a proportion of the total time spent on livestock tasks, fodder collection takes 47 per cent of the time in winter and 66 per cent of the time in monsoon. Total fodder collection time in winter is thus less than in the monsoon. In winter when labor is more readily available , fodder is scarce (Sharma and Pradhan, 1985).

The problem is that with the move from grazing to stall feeding the highest labor demand for livestock care has shifted to coincide with the peak labor period for other agricultural activities.

However, the above studies included time allocated by all members of the household. Hence, this study has emphasized on revealing effect of scheme on women's time allocation on various agroforestry activities after differentiating between gender in this aspect in time allocation. About 37 per cent and 51 per cent of *nagi*-owners and non-*nagi*-owners reported that women, at the present stocking system, had to spend more time for fodder and bedding material collection as children labor is diverted towards education. Another supporting cause for this situation as mentioned by female farmers are involvement of men in off farm activities (wage and some other income generating activities rather than farming).

As their male counterparts go outside the village for job, women are left to do all farming, livestock and household management. Similar incidence is also indicated by women in Ghana (Owusu- Bempah, 1988). However, some *nagi*-owners indicated fodder collection work becoming easy and comparatively less time consuming because of its increased availability on *nagi*land as well as farmland.

Increase interest in planting trees and awareness in new fodder trees and management are also regarded as the main effects of project on them (14 per cent households). Only few non-*nagi*-owners did not respond about effect of the project (Table 52).

Table 52 Impact of project on women's activities

Impacts realized farmers	*Nagi*-owners		Non-*nagi*-owners		Total	
	No. of HH	Per cent	No. of HH	Per cent	No. of HH	Per cent
Stock[1]	16	36.4	30	50.8	46	44.7
Fodder[2]	13	29.5	5	8.6	18	17.5
Trees[3]	4	9.1	10	16.9	14	13.6
Stock & Fodder	6	13.7	2	3.4	8	7.8
Stock, Fodder & trees	5	11.3	2	3.4	7	6.7
No impact	-	-	10	16.9	10	9.7
Total	44	100	59	100	103	100
	n = 44		n = 59		n = 103	

Note:

1 : Need to collect more fodder/ bedding material because of stocking system.

2 : Easier for women farmers in fodder collection due to availability of grasses/ fodder.

3 : Increase interest to plant trees/ Increase awareness in new fodder trees and management.

Source: Survey, 1992

5.2.4 Changes in women's overall activities

General change in overall and some criteria, in which effects are observed, were studied and sorted during PRA and informal survey. However, these were verified and were explained in detail with formal survey in order to indicate changes difference among economic status, ethnic, and *nagi*owning and non-*nagi*owning groups.

The criteria like women's workload, their awareness about tree species, interest in tree plantation, time devoted for livestock care etc., were chosen based on PRA findings. As Magar/ Gurung women have more access and control of resources, and more participation in forest meetings and discussions as compared to Brahmin/ Chhetri, they indicated increase in awareness about tree species and increase in interest of tree planting on farmland, *nagi*land and forestland.

Table 53 Changes in women's overall activities after program with respect to ethnic groups

Activities	Per cent of respondents					
	Magar/Gurung			Brahmin/Chhetri		
	I[1]	D[2]	C[3]	I[1]	D[2]	C[3]
Livestock related activities:						
Workload as children go to school	38	4	58	41	-	59
Time spent for livestock care	31	7	62	30	-	70
Time spent for fodder grass cutting	23	10	67	41	-	59
Time spent for bedding material collection	29	19	52	33	-	67
Time spent for cleaning shed	34	8	58	30	-	70
Time spent for giving water, *Khole* to livestock	38	11	51	-	-	27
Tree planting:						
Awareness about tree species	72	-	28	48	-	52
Interest of tree planting on farmland	59	2	39	37	-	63
Interest of tree planting on *nagi*land/ forestland	56	2	42	33	-	67
Others:						
Time spent for fuelwood collection	28	8	64	44	-	56
Time spent for water carrying	40	8	52	-	-	100
Leisure time	9	33	58	-	37	63
	n = 118			n = 27		

Note:
1 : Increase
2 : Decrease
3 : Constant

Source: Survey, 1992

Similar situation is also clearly revealed by rich status households irrespective of ethnic groups. Non-*nagi*-owners want to plant trees on farmland (67 per cent) more than on forestland (33 per cent) as they have no other areas for plantation. Brahmin/ Chhetri faced more workload problem due to transfer of labor division from child to women as mentioned earlier (Table 53). Owusu- Bempah (1988) indicated in the survey of Ghana that children receiving education neglect to help their parents in farming and household activities. Rich and poor women also gave same response as their male counterparts mostly work outside the village either in military, government service or daily paid labor in road construction and portering. This can also be verified by long daily working hours of women in monsoon as well as winter season.

Increase in time requirement for livestock care and management was reported by some 33 per cent of households. This situation is prominent in rich farmers which might be due to large livestock holding (Table 52). But in case of fodder and bedding material collection, non-*nagi*-owners had to spend more time than *nagi*-owners. Similarly, 40 per cent of Magar, Gurung respondents also reported increase in time spent for water carrying (Table 53).

From the observations through resource mapping and farmers' response, it was known that only few households had easy access of water resources while most of them had to go farther (at least for 15 minutes). This problem was severe in winter season as the point source of water become low. This situation could be correlated with per household livestock number owned. It is obvious that, Magar/

Gurung comparatively had large stock than Brahmin/ Chhetri. However, this response was not different between *nagi*-owners and non-*nagi*-owners and also among rich and medium economic status women.

Table 54 Change in women's overall activities after program with respect to economic groups

Activities	Per cent of respondents								
	Rich			Medium			Poor		
	I[1]	D[2]	C[3]	I[1]	D[2]	C[3]	I[1]	D[2]	C[3]
Livestock related activities:									
Workload as children go to school	64	-	36	28	6	66	40	-	60
Time spent for livestock care	76	-	24	21	9	70	28	10	62
Time spent for fodder	29	-	71	14	16	70	18	8	74
Time spent for bedding material collection	57	-	43	20	14	66	22	4	74
Time spent for cleaning shed	43	-	57	20	12	68	24	10	66
Time spent for giving water, *Khole* to livestock	36	-	64	16	5	79	30	6	64
Tree planting:									
Awareness about tree species	100	-	-	46	6	48	52	-	48
Interest of tree planting on farmland	100	-	-	44	2	54	46	-	54
Interest of tree planting on *nagi*land/ forestland	93	-	7	47	2	51	44	-	56
Others:									
Time spent for fuelwood collection	29	-	71	17	10	73	30	6	64
Time spent for water carrying	14	-	86	16	2	82	34	6	60
Leisure time	-	44	56	9	19	72	9	32	59
	n = 14			n = 81			n = 50		

Note:
1 : Increase
2 : Decrease
3 : Constant
Source: Survey, 1992

Time spent for fuelwood collection was found more in non-*nagi*-owners specially in the Brahmin/ Chhetri. It could be related to the less number of trees on their farmland as well as private forest. This forced them to walk far distance to collect fuelwood in public forest or they need to buy with other villagers. Virtually, lower income level of the farmers caused them to adopt the first option.

Table 55 Change in women's overall activities due to program

Activities	Per cent of respondents								
	Nagi-owners			Non-*nagi*-owners			Total		
	I[1]	D[2]	C[3]	I[1]	D[2]	C[3]	I[1]	D[2]	C[3]
Livestock related activities:									
Workload as children go	30	15	55	35	9	56	33	11	56
Time spent for livestock care	31	5	64	32	9	59	32	6	62
Time spent for fodder	16	11	73	22	22	56	20	18	62
Time spent for bedding material collection	18	36	46	25	25	50	24	29	47
Time spent for cleaning shed	27	15	58	34	11	55	30	12	58
Time spent for giving water, *Khole* to livestock	25	13	62	30	3	67	28	76	5
Tree planting:									
Awareness about tree species	65	-	35	56	-	44	59	-	41
Interest of tree planting on farmland	60	4	36	67	-	33	64	1	34
Interest of tree planting on *nagi*land/ forestland	58	4	38	33	-	67	43	1	56
Others:									
Time spent for fuelwood	19	5	76	33	16	51	28	12	60
Time spent for water carrying	33	15	52	33	6	61	33	9	58
Leisure time	14	26	60	13	27	60	14	27	59
	n = 55			n = 90			n = 145		

Note:
1 : Increase
2 : Decrease
3 : Constant
Source: Survey, 1992

Women, in particular, might have change in workload while changing activities of household as well as surrounding. Kumar *et al.,* (1989) reported that additional workload entailed in the collection of fuelwood, fodder and grasses to women due to the result of deforestation. In this study, it was clear that stall feeding brought increase in workload to women for water collection and other aspect of livestock management which could burden in agricultural activities.

The tree planting scheme has clearly had an effect on households other than those *nagi*-owners directly involved in the planting scheme (Table 55). The study has shown a transfer of responsibility for these tasks from the children to the parents particularly female of the household. During monsoon, when peak crop labor demand falls, the livestock labor requirement has increased with a move to stall feeding. The analysis of labor use and time allocation of gender concluded that women had an important role on fodder and animal feed related work with change in workload which is spectacular in non-*nagi*-owners.

CHAPTER VI

CONCLUSION AND DISCUSSION

6.1 Conclusion

Salle is one of the long settled hilly villages situated in Dhankuta district of eastern Nepal. The area is endowed with the diversified social strata of Brahmin, Chhetri, Magar, Gurung and Damai, among which Magar is the dominant ethnic group. Crop and livestock production are the mainstay of the villagers. There is complex farming system with most farmers depending on crop, livestock and tree/ forest for their livelihood. Most commonly encountered agroforestry system is the combination of annual crops and multipurpose trees or crop/ tree/ livestock mix typically found around homestead. However, few households (24 per cent) have off farm job like army service, teaching etc., and also portering and daily wage labor in order to maintain subsistence level of household economy. There is an increasing population pressure on the land. Literacy rate of the village is about 26 per cent. The average family size per household is 6, with average landholding of 1.71 ha. The *khet*land represents a small portion (average size of 0.52 ha). Only 21 and 13 per cent of households owned *nagi*land and private forest land respectively.

Farmers who cultivate land also raise livestock and depend on tree/ forest for the support of both components. Changes in one of the components of the agroforestry systems thus has effects on the other. The present land use situations with the scarcity of arable and productive land reflected the low capacity of agricultural system to provide subsistence for farmers. Almost all of the farmers have rainfed land for growing maize, potato, soybean and millet. Findings show that the ethnicity and economic status of the farmer has no correlation with the selection of these crops.

Cows and buffaloes are the economically important animals which have a close relationship with the prevailing resource and agricultural features in the village. Livestock subsystems are regarded as secondary in priority to crop production. Animals are always underfed and their feeding type is confined to stall feeding system. Decreasing of fodder trees in forest and marginal areas increase the pressure towards the private land. At the same time, the quality and quantity of private fodder trees is decreasing due to heavy lopping. Therefore, planting of multipurpose tree species in and around the farmland is realized to be crucial for sustaining the hill farming system.

The fodder and firewood production are highly prioritized and are the main objectives of agroforestry system. However, this may be possible for only rich farmers for long term as the medium and poor farmers have comparatively low access to farm and forestland in addition to food insufficiency problem. Almost all of the farmers with different socioeconomic status have grown trees on the farmland. An

average number of trees available to the household on *nagi* and private forestland are 1232 and 244 respectively. *Utis, Painyu, Gogan, Nevaro* and *Dudhilo* are common trees. The farm, trees and livestock linkage is stronger in the village. The farmers are very much interested in tree plantation in their *nagi*land which although is available to the minor fraction of population but hopefully could serve a potential source of fuelwood, fodder and timber to the whole community in the future. It was found that in spite of some negative effect on crops by tree crop interaction, trees have been considered beneficial to the farmers in many ways. The percentage of tree fodder to the total fodder consumed exhibits a seasonal and geographic variations. However, fodder tree and tree fodder are primary constituents of animal feed use. Analysis of the results from several PRA procedures showed a differential preference category of the fodder species to male and female. However, it was not visible in the formal survey. To both of them, *Nevaro, Gogan, Dudhilo* and *Utis* are the most preferred tree species. High milk production, nutritious to livestock, household use of leaves, good source of fuelwood and timber are some of criteria behind this preferential category.

Both men and women have been involved in production and management aspects of the agroforestry system. In general, cultivation practices (especially ploughing and land preparation) are found to be performed by men. However, dominant role of women is clear in sowing, weeding, harvesting and postharvest management of millet and soybean. Besides this, participation in overall agricultural activities is also found to be affected by ethnicity. Involvement of Magar, Gurung

women is comparatively high in all crop production activities. Finding also shows more involvement of medium and poor economic status women irrespective to ethnic groups in crop production than that of rich women. Feeding and management of livestock and poultry are exclusively performed by women in all groups. However, disease management, buying and selling of livestock and livestock products are the job in which role of men is found to be dominant. The tree management activities for example logging, buying and selling of timbers are specially performed by men and the collection of fodder, bedding material and fuelwood as routinely works are carried out by women in all of socioeconomic group.

Labor use pattern for different cropping activities by gender was found varied according to the nature of work, type of crop etc. There was no significant difference between male and female in potato sowing and storage since they equally participate and allocate the same amount of time. However, time spent by the female farmer of rich Magar/ Gurung group is found significantly different to that of male in case of harvesting and storage of potato. Likewise, medium group women work more days which is significantly greater than that of poor women for maize cultivation. In the same way, significant differences in time spent for cultivation practices of millet was found owing to more time spent by female. Soybean may also be regarded as female's crop since all production activities are performed by female. It is found that in feeding, shed cleaning and compost making processes, women of medium and poor Magar/ Gurung and poor Brahmin/ Chhetri socioeconomic group allocate significantly greater time than men ($p< 0.05$). However, milking, disease management, selling and buying of livestock and livestock products, time spent by men is greater than that of

women regardless of socioeconomic strata. Time spent by women in farmland tree activities is significantly greater than by men in Magar/ Gurung ethnic group. It was found that medium group women significantly spent more time than men in farmland tree activities. Women perform 84 per cent of the fodder collection for which on an average they spent 26 days per year for gathering fodder and bedding materials as compared to 21 days by male counterparts. Except nursery management, it was found that female farmers have greater role in tree management.

It was found that women contribute substantially more time to domestic tasks than men. On an average, 5.75 hrs/ day is spent on cooking, cleaning and washing by women whereas, men are found rarely involved in these household activities. Women have to collect water five or six times a day for cooking, drinking, cleaning kitchenware and preparing animal feed depending upon the size of family, number of livestock and use of water.

Although men are culturally accepted as the decision maker in the household, the decisions that they make are usually suggested by other members of the household, in particular by the wives. In the activities like amount of compost to be applied, time of weeding and amount of grain for the whole year consumption, women have comparatively better role. The extent of overall decision regarding crop production activities is found to be affected by ethnicity. Magar/ Gurung women have better role as compared to Brahmin/ Chhetri. In certain decisions relating to livestock e.g., on choice of area and person for fodder collection and feeding management in fodder unavailability season, women involvement is significant. Magar, Gurung and resource

poor women have stronger roles as compared to Brahmin, Chhetri and rich and medium respectively. Women of Magar/ Gurung caste have stronger decision making role as compared to Brahmin/ Chhetri in livestock activities too. A significant number of respondents (65 per cent) reported that decision on tree management is generally made by men. Magar/ Gurung women are comparatively participating more in decision making concerning to the tree management than those of Brahmin/ Chhetri. Likewise, decision making for the household activities are mostly found to be done by women. However, it was found that women's involvement is meager in decision making on participation of village meetings and training activities.

In Salle village, the private tree plantation program from the PAC was started in 1987. This program is not only responsible for planting trees on *nagi*land but also encourages farmers in planting trees on their farmland, wasteland, streambanks etc. Most of the farmers reported that the tree species planted on *nagi*land were fuelwood/ timber trees. Their choice were largely restricted to the type of tree species available in the nursery at planting time. Moreover, most of the *nagi*-owners hoped that there would be an increase in availability of fuelwood from *nagi*land in the future. The Salle experience has shown that the primary motives of the farmers whether big or small, is to attain self sufficiency in meeting their basic needs for fuel, fodder and timber. The plantation scheme has demonstrated that the private plantation program is more than just the distribution of saplings and that of private tree planting program can be successfully designed and implemented in cooperation with farming community. However, there has been a visible change occurred at the household or

the village level. The prominent impact of the planting scheme at the village level, is the change in practice of grazing to stall feeding which has brought a more advantages in terms of manure, disease control, protection over crops coupled with some disadvantages of higher fodder, bedding material as well as labor requirement. There has been an overall decrease in number of livestock i.e., higher in Brahmin/ Chhetri which is related with the unavailability of *nagi*land. The effect is more spectacular in small ruminants like sheep and goat, to them, grazing land is very important. The decreased stock holding have had a crystal clear impact on livelihood of poor farmers, as the livestock is kept for cash generation. However, farmers have adjusted to the new situation and altered their resource use pattern.

Out of some prominent advantage of the distributed fodder saplings, some particularly, *Katus, Okhar* and *Champ* found slow growing and long time taking for establishment. Farmers are more concerned to the fodder side by side fuelwood. It was found that they preferred *Nevaro, Dudhilo* and *Gogan* for fodder and *Utis, Phusre* and *Patle* for timber and fuelwood. Timely unavailability of preferred tree saplings is the most highlighted constraint in the planting program. It is obvious that new tree species have been growing after the scheme. This might directly be due to the impact of plantation program.

It was found that *nagi*land plantation program was much affected to the *nagi*-owners as compared with the others. Those include increasing availability of grasses, fuelwood and bedding material. Increase in the number of trees on farmland could

be counted as a very positive side effect of plantation program. Although a minor fraction responded for some negative impact of the program as they realized which is associated with the decreasing livestock number. It is worthy to mention that since most of the tree species on *nagi*land are still in growing stage, the fuel/ fodder requirement of the area has not been fulfilled so far. However, majority of farmers are hopeful that they will have plenty of supply in near future. It was observed that change in stall feeding of livestock caused an increase in number of children for school attendance which in turn caused adults to bear the major burden of agricultural workload. Increased responsibility in livestock causes either reallocation of household labor or work burden to the household members. About 1/3 and half of the *nagi*-owners and non-*nagi*-owners respectively reported that women at the present stocking system, have to spend more time for fodder and bedding material collection. Besides, it was also distinct that the time spent was different for monsoon and winter season showing more in monsoon than in winter. During monsoon, as there is more availability of tree fodder and grasses, women spent more time on collection, cutting of grasses which is a time consuming activity.

Problem of workload found more severe in Brahmin/ Chhetri group compared to the other groups due to transfer of labor from children to women. Rich and poor women also expressed same responses as their male counterparts mostly work outside the village. Likewise, increase in time requirement for livestock activities was prominent in rich farmers which might be due to large livestock size in contrast to non-*nagi*-owners who at the other hand had to spend more time for fodder and

bedding material collection. Time spent for fuelwood collection was more spectacular in non *nagi*-owners especially Brahmin/ Chhetri which could be due to less number of trees on their farmland. These all conclude a significant change in workload in women as a result of changing activities of household as well as change in surrounding.

6.2 Discussion

The agroforestry system in eastern hills of Nepal to the large extent is subsistence oriented. Salle village is an example of eastern hill agroforestry system where 88 per cent of households which are mostly medium and poor have food insufficiency problem. The principal means to solve food problem are either by increasing productivity of agroforestry system or adopting some income generating programs where the most common agroforestry practice is the use and/ or incorporation of trees and shrubs on private farmland. To increase the productivity of agroforestry system, emphasis should be given on each component e.g crops, trees and livestock. In fact, the relationship of these components are stronger irrespective of ethnic group, social status or the access to the resources. This fact was observed while doing PRA. It is commonly believed that, there is a common overlap between RRA and PRA. However, PRA tends to emphasize group discussions and diagramming by rural people and to pay special attention to outsiders' behaviour, attitudes and interactions with villagers. This involves rural people in the generation, analysis and ownership of information and more likely to be part of a continuing participatory processes.

Gender differentiation at the Salle village with respect to the crop cultivation, livestock management and forestry practices, particularly in relation to the fuelwood and fodder purpose tree species, were found to be very interactive and substantial in the farming system. Women's role are more visible in some crop cultivation practices and fuel/ fodder collection activities. Furthermore, women's workload has been found to be increasing due to increment in number of children going to school. These all indicated that women's role could be utilized to strengthen the private tree plantation program not only in *nagi*land but also around the farmland.

While the problem of food shortage has not been solved, the livestock population is decreasing in the context of degrading private forestland and prohibition of animal grazing on the *nagi*land. In addition to this, only few farmers have the access to *nagi*land. In these circumstances, a clear solution should be searched out in order to maintain the status of livestock as well as the productivity of crop production system.

The limitation of this study is that farmers were not asked directly what would happen if the *nagi*land was not for their access even after the area had been converted into forestland; in such a situation, how the farmers would solve these types of problems ? Would they consider the changes that occurred in agroforestry components (especially livestock and fodder status) as the problem in a subsistence type of farming system ? Similarly, it remained further unclear whether gender related-activities which are found to be stronger in Magar/ Gurung in comparison with

other ethnic groups are sufficient to point out the solution just on the basis of access and control. However, the study of agroforestry system components and their interactions are useful means to find out suitable alternatives to tackle the problems.

The tree plantation program introduced by PAC, yield positive changes in many ways. However, species preferred by the farmers are not directly coincided with the species distributed except Alnus. Considering the available barren *nagi*land, growing demand of fodder and fuelwood, as well as degrading trend of natural forests, the tree plantation program has brought beneficial changes, which is visible in terms of mutual understanding of the villagers with respect to the utilization of natural resources.

There is a criticism about private tree planting in many literature. It is argued that it is cash oriented rather than aiming to supply subsistence fuel, fodder and timber, and that only the big farmers are benefitting from the programs. Contrary to these assumptions, the Salle experience has shown that the primary motives of the farmers, whether big or small, is to attain self sufficiency in meeting their basic needs for fuel, fodder and timber. The interest in markets or cash develops only later. Furthermore, once a program demonstrates that tree planting is beneficial, the chances are high that even those with small holdings will participate with nominal or no external assistance. The Salle tree planting scheme has demonstrated that a private planting program is more than just the distribution of saplings and that a private tree planting program can be successfully designed and implemented in cooperation with the farming community.

From the case study of Salle village, several features are highlighted as the supportive aspect of self sustaining tree planting activities of villagers. The fundamental prerequisite is that they themselves must recognize that tree planting is for their own benefit. Outside intervention by government institutions or projects can affect the farmers' decision to plant trees either by demonstrating tree planting where farmers have not recognized its importance or by removing constraints to planting such as the provision of seedlings, information on government forest legislation and technical information, etc. The hill agroforestry production with crop, livestock and tree subsystems are strongly interrelated and interdependent. Interventions in the tree production system will only be successful if they can be integrated in their farming systems by the farmers. The species choice and timely availability of seedlings are essential to any acceptance of tree planting by the farmers. The issue is of importance because it demands a major shift in emphasis from the present practice of raising whatever species is available to the ones most preferred by the majority of the farmers. The encouragement and promotion of private nurseries through the local community is unique in the case of Salle village. But, the PAC scheme would be strengthened if it would incorporate farmers' preferences based on different socioeconomic status and also gender.

In the future, more emphasis could be put on parallel work with non-*nagi*-owners who lose the grazing resource. In Salle, these farmers have had the opportunity to buy tree seedlings at the planting scheme nursery and collect grass cuttings from the PAC nursery to plant on their *bari* and waste land. In the future,

more grass need to be distributed since it becomes productive more quickly than trees and allowing diversification of the fodder resource.

Methods need to be developed for improved grass production that would decrease collection time and also it should be acceptable to farmers' situation. A few farmers have been experimenting napier grass and setaria obtained from the PAC forestry nursery on *bari*land and wasteland. However, in order to be followed by other farmers, they should be encouraged and should be given appropriate technical help in planting, caring and management.

On the other hand, fodder tree which takes less time to collect than grass is also equally important for alleviating the fodder deficit during dry period. Distribution of fodder tree saplings preferred by the farmers are, therefore, need to be equally emphasized. However, as mentioned in Chapter III, there is a limit to which farmers are willing to plant trees on *bari*land due to shading effect of tree over crop, which could reduce the crop yield.

After knowing constraints, opportunities and impact of existing agroforestry practice using gender-based approach, suggestions could be provided to policymakers for the improvement of the design and implementation of the program as well as the integration of womens' concerns into agricultural development activities. Those include, need of training and career development opportunities for the women in nursery management and proper utilization of tree resource, knowledge on improved cultivation practices of some crops specially millet, soybean, maize and potato, and

improving skills on feeding practices to the animals like cows, buffaloes and pigs, as women were found to be heavily involved in these activities.

6.3 Policy implications and further research

Food insufficiency in the village to sustain throughout the year is one of the problem highlighted in this study. Development of upland maize/ potato based cropping system in order to make the village sustainable development could be the policy level approach needed at present in the area. This may bring further interactive changes in the relationship between crop, livestock and tree components which should be addressed simultaneously to lessen the complexity of the system. Research is needed to identify the best fodder tree species for combination with maize, potato, millet, soybean and wheat. Shading effect was described as main disadvantage of agroforestry, hence, the trees giving less shade effect to above mentioned crops should be experimented.

The results of gender analysis imply that findings may be helpful to formulate policies in order to strengthen the women's participation regarding with improved crop production activities. It is also clear that the management of fodder and fuelwood trees may be efficient if women are provided with necessary technical support (training, involving in the meetings etc.) in the village. To make the training efficient and for more participation, time and location for any training is essential to be decided. Through the analysis of time allocation of women, it can be suggested that the training should held in winter rather than monsoon. The unavailability of seasonal

fodder in the owned land often forces the women of poor farmers' families to go to the distant forest for fodder collection. This tendency eventually forced them to reduce their livestock population which causes finally loss of income from livestock. Such findings may by useful to be considered while conducting any livestock improvement program in the village. Women's crucial roles, therefore, in tree, crop and animal production can no longer be underestimated and ignored. Hence, women's concerns should also be integrated and analyzed before launching any agroforestry and livestock specialized researches and programs in the Salle village.

Farmers' felt need regarding the tree component should be fully recognized. They are the adopters, managers as well as users. Therefore, any tree plantation program if should be launched in the future, have an ample participation of farmers at every step of development. Species selection, site management, further training related to the forestry activities should reflect the need and aspiration of people to make any program success. It is obviously observed that in Salle village, farmers' aspiration towards the more fodder species was not fulfilled since almost all species distributed by the program were other than fodder species. This, however, equally revealed the opportunity of further expansion in tree plantation program that seems necessarily to be coincided with the interests of farmers.

Since the long term success of any development program depends to a large extent on the participation of local people, this aspect needs to be adequately addressed while initiating rural development programs in general and forestry development programs in particular.

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APPENDICES

Appendix Table 1. Gender participation in crop production activities by ethnic group (Per cent of respondents)

Activities	Magar/Gurung				Brahmin/Chhetri			
	M[1]	F[2]	B[3]	All[4]	M[1]	F[2]	B[3]	All[4]
Ploughing	87	-	-	13*	67	-	-	33
Digging/ clod breaking	4	52	18	26	11	26	41	22
Sowing								
Potato	11	24	30	35	8	21	41	30
Maize	10	17	36	37	11	8	59	22
Millet	1	37	35	27	-	29	49	22
Soybean	1	39	34	26	-	25	53	22
Wheat	-	-	66	34	14	-	57	29
Intercultural operation								
Potato	12	22	33	33	22	16	45	17
Maize	10	20	39	31	37	17	26	20
Millet	6	38	36	20	17	28	31	24
Soybean	4	39	36	21	22	27	37	14
Wheat	30	5	42	23	22	7	47	24
Harvesting								
Potato	2	15	41	42	8	11	51	30
Maize	10	14	33	43	9	15	46	30
Millet	2	32	47	19	5	29	33	33
Soybean	2	37	36	25	3	35	32	30
Wheat	23	20	42	15	20	17	33	30
Drying/ Storage								
Potato	11	21	49	19	17	21	40	22
Maize	21	22	37	20	10	14	46	30
Millet	3	30	29	38	4	30	33	33
Soybean	2	33	28	37	4	21	49	26
Wheat	12	7	49	32	18	4	52	26

n = 118 n = 27

* indicates male and children.

Note: 1= Male, 2= Female
3= Both, 4= All family members

Source: Survey, 1992

Appendix Table 2. Gender participation in crop production activities by economic group (Per cent of respondents)

Activities	Rich M[1]	Rich F[2]	Rich B[3]	Rich All[4]	Medium M[1]	Medium F[2]	Medium B[3]	Medium All[4]	Poor M[1]	Poor F[2]	Poor B[3]	Poor All[4]
Ploughing	100	-	-	-	73	-	-	27	52	-	-	48
Digging/ Clod breaking	6	52	12	30	7	47	13	33	12	36	13	39
Sowing Potato	10	6	58	26	11	16	24	50	13	15	34	38
Maize	-	8	50	42	10	15	30	45	-	15	46	32
Millet	-	10	50	40	-	27	30	43	10	20	36	34
Soybean	5	22	53	20	-	31	32	37	6	32	24	38
Wheat	-	-	60	40	4	-	30	46	7	5	45	43
Intercultural operation Potato	4	14	64	18	7	21	25	47	20	20	54	6
Maize	7	7	86	-	9	22	28	41	22	16	54	6
Millet	2	20	60	18	9	30	24	37	16	20	28	4
Soybean	4	30	50	16	2	38	20	40	16	22	24	6
Wheat	21	-	70	9	4	4	30	62	8	10	42	40
Harvesting Potato	-	20	60	20	-	19	30	51	2	12	70	16
Maize	5	9	50	36	9	19	25	47	22	16	56	6
Millet	5	15	48	32	-	38	20	42	-	28	42	30
Soybean	-	29	71	-	5	36	21	38	-	30	58	12
Wheat	10	9	71	10	6	7	37	50	20	8	38	34
Drying/storage Potato	7	10	69	14	6	22	30	42	-	20	66	12
Maize	8	2	69	21	6	10	38	46	4	20	44	32
Millet	-	15	70	15	5	32	25	38	2	22	40	36
Soybean	-	20	40	40	3	31	23	43	2	30	40	38
Wheat	10	5	45	40	8	6	44	42	6	8	40	46
	n = 14				n = 81				n = 50			

Source: Survey, 1992

Note: 1 = Male, 2 = Female 3 = Both, 4 = All family members

Appendix Table 3. Gender participation in livestock activities by ethnic group

Activities	Magar/Gurung			Brahmin/Chhetri		
	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]
Preparing and feeding *khole*	3	36	61	-	14	86
Feeding water	1	33	66	-	33	67
Feeding thinned maize/ rice straw	2	28	70	3	26	71
Shed cleaning & compost making	1	38	61	3	26	71
Making *ghee, curd* etc	14	21	65	26	26	48
Milking	6	14	80	26	19	55
Disease management	55	3	42	52	22	26
Selling/buying livestock	56	4	40	52	-	48
Selling *ghee, curd*	20	5	75	26	-	74
			n = 118			n = 27

Source: Survey, 1992

Note: 1 = Male, 2 = Female
3 = Both, 4 = All family members

Appendix Table 4. Gender participation in livestock activities by economic group

Activities	Rich			Medium			Poor		
	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]
Preparing & feeding khole	-	7	93	1	48	51	4	24	72
Feeding water	-	7	93	-	40	60	2	30	68
Feeding thinned maize/rice straw	-	7	93	1	32	67	4	26	70
Shed cleaning & compost making	-	7	93	1	63	36	2	30	68
Making *ghee, curd*	29	-	71	5	32	63	14	12	74
Milking	7	-	93	12	20	68	6	12	82
Disease management	71	-	29	57	6	37	40	2	58
Selling/buying livestock	86	-	14	50	6	44	54	-	46
Selling *ghee,curd*	50	-	50	26	17	57	19	7	74
	n = 14			n = 81			n = 50		

Source: Survey, 1992

Note: 1 = Male, 2 = Female
3 = Both, 4 = All family members

Appendix Table 5. Gender participation in tree growing activities by ethnic group

Activities	Magar/Gurung				Brahmin/Chhetri			
	M[1]	F[2]	B[3]	All[4]	M[1]	F[2]	B[3]	All[4]
Farmland: Buying, searching, carrying & planting of seedlings	47	6	28	19	7	7	56	-
Cutting branches for fodder	17	22	36	25	19	30	37	14
Firewood collection	30	42	20	8	20	30	30	20
Log collection and carrying	51	19	12	18	37	19	26	18
Buying/ selling of logs	70	-	20	10	100	-	-	-
Forest/ Nagiland: Nursery related activities	53	10	17	20	40	10	20	30
Fodder & bedding material collection	13	42	21	24	22	37	22	19
Firewood collection	7	58	20	15	8	48	20	24
Log collection and carrying	23	10	43	24	30	5	40	25
Buying/ selling of logs	34	-	66	-	25	-	50	25
	n = 118				n = 27			

Source: Survey, 1992

Note: 1 = Male, 2 = Female
3 = Both, 4 = All family members

Appendix Table 6. Gender participation in tree growing activities by economic group

Activities	Rich M[1]	Rich F[2]	Rich B[3]	Rich All[4]	Medium M[1]	Medium F[2]	Medium B[3]	Medium All[4]	Poor M[1]	Poor F[2]	Poor B[3]	Poor All[4]
Farmland: Nursery related activities	43	7	50	-	53	22	14	11	52	20	18	10
Cutting branch for fodder	-	7	93	-	12	22	11	55	16	18	40	26
Firewood collection	16	25	46	13	14	24	43	19	16	20	45	19
Log collection & carrying	43	7	50	-	57	15	14	14	48	14	30	8
Buying/selling of logs	93	-	7	-	32	-	68	-	38	-	62	-
Forest/ Nagiland: Nursery related activities	71	7	22	-	43	12	6	39	38	12	8	42
Fodder and bedding material collection	14	50	36	-	25	56	10	19	16	20	38	26
Firewood collection	14	57	29	-	3	77	11	9	14	24	38	24
Buying/selling of logs	100	-	-	-	49	-	51	-	46	-	54	-
	n = 14				n = 81				n = 50			

Source: Survey, 1992

Note: 1 = Male, 2 = Female
3 = Both, 4= All family members

Appendix Table 7. Gender related decision making processes concerning crop production by ethnic group

Decisions to be made	Per cent of respondents								
	Magar/ Gurung			Brahmin/ Chhetri			Total		
	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]
What crop to plant & how much land to be allocated for crop?	35	16	49	52	11	37	38	15	47
Which variety?	38	13	49	59	-	41	42	10	48
When to sow seeds?	32	17	51	56	7	37	37	15	48
How much compost to be used?	34	21	45	48	11	41	37	19	44
When to weed crop?	26	22	52	48	7	45	30	19	51
Plant protection	45	8	47	37	-	63	43	6	51
When to harvest and who will harvest?	32	14	54	52	-	48	36	12	52
How and where to store products?	35	17	48	40	11	45	36	16	48
Amount of grain to be consumed	33	20	47	48	11	41	36	17	47
Selling of grains: Where to sell?	39	15	46	52	4	44	41	13	28
Buying of grains: Where to buy?	47	13	40	52	7	41	49	12	39
Mean	36	16	48	49	8	43	39	14	47
	n = 118			n = 27			n = 145		

Source: Survey, 1992

Note: 1 = Male, 2 = Female
3 = Both, 4= All family members

Appendix Table 8. Gender related decision making processes concerning crop production by economic group

Decisions to be made	Per cent of respondents								
	Rich			Medium			Poor		
	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]
What crop to plant & how much land to be allocated for crop?	64	-	36	28	16	56	46	22	32
Which variety?	64	-	36	35	10	64	48	14	38
When to sow seeds?	57	7	36	31	15	54	40	18	42
How much compost to be used?	64	-	36	28	21	51	42	22	36
When to weed crop?	57	7	36	21	23	56	38	20	42
Plant protection	86	-	14	46	7	47	28	10	62
When to harvest and who will harvest?	50	-	50	27	15	58	46	14	40
How and where to store products?	36	-	64	28	14	58	52	24	24
Amount of grain to be consumed	43	-	57	28	8	64	50	24	26
Selling of grains: Where to sell?	43	-	57	35	14	51	50	16	34
Buying of grains: Where to buy?	43	-	57	38	14	48	64	14	22
Mean	55	7	38	31	14	55	46	18	36
	n = 14			n = 81			n = 50		

Source: Survey, 1992

Note: 1 = Male, 2 = Female
3 = Both, 4 = All family members

Appendix Table 9. Gender related decision making processes concerning livestock production by ethnic group

Decisions to be made	Decision maker (No. of respondent)								
	Magar/ Gurung			Brahmin/ Chhetri			Total		
	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]
Type of livestock to be kept	42	12	46	44	8	48	42	12	46
No. of livestock to be raised	40	12	48	44	8	48	41	11	48
Selection of breed	42	12	46	56	3	41	44	10	46
Where to make shed?	64	9	27	59	-	41	63	9	28
When and where to collect fodder?	36	25	39	48	11	41	38	25	37
Feeding management in fodder unavailability season	36	17	47	48	8	44	37	18	45
When and where to sell livestock?	43	12	45	59	-	41	46	11	43
When and in how much to buy livestock?	51	10	39	59	-	41	52	10	38
Amount of livestock to be consumed	36	15	49	59	-	41	42	12	46
Amount of livestock product to be sold	43	15	42	59	-	41	46	12	42
Mean	43	14	43	49	8	43	45	13	42
	n = 118			n = 27			n = 145		

Source: Survey, 1992

Note: 1 = Male, 2 = Female
3 = Both, 4 = All family members

Appendix Table 10. Gender related decision making concerning livestock production by economic group

Decisions to be made	Decision maker (No. of respondent)								
	Rich			Medium			Poor		
	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]
Type of livestock to be kept	43	7	50	35	9	56	54	16	30
No. of livestock to be raised	50	-	50	33	10	57	50	16	34
Selection of breed	57	-	43	38	10	52	50	14	36
Where to make shed?	70	-	30	63	9	28	58	12	30
Who and where to collect fodder?	64	-	36	35	27	38	36	24	40
Feeding management in fodder unavailability season	50	7	43	36	16	48	40	20	40
When and where to sell livestock?	50	7	43	41	10	49	54	14	32
When and in how much to buy livestock?	65	-	35	47	9	44	58	14	28
Amount of livestock to be consumed	57	-	43	31	15	54	52	16	32
Amount of livestock product to be sold	57	-	43	38	14	48	56	32	26
Mean	56	7	37	40	13	47	50	18	32
	n = 14			n = 81			n = 50		

Source: Survey, 1992

Note: 1 = Male, 2 = Female
3 = Both, 4 = All family members

Appendix Table 11. Gender related decision making processes concerning tree management by ethnic group

Decisions to be made	Decision maker (No. of respondent)								
	Magar/ Gurung			Brahmin/ Chhetri			Total		
	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]
Where and when to plant trees?	65	9	26	59	7	34	64	9	27
From where to get seedlings?	19	10	71	60	3	37	61	9	70
What tree species to be planted?	64	8	28	63	-	37	64	7	29
When to cut trees for timber?	72	8	20	63	-	37	71	7	22
When to cut leaves, branches for fuelwood?	50	23	27	52	11	37	50	21	29
Where and in how much to sell timber?	77	5	18	70	-	30	76	4	20
Mean	58	11	32	61	7	35	64	10	33
	n = 118			n = 27			n = 145		

Source: Survey, 1992

Note: 1 = Male, 2 = Female
3 = Both, 4 = All family members

Appendix Table 12. Gender related decision making processes concerning tree management by economic group

Decisions to be made	Decision maker (No. of respondent)								
	Rich			Medium			Poor		
	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]
Where and when to plant trees?	71	-	29	62	6	32	66	16	18
From where to get seedlings?	64	-	36	62	7	31	60	14	26
Which tree species to be planted?	71	-	29	62	5	33	66	12	22
When to cut trees for timber?	71	-	29	70	4	26	70	14	16
When to cut leaves, branches for fuelwood?	64	15	21	48	17	35	50	28	22
Where and in how much to sell timber?	79	-	29	73	4	23	80	6	14
Mean	70	15	29	63	7	30	65	15	20
	n = 14			n = 81			n = 50		

Source: Survey, 1992

Note: 1 = Male, 2 = Female
3 = Both, 4 = All family members

Appendix Table 13. Gender related decision making processes concerning household and other activities by ethnic group

Decisions to be made	Decision maker (No. of respondent)								
	Magar/ Gurung			Brahmin/Chhetri			Total		
	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]
When and where to buy necessary household materials?	36	16	48	63	-	37	41	13	46
When to buy/ sell house/ land?	54	9	37	66	-	34	57	8	35
Where to buy land/ houses?	60	10	30	69	-	31	62	8	30
How much to be spent for buying household materials?	36	25	39	48	18	34	32	23	45
Sending children to school	36	12	52	55	-	45	40	9	51
Participation in village meetings	65	13	22	74	-	26	67	10	23
Participation in training activities	69	10	21	78	-	22	71	8	21
Mean	51	14	36	65	18	33	53	11	36
	n = 118			n = 27			n = 145		

Source: Survey, 1992

Note: 1 = Male, 2= Female
3 = Both, 4= All family members

Appendix Table 14. Gender related decision making processes concerning household and other activities by economic group

Decisions to be made	Decision maker (No. of respondent)								
	Rich			Medium			Poor		
	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]	M[1]	F[2]	B[3]
When and where to buy necessary household materials?	29	7	64	27	14	59	68	14	18
When to buy/ sell land/ house?	50	-	50	48	5	47	72	14	14
Where to buy land/ house?	50	-	50	62	5	33	70	16	14
How much to be spent for buying household materials?	36	7	57	32	21	47	54	32	14
Sending children to school	36	7	57	33	10	57	50	16	34
Participation in village meetings	29	14	57	67	10	23	76	16	8
Participation in training activities	29	7	64	69	10	21	84	12	4
Mean	32	8	57	48	11	41	68	17	15
	n =14			n = 81			n = 50		

Source: Survey, 1992

Note: 1 = Male, 2 = Female
3 = Both, 4 = All family members

Appendix Table 15. Variables considered during the survey

a) Pre- diagnostic description and PRA

Biophysical
1. Different crops and cropping patterns.
2. Crop calender and farming activities.
3. Livestock population and fodder management practices.
4. Information about soil erosion and its traditional management practices.

Tree Management system
1. Uses of indigenous and Project's introduced tree species.
2. Natural distribution and regeneration of those tree species.
3. Existing fuel, fodder and timber species on farmland.
4. Problems of fodder, fuelwood and timber trees.
5. Tree nursery- knowledge of location, what it provides.

Land use
1. Land use patterns: Agricultural land- lowlands and uplands.
   Forest land and community based land.
2. Land holding sizes and available farm trees.

Socioeconomic
1. Population and family sizes.
2. Cultural and social acceptances to grow fuel and fodder tree species on agricultural land.
3. Farmers' preferences for different farm trees.

Gender issue
1. Male and female farmers' participation in different agroforestry activities.
2. Participation of male and female farmers in different household activities.
3. Participation and attitude of male and female farmers in private tree planting on their farmland.

b) Formal Survey

- Farm size, household size and land holding size.
- Farmers' preferences for farm trees.
- Uses of different trees.
- Needs of farmers (like certain multipurpose trees).
- Cropping systems.
- Activities performed by male and female farmers.
- Time alloted by male and female farmers on different forestry and household activities.

Appendix Table 16 Scientific name of tree species

Local name	Scientific name
Bains	*Salix babylonica*
Bans	*Bambusa sp.*
Dudhilo	*Ficus nerifolia*
Dhupi	*Juniperus sp.*
Falant	*Quercus glauca*
Gogan	*Saurauia napaulensis*
Ghurmiso	*Leucosceptrum canum*
Katus	*Castanopsis hystrix*
Khanyu	*Ficus cunia*
Nevaro	*Ficus roxburghii*
Okhar	*Juglans regia*
Painyu	*Prunus cerasoides*
Salla	*Pinus wallichiana*
Utis	*Alnus nepalensis*

Formula for "t" and "Chi square" tests

t-test

$$T = Y_1 - Y_2 / S\,(1/n_1 + 1/n_2)^{1/2}$$

Where, T is calculated t-value; Y1 and Y2 are two population means; S is standard deviation; n_1 and n_2 are number of observations.

S is calculated as follows,

$$S = (n_1 - 1)\,s_1^2 + (n_2 - 1)\,s_2^2 / (n_1 + n_2 - 2)$$

Where, s_1^2 and s_2^2 are standard deviation for two different populations.

$$s = \frac{1}{n} \sum_{I=1}^{n} (Y_i - Y)^2 \qquad Y = \frac{1}{n} \sum_{i=1}^{n} Y_i$$

Hypotheses :

Ho : $(\mu_1 - \mu_2) = 0$

Ha : $(\mu_1 - \mu_2) > 0$

Rejection region : $T > T\alpha$ ($T\alpha$ is table value)
For specified α. Where α is confidence level.
(generally 0.05)

Chi square test

$$\chi^2 = \Sigma \frac{(O - E)^2}{E}$$

where O and E are observed and expected values respectively.

v (degree of freedom) = (r-1)(c-1)
where 'r' and 'c' are number of rows and columns respectively.

Rejection of hypothesis if $\chi^2 > \chi^2_{0.05}$
i.e. calculated > Table

References :

1. Statistical Methods. Dr. S.P. Gupta. New Delhi : Sultan Chard and Sons. 1982.
2. Mathematical Statistics with applications. William Mendenhall and Richard. L. Scheaffer. North Scituate, Massachusetts : Duxubury press. 1973.

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