THE RELATIONSHIP BETWEEN THE FOREST AND THE FARMING SYSTEM IN CHAUTARA, NEPAL, WITH SPECIAL REFERENCE TO LIVESTOCK PRODUCTION

by

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A sub-thesis submitted in partial fulfilment of the requirements for the degree of Master of Agricultural Development Economics in The Australian National University

November, 1982

DECLARATION

Except where otherwise indicated,
this sub-thesis is my own work.

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ACKNOWLEDGEMENTS

During the preparation of this thesis I was fortunate to draw upon the advice and cooperation of a number of people, whose assistance I gratefully acknowledge.

I am infinitely grateful to Dr. D. Evans who not only supervised the preparation and presentation of this thesis, but also forsook a lot of time and comfort to actually visit the site of the survey to advise me upon the mode of research.

I am greatly indebted to Dr. D. Etherington, the MADE Programme Convenor, and to Prof. D. Griffin, the Head of the Department of Forestry, Australian National University, without whose inspiration and encouragement this study would not have been realised. I am also obliged to Dr. D.P. Chaudhri and K. Sawyers for their advice.

It would be grossly remiss of me, were I not to express my gratitude to the members of the Nepal Australia Forestry Project. Professor Griffin kindly arranged for some invaluable financial assistance and the staff in Kathmandu and Chautara took the time to introduce me to the project, and helped with travel between Kathmandu and Chautara. Special mention should be made of Mr D. Parajuli and Mr G. Neville. I was also privileged to be able to use the facilities of the project guest house while in the field.

It would not have been possible for me to attend the MADE Programme and carry out this research, if it had not been for the sponsorship of the Agricultural Development Council. In this respect, I would like to express my appreciation for the help extended by members of the ADC staff, in particular, Mr G. Rixon and Dr. S. Ong.

ABSTRACT

Livestock raising is an important activity in the hill farming systems of Nepal. The high dependency of farmers on the forest, for raising livestock and meeting domestic needs, is considered to be one of the major reasons for deforestation and soil erosion.

In this thesis an attempt is made to discover the reasons why Nepalese farmers attach such great importance to livestock. This involves examining the role of livestock in the farming system. The interaction of the farming system with the forest then is examined to discover if there are grounds for believing that rural people contribute significantly to deforestation. The analysis is based on cross-sectional data which was collected in a survey of 40 families in Chautara panchayat of the Sindhu Palchok district of Nepal. Chautara panchayat was selected mainly because it is the centre of field operations for the Nepal Australia Forestry Project.

These data show that households spent a considerable portion of their time looking after livestock. Reasons are examined and it is concluded that livestock raising is profitable from the farmer's viewpoint. The data also reveal that families depend heavily on the forest, but collect greater quantities of fodder for their animals than firewood.

Farm families could, therefore, be contributing to deforestation. Policies to alleviate the problem are suggested. They involve trying either to reduce animal number or to provide more fodder. However, it is possible that these policies could be contradictory, in that providing more fodder would encourage farmers to keep more livestock.

The second part of the thesis examines this possibility. Regression analysis is conducted in order to determine the effect on livestock units of

the "number of privately owned fodder trees" and the "time taken by a family member to collect a load of fodder", factors likely to be affected by reforestation.

The analysis reveals that an increase in the number of fodder trees might result in an increase in the number of buffaloes. Similarly, a reduction in the time involved in collecting fodder might increase the number of goats. However, no relationship can be found between these variables and the number of cattle.

Thus, reforestation projects might encourage farmers to raise more livestock. Therefore, if reforestation is conducted according to estimates based on current stocking rates of livestock, future demands can probably not be fulfilled.

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on

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CHAPTER 1

INTRODUCTION

1.1 Country Background

Nepal has a total land area of about 14 million hectares (Department of Food and Agricultural Marketing Services, 1977) and a population of about 15 million (National Population Census Commission, 1981). When compared with other countries, the person-land ratio of 1.06 is relatively high (Table 1.1). This implies that there is significant population pressure on the available land resources.

TABLE 1.1

Person/Land Ratio of Selected Countries

Countries	1979 Population[1] (Millions)	Land (Million Hectares)	Population/ Land Ratio
Australia	14	769	0.02
Burma	32	68	0.47
China	971	956	1.02
India	651	327	1.99
Malaysia	13	33	0.39
Nepal	15	14	1.07
New Zealand	3	27	0.11

Note: 1 Population figures for Nepal are for 1981.
Source: Far Eastern Economic Review, 1981.

A considerable proportion of the total land area is unsuitable for cultivation. This is especially true in the mountainous northern region (16% of the total land area) and to a lesser extent in the hilly region lying just to the south (61% of land area). Most of the arable land lies in the Terai (plains) in the south of the country (World Bank, 1979).

Accordingly, Table 1.2 shows that only 16 per cent of the country's land resources is cultivated. This gives a person/cultivated land ratio of 6.52, which also is relatively high compared to other countries (Table 1.3). The

TABLE 1.2

Land Use in Nepal, 1974/75

Land Distribution	Area (Hectares)	Per Cent
Forest Area	4,823,000	34.20
Cultivated Area	2,326,000	16.49
Pasture	1,785,700	12.66
Water	400,000	2.83
Residential Area and Road	30,000	0.21
Waste Land	2,629,100	18.64
Land Under Perpetual Snow	2,112,100	14.97
Total	14,105,900	100.00

Source: Department of Food and Agricultural Marketing Services, 1977.

TABLE 1.3

Population/Cultivated Land, Ratio
- Selected Countries

Countries	
Australia	0.83
New Zealand	3.33
U.K. (Britain)	5.00
Nepal	6.52

Source: Based on P. Newbould, 1977.

World Bank estimated that the ratio of population to arable land varied from 15 per hectare in more mountainous regions, to 3.79 in the Terai (World Bank, 1979, p.2). This situation has been exacerbated by the rate of population increase, which has reached 2.66 per cent per year (National Population Census Commission, 1981).

Nepal is mainly an agricultural country, with 93 per cent of the total population depending upon agriculture. It does not have any commercially exploitable mineral resources. The only resources that can be exploited are hydro power and tourism. Due to the limited land area and the population pressure, the average farm size per family is less than 0.4 ha. (World Bank,1979)

Livestock plays an important role in agriculture, especially in the hills. There, the average land holding is very small and only a small proportion is irrigated. Livestock provide milk and meat to supplement the low level of crop production.

They also provide essential inputs to crop production. Bullock labour is used for ploughing, and animal manure provides the bulk of the fertilizer that is used. Almost no chemical fertilizer is used, partly because of the poor transport and communication systems in the hills, and partly because of the negligible purchasing power of most farmers.

1.2 Interaction of the Farming System With the Forest

Recently there has been a growing concern in Nepal about the rapid rate of deforestation and the problems which have resulted. Explanations have been focussed on the heavy dependence rural people have on the forest. They use it for fodder to feed their livestock, for fuelwood, timber and for litter which is used as flooring in animal sheds.

The first two uses are by far the most important. They are discussed in turn in this section. Then, some of the problems caused by the rapid deforestation are considered.

1.2.1 Fodder Collection

Only rough estimates of the livestock population of Nepal exist. The 1977 population of cattle, buffaloes, sheep, goats and pigs was estimated to be 15.6 million (World Bank, 1979). Details are provided in Table 1.4.

TABLE 1.4

Livestock Numbers in Nepal - 1977
(Million Head)

	Hills	Terai	Total
Cattle	4.6	2.2	6.8
Buffaloes	3.1	0.8	3.9
Sheep and Goats	3.6	1.0	4.6
Pigs	0.2	0.1	0.3

Source: World Bank, 1979.

The average number of bovine animals per family was estimated at 4.4 and 6.2 in the hills and the Terai respectively.[1] The bovine population per hectare was estimated to be 8.8 in the hills and 2.4 in the Terai (World Bank, 1974).

One of the major reasons for the large animal population is that it is illegal to slaughter any type of cattle in Nepal. This is for religious reasons. However, similar, though less rigorous restrictions exist in India which has 3.9 animals per household as compared to Nepal's 5.3 per household (World Bank, 1974).

The limited amount of grazing land in the hills provides enough feed for animals only during the Monsoon season, between June and September. Private

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1 Calculated by the World Bank (1974) on the basis of the Farm Management Survey (1968/69).

fodder trees together with crop residues provide some feed during other months, but these are insufficient because land holdings are small. Families rely on the forest to make up the difference, estimated to be about 23 per cent of total consumption (Rajbhandary and Shah, 1981).

This proportion obviously varies over the country and between farms of different sizes. For example, households in the eastern hills own fewer fodder trees than those in the western hills, implying that the former group probably relies more on the forest. Similarly, the dependence on the forest for fodder is inversly related to the farm size (Wyatt-Smith, 1982). This is because small farmers are less willing to plant fodder trees as they fear that trees would subject their crops to root and shade competition.

Despite this dependence on the forest, animals are not well fed. The Lumle Agricultural Centre has calculated the feed ration necessary to ensure that animals produce at the maximum level. At present, it is estimated that animals on average obtain only a half of the recommended ration (Wyatt-Smith, 1982). Given this low consumption, Wyatt-Smith estimated that the average family would require 3.5 ha. of forest to support their livestock.[2] This ratio would ensure the "continuation of a given agricultural system based on sustained productivity" (Wyatt-Smith, 1982, p.2). Presumably, it would also ensure that there was no significant deforestation. Obviously each family would require a much larger area of forest if animals were to be provided the full recommended amount of feed.[3]

It is not possible to calculate the area of the forest currently available to each hill family. However, on a national level, the area of land under forest, given in Table 1.2, can be divided by the number of households to give an area of about 1.75 ha. per family. Given the number of animals and their

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2 The average family consisted of 5 to 6 people, on 1.25 ha. of land with no more than 5 bovine animals.

3 It would be more than double the 3.5 ha. on the assumption that existing communal grazing areas and private land holdings could not provide significantly more feed than at present.

present consumption patterns, this is only half the area required to allow the agricultural system and the forest to maintain themselves.

1.2.2 Firewood

In Nepal, rural families use relatively low amounts of energy (Griffin, 1981). Each family collects barely enough to cook two meals per day and to produce a small amount of heating. However, the proportion of people depending on the forest for fuelwood is high. About 87 per cent of the country's total energy need is derived from wood (World Bank, 1978).

This places an enormous demand on the forest. The World Bank (1978) forecast that over 80,000 ha. per year would have to be afforested to meet the projected rural energy demands up to the year 2000. The current rate of afforestation is only 5,000 ha. per year.

Consequently, fuelwood is becoming scarce. Families are increasingly resorting to burning dung or plants which could be used for fodder. At the present rate of forest destruction, the World Bank (1978) estimated that, sometime between 1985 and 1995, the quantity of dung and fodder used for fuel would rise to over 8 million tons. This represents foregone food grain production of over one million tons.

1.2.3 Costs of Deforestation

It was shown earlier that Wyatt-Smith (1982) estimated that the average hill family required 3.5 ha. of forest to provide fodder for their animals. He also calculated that they required between 0.3 and 0.6 ha. for fuelwood. This implies that the agricultural system and the forest could maintain themselves if each family had access to about 4 ha. of forest. However, there was sufficient forest to allow each family less than two hectares. The World Bank (1978) estimated that 25 per cent of Nepal's forest area had been destroyed between 1964 and 1975.

One of the most important costs is that Nepal is beginning to import increasing quantities of oil fuels. This will put a major strain on an

economy short of foreign exchange. The cost of foregone production caused by burning animal dung, almost the sole form of fertilizer, has already been mentioned.

However, the most obvious effect of deforestation is erosion. There is already a great deal of natural erosion in Nepal because of the very heavy Monsoons and the steep terrain. Yet it has been suggested that half of the erosion which occurs is man made (Field and Pandey, 1968). Part of this is due to the high rate of population growth, which means that marginal land is being brought into cultivation, much of it on steep slopes. Part is due to the overgrazing of pastures and part is attributable to the excessive use of the forest for fodder and fuelwood.

1.3 The Nepal Australia Forestry Project (NAFP)

Recently, the Nepalese Government has recognized the extent of the problem of deforestation and has begun to take appropriate action. A number of afforestation projects have commenced, one of them being the NAFP.

Australian involvement in forestry in Nepal began in 1962.[4] It was on a rather ad hoc basis until taken over by the Forestry Department of the Australian National University (ANU) in 1972. The Australian Development Assistance Bureau was the funding agency. Activity was focussed mainly on the establishment of nurseries and species trials, although Australian staff advised and assisted in reforesting about 13,000 hectares throughout the country between 1967 and 1977. About 68 per cent of this area was in the hill regions and the remainder was in the Terai.

The old project was discontinued in 1978, and a new project, known as NAFP Stage 2, commenced. It also was administered by the Forestry Department of ANU on behalf of the Australian Development Assistance Bureau. The new project had three main objectives:

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4 Most of the information in this section is taken from Department of Forestry, ANU (1981).

(i) To provide assistance to implement the National Forestry Plan in the Chautara Forest Division. This largely involves reforestation of government owned land, giving advice to the local government administration on reforesting community owned land, and encouraging private land owners to plant suitable types of trees on their land. Further details are provided in Chapter 2.

(ii) To make a contribution to training and education in forestry in Nepal.

(iii) To help in the construction of an adequate seed storage and testing unit in Kathmandu.

The project in Nepal is jointly managed by an Australian Project Office and the Forest Division of Chautara, which is under the control of the Forest Department, Ministry of Forests, His Majesty's Government of Nepal. The field activity of the project is centred at the Chautara forestry division which lies to the north-east of Kathmandu. The Chautara division includes the Sindhu Palchok and Kabhre districts. Details about the area are provided in Chapter 2. Chautara panchayat is shown in Figure 1.1.

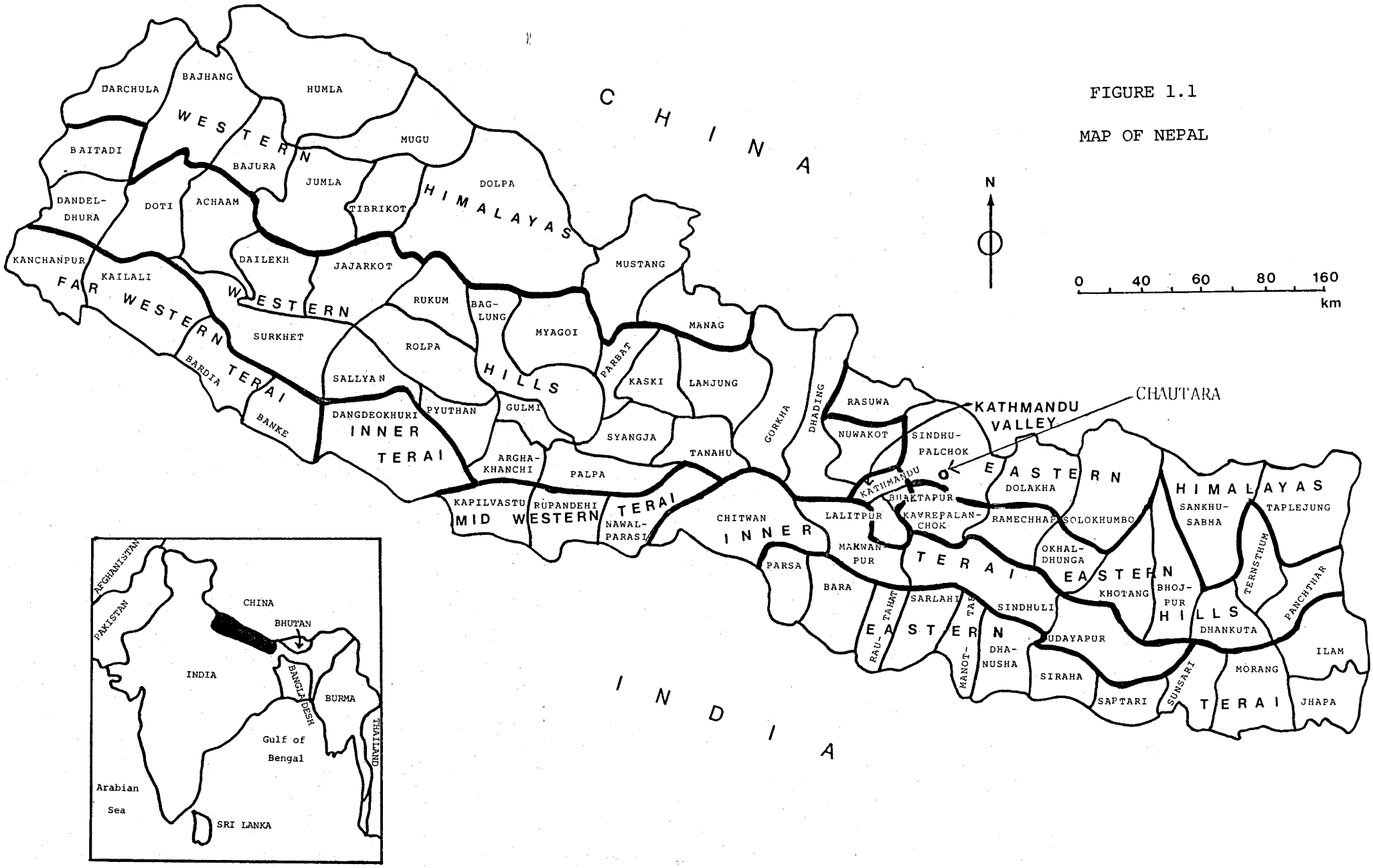
1.4 Aims of the Present Study

The extent of deforestation in Nepal is well known. It has been suggested that it is in large part due to the dependence of rural people on the forest, and that an important cause of this dependence is the need to collect fodder for livestock. Some of the problems caused by deforestation have been discussed. Official recognition of these problems has led to a number of reforestation projects, including the NAFP.

Despite the postulated importance of livestock as a cause of deforestation, very few studies on the role of livestock in the farming system of Nepal have been done. Little is known, therefore, about the reasons why families keep such large numbers of livestock, the resources devoted to, and the output

FIGURE 1.1

MAP OF NEPAL



provided by these livestock. Accordingly, the first aim of this study was to document the relative importance of livestock to a group of farmers in the Chautara region of Nepal. As part of this process, information on the way households interacted with the forest was collected as well.

Chautara was chosen because it is the centre of field operations for the NAFP. Understanding why people keep livestock and how animals fit into the farming system could be of crucial importance to the project. This was recognized by the people involved in the project, which was another reason for choosing a sample from Chautara farmers.[5]

Some of the reasons why people keep livestock should emerge from the first part of the study. This would enable an assessment to be made of whether reforestation projects are likely to affect people's desire to raise livestock. This has important policy implications. For example, projections of the rate of reforestation necessary to meet future demands are based, in the past, on current usage rates. These projections would be inaccurate if reforestation projects were to encourage farmers to keep more livestock. This topic is examined in the second part of the thesis.

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5 A great deal of assistance was provided by the NAFP. See acknowledgements.

CHAPTER 2

DESCRIPTION OF THE SURVEY AREA

2.1 Sindhu Palchok District

From an administrative point of view, Chautara, which lies to the north-east of Kathmandu, is the most important "Panchayat" of Sindhu Palchok district.[1] Himalayan peaks ranging from 6,000 metres to 7,084 metres loom to the north of this district while lowlands of around 850 metres spread to the south.[2]

Sindhu Palchok district can be divided into four geographic regions, according to the altitudes above sea level.

2.1.1 Himalayan Region

Except for the north-eastern corner, the northern part of the district is permanently covered by snow. This Himalayan region lies above the snow-line, which begins at about 4,880 metres above sea level. The 'Jugal' Himalayan range which is found here comprises six peaks ranging from 6,000 to 7,084 metres. The highest peak (7,084 metres) in the district is Lang Pogang (Big White Peak).

The Himalayan climate is extremely cold throughout the year and is similar to the Tundra climate. This type of climate is also similar to that found in the Arctic Prairies of Canada.

As the Himalayan region is snow-clad throughout the year, the only vegetation that can survive is moss. The region, therefore, is uninhabited and with no forestry or agricultural activities.

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1 Administratively and geographically Nepal is divided into 14 zones. Each zone is subdivided into districts and each district into town or village 'panchayats'. Each 'panchayat' comprises 9 wards.

2 Most of the data in this section are taken from His Majesty's Government (1974). References are provided separately when information is taken from other sources.

2.1.2 'Lekali' Region[3]

This, the second region, consists of land between altitudes of 2,135 and 4,880 metres. There are two different types of climate to be found in the two parts of this region. Between 4,000 and 4,880 metres altitude is found a Coniferous Forest climate, a type of climate which is also found in Northern Russia and Siberia. It is extremely cold throughout the year and the land is covered with snow for six months of the year. This area is not suitable for any type of cultivation. However, when the snow starts melting in summer people from lower areas move their livestock in, and remain there for six months, till the onset of the next winter when they return to lower altitudes.

The lower part of the 'Lekali' region, lying between 2,135 and 4,000 metres, has a cold Temperate or Deciduous Forest climate which is similar to that found in central Europe and British Columbia. This climate implies very cold temperatures in winter and mild warm ones in summer.

Various types of trees are to be found here, among which are 'Thigre Salla' (Tsuga dumosa), 'Dhupi' (Cupressus arixonica) and Walnut. Potato is the only crop grown successfully in this area and so the major occupation of its few inhabitants is raising livestock - mainly yak, sheep and mountain goats.

2.1.3 Hilly Region

The area lying below 2,135 metres and down to 1,515 metres can be categorised as the Hilly Region. With a warm temperate climate this area is very densely populated. The climate here is similar to that of the south-eastern coastlands of Australia. Temperatures are neither very cold in winter nor very hot in summer.

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[3] An area located on a ridge or on the higher slopes of a mountain is called 'Lekali'.

Although a high proportion of the forest has been deforested, some forest still remains in the upper part of the region. However, all land that is suitable for agriculture is used to produce various types of grains. Chautara, the major 'panchayat' of the district, lies in this region. Its characteristics are described in more detail at a later stage.

2.1.4 Lower Plains

The final region in Sindhu Palchok district consists of plains lying between 850 and 1,515 metres. Summers in this region are very hot, but winters are very mild. These plains are particularly suitable for agriculture - paddy, mustard and various other grains being the main products.

2.1.5 Population

The 1981 national population census estimated the total population of Sindhu Palchok district to be 232,804. The annual growth rate over the previou ten years was 1.21% which is lower than the national rate of 2.66% (National Census 1981). As in other districts of Nepal, the majority of the population of this district depends upon agriculture. Although no figures are as yet available for 1981, the 1971 census revealed that 96.5% of the economically active population of Sindhu Palchok depended on agriculture and other related activities.

2.1.6 Agriculture

Two types of land are commonly identified in the hills of Nepal. First, land that can be irrigated throughout the year is known locally as 'Khet'. This is usually situated in a valley or close to a river or some other source of water. The second type of land is called 'Pakho Bari' or just 'Pakho' which lies on slopes and the upper parts of hills. This land is difficult to irrigate because of its location and so farming depends on the availability of rain.

The total land area of the district is 252,800 hectares. No recent land survey has been conducted in any part of Sindhu Palchok district.[4] The last survey was conducted in 1895 for 'Khet' land and in 1945 for 'Pakho' land. Land holdings and ownership have changed significantly since then, and these surveys are not very useful.

However, a series of land reforms were introduced in the district during 1964-65. As part of these reforms, land owners were required to register their holdings with a Land Reform office. These records show that the total area of cultivated land in the district is 17,834 hectares, while the total number of land owners is estimated to be 34,008. Not all land owners cultivate their own land as some forms of tenancy also exist. The Land Reform office does not have a complete record of the proportion of owner operators to tenants. Its information relates to only 68% of the cultivated land area. It reveals, however, that almost 97% of this area is cultivated by the owners.

Table 2.1

Ownership of Land by Strata in Sindhu Palchok District

Land Holding (in hectare)	Land Owners		Total Land Area Owned	
	Number	Per Cent	Hectare	Per Cent
0.5 or less	32,634	95.95	15,622.55	87.60
0.5 to 0.75	1,030	3.03	1,360.10	7.63
0.75 to 1.4	186	0.55	355.55	1.99
1.4 to 3	146	0.43	436.55	2.45
3 to 4	10	0.03	35.25	0.20
Above 4	2	0.01	23.75	0.13
Total	34,008	100.00	17,833.75	100.00

Source: His Majesty's Government (1974).

[4] The government is soon to conduct a land survey in the area.

About 96 per cent of the land owners in the district own 0.5 hectare or less each. The land owned by these people is about 87% of the total area. Large farmers, classified as those owning more than 3 hectares, own only 0.04% of the total land area.

2.1.7 Livestock

In the Lekali region of the district the main occupation is livestock raising. People shift their livestock from the lower to the upper part of the region in summer and remain there for six months. Yak and Chauri[5] are the main livestock raised in this area. However, in the lower regions raising livestock is the second-most important occupation and is generally undertaken at the same time as farming. Cattle, buffaloes, sheep, goats, pigs and chicken are the main livestock raised. The Agriculture Census of 1972 estimated that there were 68,000 cows, 22,000 bullocks, 44,000 buffaloes and 71,000 goats in Sindhu Palchok district.

2.2 Chautara Village Panchayat

The research reported in this thesis was undertaken in Chautara Panchayat which, as stated earlier, lies in the Hilly region of Sindhu Palchok. Chautara Village Panchayat itself lies at an altitude of 1,460 metres above sea level. The Panchayat is situated on a series of ridges about a four hour drive from the capital of Nepal, Kathmandu.

For many centuries one of the major trade routes between Kathmandu and Tibet passed through Chautara. This could be the major reason for the existence of a thriving market here. About 28% of all the households in the Panchayat live in this market area (New Era, 1980).

Chautara Panchayat has also become the administrative headquarters of the entire Sindhu Palchok district, and several government and semi-government district offices are located here. Moreover, it is also the

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5 Chauri is a crossbreed of cow and yak.

centre of the field operations of the Nepal Australia Forestry Project (NAFP). This is the reason why Chautara was chosen as the focal point for the field research reported in this thesis.

2.2.1 Climate

The climate of Chautara is classified as warm temperate, as mentioned earlier. There are no records of temperatures at Chautara. However, for seven years in the late 1960s, records were kept at a nearby hill which lies at about the same altitude (1,680 metres). These temperatures can be taken as a rough guide. The average monthly temperatures of this site are recorded in Table 2.2.

Table 2.2

Average Temperature

Name of Site : Timure

Altitude : 1,680 metres

Month	Temperature (^{o}C)
January	9.1
February	11.2
March	14.3
April	18.5
May	21.8
June	22.5
July	21.9
August	21.8
September	20.6
October	17.3
November	12.9
December	10.2

Mean Temperature : 16.8^{o}C
Number of Years Recorded : 7

Source: Field, D.I. and Pandey, K.R.,(1969).

These temperatures follow the same seasonal patterns found in the rest of Nepal, though they are milder, on average, than those of the 'Terai', and warmer than those of the more mountainous areas. Temperatures begin to rise in March and reach the maximum in June. They begin to drop sharply from November to reach the minimum in January.

2.2.2 Rainfall

Nepal receives most of its rainfall from the Monsoon winds. The main Monsoon rains fall in summer between June and September. There is also a brief but regular pattern of rainfall for a few weeks in winter.

The diverse relief of the country plays a decisive role in the precipitation pattern. The general tendency is for rainfall to decrease from the east to the west. The amount of rainfall rapidly increases as the terrain changes from the 'Terai' (southern plains) to the mountain region up north, but begins to decrease again in the Himalayan region further north (National Council for Science and Technology, 1980). From the foothills of the lower Himalayas in the south to the greater Himalayas in the north, rainfall is greater on the windward slopes of the mountains than the leeward slopes.

The only available record of rainfall in Chautara is for the two recent years of 1979 and 1980. At the time of the survey, the local people expressed the belief that those were two average years for rainfall. So the figures can be taken as fair representation of typical patterns. These figures suggest that Chautara has its heaviest rains in July and August - the average falls over the two years were 563.30 and 513.88 mm respectively in these months. The lowest average rainfalls of 1.05 and 1.65 mm occurred in October and January respectively. The average total yearly rainfall was 1,914.80 mm (Table 2.3).

This pattern of heavy rains in summer and very light falls throughout the most of winter has critical implications for agricultural patterns.

Table 2.3

Average Rainfall of Chautara in 1979 and 1980

Month	Rainfall (mm)
January	1.65
February	52.05
March	20.45
April	39.75
May	86.00
June	317.60
July	563.30
August	513.80
September	296.15
October	1.05
November	3.70
December	19.30
Total	1914.80

Source: Records held at Chautara Forest Division.

It is impossible to produce crops on unirrigated land during winter. 'Pakho Bari', therefore, lies idle from the end of millet harvesting in late November or early December until the preparation for maize cultivation in late February or March after the start of the winter rains.

2.2.3 Population

Like every other 'Panchayat' in Nepal, Chautara is divided into nine 'wards'. The total population of 6,808 is subdivided according to ward and sex in Table 2.4. Records held at the Panchayat office in Chautara indicated that this population consisted of 1,106 households in 1981.

Both Buddhist and Hindu households live in the 'Panchayat'. An accurate break-down by religion is not available, but another survey revealed that

Table 2.4

Population of Chautara Panchayat

Ward No.	Male	Female	Total Population of Each Ward
1	336	293	629
2	501	479	980
3	433	411	844
4	274	288	562
5	465	460	925
6	161	189	350
7	600	558	1,158
8	371	389	760
9	308	292	600
Total	3,449	3,359	6,808

Source: National Population Census Commission, 1981

three ethnic groups of Hindus accounted for almost 62% of the total population. These were Newar (26.3%), Chhetriya (19.7%) and Brahmin (15.9%). A group of Buddhists, known as Tamangs, comprised a further 14.4%. The remaining 23.6% were classified as 'others', which would have included both Hindus and Buddhists (New Era, 1980).

2.2.4 The Farming System

As in the other hill areas of Nepal, terraced farming is practised in Chautara. Most 'Pakho' land has been terraced on areas which slope at about 45^{o}. 'Khet' land is found either in valleys or on the sides of hills near springs. No figures on the total area of cultivated land in the Panchayat are available.

Maize and millet are the main crops traditionally grown on 'Pakho' land in Chautara, while paddy is the most important crop grown on 'Khet' land. However, paddy is grown at the time of the summer monsoons. In winter, 'Khet' land is often sown with maize and mustard.

2.2.5 Livestock

It was shown in Chapter 1 that livestock have a particularly important role in Nepalese farming communities. Accordingly, most of the households in Chautara keep livestock to complement cultivation.

Except for goats, other livestock are rarely raised for commercial purposes. Livestock are usually sold when there is an urgent need for cash, while livestock products are sold only after fulfilling household demands.

A survey conducted by the Livestock Development Centre in 1981 showed that the total number of livestock in Chautara was 9,469. The figures provided in Table 2.5, reveal that if chickens are excluded, goats are the largest in number, followed by buffaloes and cows.

2.2.6 Forestry

The pressure of population on land in the Panchayat is quite severe. Even steep slopes have been cleared and terraced for farming. Moreover, households keep more animals than can be supported by their farms alone - a large proportion of fodder must come from the forests. These two factors have led to a rapid decline in natural forests.

The Department of Forestry has begun an intensive afforestation programme to supplement the remaining 460 hectares of natural forest. Since the start of the NAFP in 1979, 812 hectares of the whole of the project area has been afforested, of which 478 hectares fell within Chautara Panchayat.[6] Of the trees planted, timber and firewood accounted for 92% while fodder made up the remaining 8%. The target and achievement of the Project for afforestation in the whole of the project area are given in Table 2.6.

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6 Records held at the Chautara Forest Division Office.

Table 2.5

Livestock Population of Chautara Panchayat in 1981

(1106 Households)

Ward No.	Cows	Buffaloes	Goats	Sheep	Pigs	Ducks	Chickens
1	81	50	300	-	6	-	300
2	250	300	513	-	-	-	657
3	263	233	449	37	4	-	636
4	99	116	269	-	-	-	366
5	73	59	248	-	-	9	598
6	67	77	146	6	-	-	464
7	143	85	291	20	-	22	676
8	197	113	234	7	-	-	207
9	14	220	290	40	4	4	200
Totals	1213	1253	2740	110	14	35	4104
Per Household	1.10	1.13	2.48	0.10	0.01	0.03	3.71

Source: Records held at the Livestock Development Centre, Chautara.

Table 2.6

NAFP Targets and Achievement

Year	Plantation Target	Achievement
1979/80	400 ha	360 ha
1980/81	560 ha	452 ha
1981/82	500 ha	

Source: Records held at Chautara Forest Division.

2.3 Summary

The NAFP field office is based in Chautara Panchayat of Sindhu Palchok district. Some of the characteristics of the district were described in the first section of this chapter while some of those specific to Chautara Panchayat were described in the second part.

This study aimed firstly to examine the importance of livestock in the farming system of families affected by the project, and secondly to analyse the interaction of households with the forest. Analysis focused on a sample which was selected from the households in Chautara district. The way in which this sample was selected, and some of its characteristics, are described in the next chapter.

CHAPTER 3

THE SAMPLE

3.1 Sample Size

Before the period of field work very little information about the recent population of Chautara panchayat was available. The results of the 1981 population census were not available at that time.[1] The only information was a list of voters over the age of 20, which was held at the panchayat office of Chautara.

It was difficult to stratify the population for the sample selection, due to a lack of relevant information. However, local forest officals helped to identify four communities within a two-hour walk from Chautara market area. All of these were visited and a list of households owning livestock obtained. Households to be included in the sample were selected randomly from this list.

It was decided not to spread the samples beyond a two-hour walk. Even then it would take a whole day of walking to visit 15 farmers. There was trade off between the representativeness of the sample on the one hand, and the number of farmers who could be visited, and the amount of time spent with each, on the other hand. Samples could have been collected from distant communities, say within half a day's walking distance. Perhaps this would have produced data more representative of the whole panchayat, but it would have been necessary to adjust by reducing the sample size, or by asking fewer questions, or both. Clearly, the aim when selecting the sample size, the households to be included and the survey technique, was to get as much information as possible from as many farmers as possible. However, it was

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[1] Results of Population Census 1981 became available after the field survey was over.

also necessary to remember that time constraints allowed only four weeks in Chautara and resources allowed only one helper to be hired. Obviously, the sample size had to be decided in conjunction with survey technique. Given the survey technique described in the next section, 40 families were selected.

3.2 Survey Technique

The field survey was done in January-February 1982. Questionnaires had been prepared beforehand and necessary adjustments and improvements were made after some trial interviews in the field. The total time available for interviewing in the field itself was one month. An additional two weeks were spent collecting secondary information and material from different departments and institutions in Kathmandu.

Different types of questionnaires were designed for different visits. All questionnaires are reproduced in the Appendix. For the first visit, a preliminary questionnaire was prepared seeking information about basic socio-economic variables such as family and religion and farm details, about livestock and stall feeding. It took five days to test the questionnaires, select the sample and conduct the preliminary visits.

It was decided to visit each household in the sample every alternate day for the remainder of the period. At each visit, an 'intensive questionnaire' was completed. Details were sought of the daily activity of all household members on the day immediately before the visit. The quantities of firewood and fodder collected and the returns provided to the family by livestock were recorded. Detailed information about ten days activity were recorded for each household using this method. Allowing for difficulties involved in locating some farmers, this process took 23 days to complete.

It was hoped that these interviews would help to paint a picture of the interaction of families with the forest over the year. However, the survey had to be conducted during Winter when no crops were being cultivated. Thus, during the time that the intensive questionnaires were being filled, four other questionnaires were also asked. Three of them concerned human and animal labour requirements for paddy, maize and millet production during the previous year. The fourth covered a number of miscellaneous and subjective questions. These questionnaires are also reproduced in the Appendix.

Filling these questionnaires was time consuming, and it was not possible to administer to the entire sample. Moreover, they asked for detailed information about last year's activities, so the questions were asked of a selected number of farmers who seemed to have good memories and who were willing to spend a lot of time answering questions.

Obviously, it would have been better to collect information from a larger sample over a longer period of time. However, within the time and resource limits that were available, it is considered that the method described above produced interesting and useful information. Although it may not be as representative as if it were possible to interview 100 families, or as accurate as if it were possible to observe each family over a year, the survey design and sample size reached a compromise between the representativity of the sample and completeness of information for each family.

Certainly there does not seem any reason to doubt the data that were collected, although some farmers were suspicious at first, their full co-operation was obtained eventually. Moreover, the limited data which could be obtained from secondary sources seems to be consistent with the data collected.

3.3 Selected Characteristics of the Sample Households

In previous sections it was shown that the aim of the study was to examine the relationship between farm families and the forest, in particular the interaction between livestock and the forest. Accordingly, it was desirable to select a sample from families who owned livestock. This automatically meant that the sample was not completely representative of either Chautara Panchayat or the whole of Sindhu Palchok district, as a proportion of families in the region do not own animals.

Nevertheless, it is interesting to examine whether families in the sample are similar in other respects to those in the district as a whole. Thus, some of the characteristics of the sample are described in this chapter, and where possible, compared to the characteristics observed in other areas of Sindhu Palchok district.

3.3.1 Family Size

The average family size of the 40 households included in the sample was 6.96, which is slightly larger than the average of 6.16 of Chautara as a whole.[2] Of these people, 6.23 lived on the farm while 0.73 per family lived outside Chautara. The latter group consisted largely of young men who had left the farm in search of wage labour opportunities.

A break-down of average household size by age and sex is presented in Table 3.1. The typical household contained 3.73 persons in the major economically active age group from 16-59 years. However, children between 10 and 16 years and sometimes even younger also helped in the supervision of livestock and the collection of fodder. There were 1.26 children aged between 6 and 15 in the average family.

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[2] The population of Chautara was taken from Census 1981, and the household numbers were provided by the Panchayat office of Chantara.

Table 3.1

Population Per Household Living on Sample Farms - According to Age Group

Age Group	Average per Family	
	Male	Female
> 59	0.33 (0.47)*	0.23 (0.42)
16-59	1.75 (1.13)	1.98 (1.27)
6-15	0.53 (0.72)	0.73 (0.82)
< 6	0.68 (1.05)	
Total	6.23	

* In all subsequent tables, figures in parentheses are standard deviations.

3.3.2 Literacy

In the sample, 28.70 per cent of the adults claimed to be able to read and write which seems very high for a rural area. This is, however, lower than the literacy rate of Kathmandu which was 38.27 per cent in 1971 (National Council for Science and Technology, 1980). The 1971 census estimated that the literacy rate of Sindhu Palchok district was only 8.28 per cent (National Council for Science and Technology, 1980). The difference may be explained in part by the fact that literacy has improved in the ten years since that census, and partly by the fact that the sample was selected from an area relatively close to the market area of Chautara. Education and literacy rates in Nepal are lower in the more isolated areas.

3.3.3 Religion

Table 3.2 shows that the sample included people of seven different ethnic origins. Buddhists comprised 62.5 per cent and Hindus the remaining 37.5 per cent.

Table 3.2

Number of Households in the Sample - By Religion and Ethnic Group

	Number of Households	
	Religion	
Ethnic Group	Buddhist	Hindu
Tamang	9	
Brahmin		1
Newar		1
Ghale	13	
Puri		7
Biswakarma		6
Gurung	3	
Total	25	15

3.3.4 Land Holding

Most of the cultivated land in Chautara is terraced and therefore level holdings are often very small and fragmented. The average holding of "Khet" land in the sample was 0.08 ha and the average "Pakho" holding was 0.25 ha per household (Table 3.3). Taken together this is slightly less than the 0.52 ha, which was the average total holding in the district as a whole in 1971 (His Majesty's Government, 1974).

Table 3.3

Average Land Owned Per Household

Average Land Owned (In Ha)	
'Khet' Land	'Pakho' Land
0.08	0.25
(0.06)	(0.18)

In the sample, only five households rented in "Khet" land. These families rented an average of 0.42 ha. Two families rented in a total of 0.48 ha of "Pakho" land. Typically, rent for "Khet" land is paid in paddy while that for "Pakho" land is paid in maize and millet. Details of the average rents paid by the sample households which rented in land are found in Table 3.4. Only one farmer in the sample rented out "Khet" land. He rented only 0.013 ha for which he received 103.68 kg of paddy.

Table 3.4

Average Rented-in Land and Rent Paid Per Household

	"Khet" (5 households)	"Pakho" (2 households)
Average Land Rented-in (ha)	0.42	0.24
	Rent Paid in Paddy	Rent Paid in Maize & Millet
Average Rent Paid (kg)	217.73	117.45

3.3.5 Cropping Patterns

Paddy is the main crop grown on "Khet" land although some maize is also grown. Maize and millet are mainly cultivated on "Pakho" land. Table 3.5 shows the average area cultivated for different crops by families in the sample in the year immediately before the period of field work.

Table 3.5

Average Areas Cultivated and Quantities Harvested in 1981 Crop-Year

	Maize		Paddy	Millet	Others
	'Khet'	'Pakho'	'Khet'	'Pakho'	'Khet' or 'Pakho'
Average Area per Household (ha)	0.07 (0.07)	0.26 (0.19)	0.12 (0.20)	0.25 (0.20)	0.06 (0.19)
Quantity Harvested per Household (kg)	92.16 (2.21)	237.96 (3.38)	514.77 (8.74)	284.69 (3.35)	25.29 (1.86)

Due to the lack of sufficient land for paddy, people must grow considerable quantities of maize and millet. Limited quantities of other crops such as wheat, mustard, soya bean and vegetables are also grown. The overall cropping patterns observed in the sample appear to be followed in most parts of Sindhu Palchok district (His Majesty's Government, 1975).

3.3.6 Livestock

Table 3.6 shows details of the average sample household's livestock holding. In the same table these figures are compared to the findings of two other studies of the Chautara area. Details for Sindhu Palchok district as a whole and for another hill area of Nepal are also provided as a matter of interest.

Table 3.6

Average Livestock Per Household in the Sample Compared With Other Studies

Type of Livestock	Chautara (1982)[1]	Chautara (1981)[2]	Chautara (1980)[3]		Sindhu Palchok (1980)[3]	Phewa Watershed Area (1980)[4]
			Market Area	Non-Market Area		
Cattle	2.13	1.10	0.98	2.49	2.21	1.40
Buffalo	1.56	1.13	0.71	2.13	1.47	1.70
Goat and Sheep	3.60	2.58	1.63	3.28	2.39	1.50
Pig	0.08	0.01				0.19
Chicken	4.20	3.71				2.84

Sources:
1. Present sample
2. Livestock Development Centre, Chautara.
3. New Era (1980).
4. Shah S.G. (1980).

In general, the findings of the present study seem consistent with those of other studies of the same area. Perhaps the slightly higher number of goats per household requires some explanation. Two explanations can be offered. Firstly, the households included in the present sample were relatively close to the major market. After chickens, goats were the most readily marketable animals and it would appear to be rational for families with easy access to the market to keep more goats. Secondly, the average land holding of these farmers was fairly small and, living closer to the market, they were further from remaining forest areas. Moreover, goats do not require large fodder inputs and so to keep more of them in preference to other animals seems to be reasonable.

As grazing land is scarce, the feeding pattern for animals varies according to the season. Livestock are fed grass in the rainy season when there is plenty of it available on private land as well as in the forest. As Winters are generally dry, there is not enough grass in the forest. Livestock are then fed on the little grass brought from the forest and on leaves from fodder trees, but mainly on paddy and millet straw. Other studies have shown that animals are undernourished in Winter as dry straw is not very nutritious (Shah S.G., 1980). Further details of feeding patterns are provided in the next chapter.

3.3.7 Trees

Table 3.7 gives details of the average number of trees of different varieties owned by families in the sample. The average number of fodder trees in the sample was 7.83. The maximum number of fodder trees owned by a single household was 30, and only 30 per cent of the sample owned 10 or more fodder trees.

Considering fruit, fodder and firewood trees together, the average numbers of trees per household was 17.01. A previous study of Chautara showed that the average family in the market and non-market areas of

Table 3.7

Trees Owned by Average Household

		Fruit Trees	Fodder Trees		Fuel Wood		Timber	Bamboo	Others	Total
			'Kutmiro'	Others	'Chilaune'	Others				
Average No. of Trees Per Household in Present Sample		3.70 (7.35)	6.93 (6.24)	0.90 (1.46)	4.95 (11.95)	0.53 (3.16)				17.01
Percentage		21.75	46.03		32.22					
Composition of Trees in Previous Study[1] (In Percentage)	Market Area	10.70%	40.80%		42.30%		4.00%	2.20%		(Total Number) 36.70
	Non-Market Area	16.20%	39.00%		30.50%		12.10%	1.10%	1.10%	(Total Number) 42.60

[1] New Era (1980).

Chautara owned 36.7 and 42.6 trees respectively (New Era, 1980). The disparity between this and the present study is remarkable.

Apparently the trees included in the previous study were fruit, fodder, firewood, timber as well as bamboo. However, it did not list the specific species that were considered. The present study did not count bamboo, firstly because it is difficult to determine how many individual plants exist in a clump of bamboo. No details of how the previous study approached this problem are available and it would therefore have been impossible to ensure consistency in counting the bamboo. The second reason for omitting bamboo is that it is rarely used for fodder and so is not relevant to the present study. This may help to explain the difference between the two studies.

However, very few farms in the area were observed to have significant amounts of bamboo, certainly not enough to account for the difference between 17 and 37 trees per family. Another possible explanation is that many farms contained shrubs known locally as "Banmara". This was not counted in the present study because the popular belief in the region is that "Banmara" is harmful to livestock, although it occasionally is fed to goats in winter when feed is very scarce. It is not, therefore, very relevant to the present study. However, "Banmara" shrubs may have been counted as trees in the previous study.

Thus, if the previous survey counted individual stalks of bamboo and the "Banmara" shrub as being equivalent to a tree, the difference in the two estimates of the average number of trees may be explained. It would not, however, have been a very sensible way of counting trees. If they did not count in that fashion, the difference is difficult to explain. Certainly, casual observation of the households that were not included in the present sample suggests that very few had many large trees growing on their farms.

3.4 Stocks Held in the Farms

3.4.1 Firewood

As it is prohibited to fell trees in public forests, it is not possible for families to collect firewood or fodder by that means. To obtain wood for burning, households are restricted to collecting fallen limbs from trees and dead branches from shrubs on public land. This is supplemented by portions of trees not suitable for animal fodder.

Consequently, firewood is scarce in the area. The average quantity of firewood stored in the sample farms was 3.28 loads or approximately 72 kgs (Table 3.8)[3]

Table 3.8

Stocks Kept by Average Household

Average Load Per Household		
Firewood[1]	Straw[2]	Manure
3.28 (7.06)	19.25 (19.15)	78.33 (76.85)

1. One load of firewood = 22kg (Griffin D.M., 1981).
2. One load of straw and manure = 13.6 kg (Stone L., 1980).

3.4.2 Fodder

It was shown earlier that straw from millet and paddy was used to feed buffalo and cattle during winter when green fodder was scarce. As this survey was conducted only a month after the paddy harvest, stocks of straw were relatively high - averaging 19.25 loads per family.[4]

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[3] One load of firewood = 22 kg (Griffin D.M., 1981).

[4] Stone (1980) calculated that a load of grass, fodder or manure carried by an adult female weighed 13.6 kg. It was slightly more when carried by an adult male. All subsequent calculations of weights are based on this figure.

3.4.3 Manure

Farmers spread dry leaves in the livestock shed and later collect this when it has been mixed with dung. This is stored ready for the planting season when it is the chief fertilizer used. At the time of the survey the average stock of manure was 78.33 loads (1065.29 kg) per family.

3.5 Conclusion

In this chapter, the method of sample selection and the survey technique that was used were described. Then some selected information about the farmers included in the sample was briefly presented. The aim of this study was not to select a sample representative of Sindhu Palchok district or of Chautara Panchayat. Rather it was to examine the relationship between the farming system and the forest.

However, the data discussed in this chapter indicated that most of the characteristics of the sample households were similar to those observed in Chautara Panchayat and Sindhu Palchok district. The average land holding, family size, cropping pattern and number of livestock were consistent with those found in other studies. The major difference seemed to be in the number of privately owned trees. That disparity could perhaps be explained by the way previous studies had counted trees.

CHAPTER 4

THE IMPORTANCE OF LIVESTOCK AND THE INTERACTION OF THE FARMING SYSTEM WITH THE FOREST

4.1 Introduction

It was shown in Chapter 1 that livestock are very important in Nepalese communities. Some of the problems this poses were discussed, especially the interaction of livestock with the forest. However, in the Nepalese hill farming system, it is not possible to consider the interaction of livestock with the forest without considering the cropping pattern as well. In this chapter then, the cropping pattern over a typical year in Chautara is described. Attention is focused on the way livestock fit into the farming system and the extent to which farmers utilize the forest.

In 1976, a Rockefeller Foundation team conducted a study of hill agriculture in Nepal. Its description of a typical hill farm production system is reproduced in Fig. 4.1. In general, this diagram applies to the Chautara region as well.

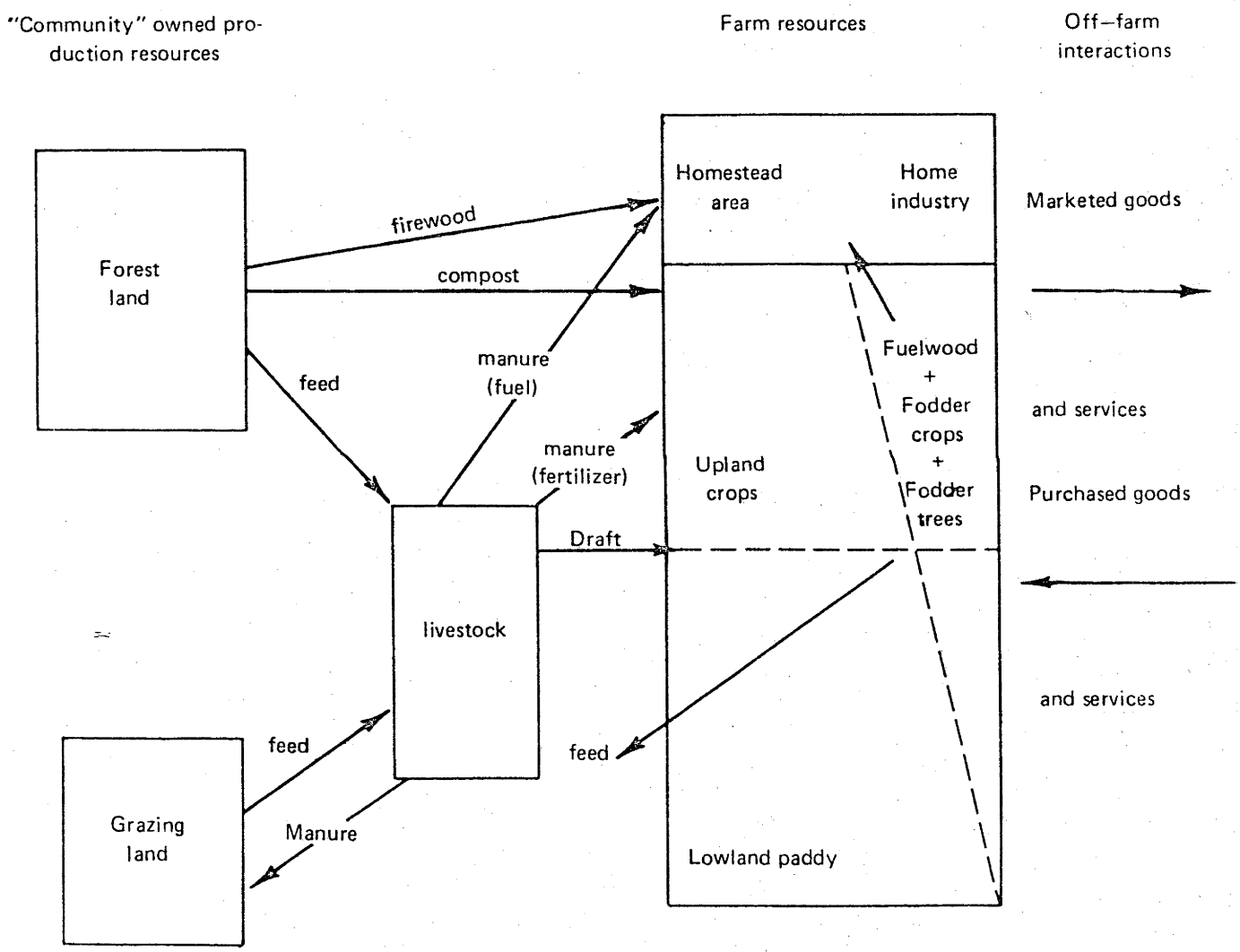
Nepalese farm families utilize the forest for feed for livestock, for firewood and for compost. They do not, however, put anything back into the forest. This is one of the main causes of deforestation. Nepalese rural people do not seem to recognise the need to plant new trees after cutting down the old ones.

4.2 Cropping Patterns

The main crops grown in the survey area are paddy, wheat and mustard in 'Khet' land, and maize, millet, soya and other beans in 'Pakho' land. Some farmers also grow sugarcane, potatoes and other vegetables. However, the important crops which all grow are paddy, maize and millet.

FIGURE 4.1

INTERRELATIONSHIP BETWEEN FIREWOOD, FODDER AND FARMYARD MANURE LIVESTOCK AND ARABLE CROP OUTPUT



Conceptual model of a Nepal hill farm production system

Source: The Rockefeller Foundation Team, 1976.

As the average holding of 'Khet' land is very small the paddy grown there is enough for a few months only. In other months people depend mainly on maize and millet. The planting and harvesting months for the different crops are given in Table 4.1.

Only one crop of paddy can be grown on 'Khet' land each year. Most farmers, therefore, plant maize on this land a few months after harvesting paddy, although some plant wheat instead. In the present sample, 73% of the people who owned 'Khet' grew maize on this land, and 11% grew wheat in addition to the major crop, paddy. The rest planted soya beans or other vegetables. A limited number of farmers grew mustard after harvesting paddy and before planting maize, but most left the land fallow during this time.

All farmers in the sample grew maize on 'Pakho' land. About one month before harvesting maize they typically plant millet in between the maize stalks. After the maize is harvested, crops such as soy beans or some other types of beans are intercropped with the millet. The only time 'Pakho' land is left fallow is from mid December to mid February.

The time of planting the same crop differs by up to a few weeks among farmers, due to variations in the availability of water and bullocks. But the majority of the farmers conduct their sowing and harvesting in the middle of the respective periods.

All farmers have to wait for the Monsoon rains before planting paddy. Some farmers can irrigate their land quite easily after the early Monsoon rains while others cannot. Paddy is planted during the major Monsoon period which begins in June and lasts for about four months. Similarly, in winter, maize is planted after the winter rains start. These winter rains usually begin in February and last for about two or three weeks.

Table 4.1

Planting and Harvesting Months for Different Crops

Crops	Months of Planting	Months of Harvesting
'Khet' Land		
Maize	Mid February to mid March	Mid June to mid July
Paddy	Mid June to mid August	Mid November to mid December
Wheat	Mid November to mid January	Mid April to mid June
Mustard	Mid December to mid January	Mid March to mid April
'Pakho' Land		
Maize	Mid February to mid April	Mid July to mid September
Millet	Mid June to mid September (Majority - mid July to mid August)	Mid October to mid December (Majority - mid November to mid December)
Soy bean	Mid July to mid August	Mid November to mid December
Beans	Mid July to mid August	Mid October to mid December

4.3.1 Methodology

In this section, an attempt is made to estimate the yearly labour inputs of a typical household. The aim is to determine firstly, the proportion of the family's time devoted to maintaining livestock and secondly, the extent to which they depend on the forest.

Initially, yearly labour inputs to the three major crops, maize, paddy and millet are estimated. The data are based on three very detailed questionnaires on paddy, maize and millet.

These questionnaires were not administered to all farmers in the sample, but to only 7 of them. The reasons were explained in Chapter 3.

From these responses, the time it typically took to prepare, plant, maintain and harvest 0.1 hectare of land was calculated for each crop.

The figure for a particular crop was then applied to the average area planted for that crop by the 40 farmers in the larger sample. This produced an estimate of the average family's labour input to the crop. Obviously this method does not allow for any economies of scale in cultivation. This is not, however, serious because the average land holding was very small (0.08 ha of 'Khet' and 0.25 ha of 'Pakho') and the maximum land holding was only 0.21 ha of 'Khet' and 0.79 ha of 'Pakho'.

The respondents provided answers in terms of days instead of hours. The labour inputs in the following sections are therefore in terms of man days, woman days, child days and bullock days. Children are defined as between the ages of 6 and 15 years.

At the next stage, annual labour inputs to livestock raising are calculated on the basis of a detailed questionnaire used during the intensive daily visits discussed in Chapter 3. All 40 sample farmers are included in this estimate.

Information is also provided on the reasons for keeping animals, as stated by farmers. These data are based on the summary questionnaire which was put to a limited number of farmers at the conclusion of the larger, more important survey.

4.3.2 Estimated Labour Inputs to Maize

Maize is planted both in 'Khet' and 'Pakho' land, and labour inputs are estimated separately for each. The sample farmers claimed that maize-growing in 'Khet' typically required 33.6 man-days, 33.24 woman-days and 14.77 bullock-days of work per year for the 0.1 hectare block. The figures for 'Pakho' land were 19.86 man-days, 34.68 woman-days, 0.22 child-days and 11.55 bullock-days per year per household.

As described earlier, the above estimates were based on a sample of 7 farmers.

These estimates can be generalised to the original sample of forty. The 40 farmers in the sample cultivated an average of 0.07 ha of maize in 'Khet' and 0.26 ha in 'Pakho' land. The implied labour inputs are presented in Table 4.2. This labour is applied from mid-February to mid-September. Details of labour inputs to separate activities, for example, ploughing or harvesting are found in Appendix 2.

Table 4.2

Estimated Average Yearly Labour Input to Maize - 40 Farmers

(For Average Area Under Maize)

	'Khet' (0.07 ha)	'Pakho' (0.26 ha)	Total
Man days	23.52	51.64	75.16
Woman days	23.27	90.17	113.44
Child days	-	0.57	0.57
Bullock days	10.34	30.03	40.37

4.3.3 Estimated Labour Inputs to Millet

Millet is grown in a seed bed and transplanted on 'Pakho' land just before the maize is harvested. The average labour used to prepare the seed bed sufficient to cover 0.1 hectare when transplanted was 5.6 man-days, 7.19 woman-days and 0.52 bullock-days. The main planting, cultivating and harvesting required 26.78 man-days and 63.46 woman-days. No bullocks are used for these activities.

The average household in the larger sample had planted 0.25 ha for millet in the season immediately before the survey. The implied average labour requirement, which must be applied from mid July to mid December, therefore, was 80.95 man-days, 176.63 woman-days and 1.3 bullock-days.

4.3.4 Estimated Labour Inputs to Paddy

Paddy, which is planted only on 'Khet' land, is also transplanted from a seed bed. To prepare the seed bed capable of covering 0.1 hectare of transplanted paddy required 9.86 man-days, 12.47 woman-days and 1.49 bullock-days. For the main activities like planting, weeding and harvesting the 0.1 hectare unit of land, 45.66 man-days, 51.99 woman-days and 10.18 bullock-days were used. These estimates were provided by 7 families.

The 40 farmers in the larger sample averaged 0.12 hectare of land under paddy. Thus, the average household labour requirement for paddy, which is applied from mid-June to mid-December, was 66.62 man-days, 77.35 woman-days and 14 bullock-days.

4.3.5 Summary of Labour Inputs to the Three Crops

The estimates of average yearly labour inputs to the three major crops are summarized in Table 4.3. Although this labour is concentrated from mid-February to mid-December, over 65% of it is conducted between the months of June and December.

4.3.6 The Importance of Livestock

The typical farmer in the survey area is a subsistence farmer with a small piece of land and a few head of livestock. None of the farmers have a large herd, but very few are without animals. Farmers regard livestock as a very important part of the farming system.

None of the sample farmers had private uncultivated land, or land set aside purely for grazing. Moreover, there is very limited common grazing land. Therefore, livestock depend on crop residues, private fodder trees and the forest for feed. Some family members spend a large proportion of their time collecting fodder every day.

Eight farmers were asked to answer a detailed summary questionnaire about their reasons for keeping livestock. Their answers are summarized in Table 4.4.

Table 4.3

Estimated Average Yearly Labour Inputs to Maize, Millet and Paddy

(40 Families)

Crops	Average Cropped Area		Estimated Labour Inputs							
			Man-days		Woman-days		Child-days		Bullock-days	
	Khet	Pakho	Khet	Pakho	Khet	Pakho	Khet	Pakho	Khet	Pakho
Maize	0.07	0.26	23.52	51.64	23.3	90.17		0.57	10.34	30.03
Millet		0.25		80.95		176.63				1.3
Paddy	0.12		66.62		77.35				14	
Total	0.19	0.51	90.14	132.59	100.65	266.8		0.57	24.34	33.33

Table 4.4

Stated[1] Reasons for Keeping Livestock

in Order of Importance

(in Per Cent)

Importance	Manure	Ploughing	Milk & Milk Product	Selling	Festival & Household Consumption	Total
1st	85.71	14.29				100
2nd	14.29	28.57	28.57	14.29	14.29	100
3rd			28.56	28.57	14.29	71.43[1]
4th			14.29		14.29	28.58[1]
5th				14.29		14.29[1]

Per cent of the interviewee

[1] Some families did not give more than two reasons

Over 85% of the people in this sample said that they kept animals mainly for manure, and the remaining 14.29% revealed that manure was the second most important reason. Ploughing was given as the most important reason by 14.29% of the families, and as the second most important reason by 28.57%. No families listed ploughing as the third, fourth or fifth reason for keeping animals. The table reveals that milk production was considered to be the next most important reason after manure and ploughing. Sale potential and home consumption were relatively unimportant. The reason that the rows do not sum to 100% is that some farmers gave only two reasons - only 91.43% gave a third reason.

Studies in other areas of Nepal suggest similar reasons for keeping cattle and bullocks (Rockefeller Foundation Team, 1976). However, goats are obviously not kept for ploughing purposes, nor was manure a very important reason for keeping them. The farmers keep different types of livestock for different purposes. As the cow is considered sacred in the

Hindu religion, the slaughter of cows, bulls or bullocks is forbidden in Nepal.

Bullocks are kept mainly for ploughing the farmer's own land and for manure. However, they can also be rented out and can also be sold fairly easily if the farmer is in need of cash. Although cows provide milk and manure, they are kept mainly because they may yield bulls for the farm.

If farmers wanted to keep livestock mainly for milk, they would choose buffaloes in preference to cows. They claimed that local buffaloes yielded more milk than cows. Besides this, there is a strong demand for the bulls of buffaloes in the market, as buffalo meat is consumed by a high proportion of the population.[1] Buffaloes also provide manure for the farm. Because they are almost always stall fed their manure is easier to collect.

Goats are kept for manure and meat. Moreover, goats are the easiest animals to sell in the market, apart from chickens, and can therefore provide cash at short notice. The demand for goat meat is very high as it is preferred to any other type of meat, again apart from chickens. Pigs and sheep are kept by a very few people in Chautara. Only two families in the sample kept pigs while only one kept sheep. They are used mainly for meat, but the wool of sheep is also used at times.

4.3.7 Estimated Labour Inputs to Livestock Raising

It was shown earlier that details of the daily activities of the 40 families were noted on each day for a period of 10 days. The responses reveal that over this time the average family spent a total of 1.54 man-hours, 3.99 woman-hours and 2.04 child-hours in activities directly related to livestock. These included collecting fodder, looking after livestock at

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[1] The slaughter of cattle of any type is totally forbidden in Nepal. However, the importance of the motherhood concept means that it is also socially unacceptable to kill female livestock. Male livestock therefore have a much higher market value.

home and supervising grazing livestock. Information on livestock raising activities during the 10 days of intensive interviewing is found in Table 4.5

Table 4.5

Labour Inputs to Livestock During Ten Days

(Average of 40 Families)

	Collecting Fodder	Looking After[1] Livestock at Home	Grazing Livestock	Total Hours (10 days)	Hours Per Day
Man-hours	2.25	6.00	7.15	15.4	1.54
Woman-hours	15.90	17.36	6.63	39.89	3.99
Child-hours	3.78	2.18	14.48	20.44	2.04

[1] Looking after livestock at home includes feeding at home, cleaning, etc.

An estimate of the average family's labour input to livestock over a year is found in Table 4.6. It is calculated on the assumption that the daily inputs of Table 4.5 would apply throughout the year. However, the survey on which the daily estimates are based took place in winter, and it is shown at a later stage that fodder is relatively scarce in winter and plentiful in summer.

It is not clear what difference this would make to labour inputs. The farmers in the sample claimed that they would still go to the forest about the same number of times in summer, suggesting no major differences in labour inputs. On the other hand, other studies have shown that livestock in some areas of Nepal are in a semi-starved condition during winter, suggesting perhaps that more fodder would be collected in summer, involving higher labour inputs (Shah, S.G., 1980). The conclusion would seem to be that the estimates of Table 4.6 would, if anything, understate yearly labour inputs to livestock. This possibility should be kept in mind when

Table 4.6

Estimated Average Yearly Labour Inputs to Livestock

40 Families

	Collecting Fodder	Looking After Livestock at Home	Grazing Livestock	Total Hours	Total Days
Man-hours	82.13	219	260.98	562.1	80.3
Woman-hours	580.35	633.64	242.00	1455.99	208.00
Child-hours	137.97	79.57	528.52	746.06	106.58

considering the relative importance of livestock to the farming system, the topic of a subsequent section.

4.3.8 Estimated Labour Inputs to Other Activities

In order to determine the relative importance of livestock in farm labour patterns, it is necessary to estimate labour inputs to other activities as well. During the ten days of intensive visits to the 40 farms, a detailed picture of all labour inputs was constructed. Details of the average daily labour inputs which emerged from these visits are found in Table 4.7. These times are in excess of those spent raising livestock.

Females spent the largest proportion of their time in household work, which included cooking, cleaning, washing, fetching water and grinding grain. Males spent the greatest proportion of their time in 'other activities' which consisted of going to the market, visiting government offices and doing construction work. It also included family members who had regular wage employment or conducted a trade, such as metal work, at the farm. This is a separate category to 'casual wage earning activities' which consisted of casual paid farm work. At the time of the survey, some families had begun to prepare 'Pakho' land for maize planting, which accounts for the relative importance of farm work.

Table 4.7

Average Daily Labour Inputs to Different Activities, Intensive Visits

Activities	Man hours Per Day	Woman hours Per Day	Child hours Per Day
Household work	0.63	4.41	0.32
Farm work	2.19	2.99	0.73
Collecting Fuel wood	0.16	0.45	0.12
Casual wage earning activities	1.17	1.09	
Other activities	2.93	1.22	0.77
Total	7.08	10.16	1.94

Occasionally, households in the sample would also hire outside labour to help on the farm or in some construction work. Other sample households were prepared to do such work on other farms as wage labour. During the ten day intensive survey, the average household hired in 1.70 man-hours and 0.21 female-hours of labour (Table 4.8). However, it also offered 1.17 man-hours and 1.09 female-hours to other farms as wage labour. This appears in Table 4.7 as 'casual wage earning activities'.

This wage labour, whether hired in or out, generally was divided by sex. In farm work, female labour was used for breaking soil and carrying manure, while male labour was used for ploughing. In construction work, males were used in such activities as masonry and carpentry. Females carried the stones and bricks used for constructing houses and walls.

Table 4.8

Average Daily Hired Labour, Intensive Visits

Hired In Labour	Man-Hours Per Day	Woman-Hours Per Day
Farm work	0.41	0.03
Construction work	1.29	0.18
Total	1.70	0.21

This information can be used to estimate the average household's labour input to household work, fuel wood collection, wage earning and other activities. The daily rate is extrapolated to a yearly rate on the assumption that activity patterns are similar throughout the year. It cannot be used to estimate inputs to farming activities because of the seasonal nature of farming. The method outlined earlier is preferable in this respect.

An estimate of yearly labour inputs to all activities is found in Table 4.9. Some estimates were given earlier in labour days and some in hours. For consistency, all estimates in Table 4.9 are in labour days on the assumption that 7 hours equals one labour day.

4.3.9 The Relative Importance of Livestock in Labour Patterns

Table 4.9 shows that the average family, with 6.23 family members, 7.37 animals, farming 0.13 ha of 'Khet' and 0.26 ha of 'Pakho', applied 558 man-days, 949.31 woman-days and 170.25 child-days to all major activities over a year. Livestock demanded the second highest allocation of time after crops, accounting for 14.39%, 21.91% and 62.60% of total man-days, woman-days and child-days in turn. These are quite significant proportions of the total labour inputs.

Table 4.9

Estimated Yearly Labour Input of a Farm Household for Different Activities

Activities	Yearly Labour Input			
	Man-days	Woman-days	Child-days	Bullock-days
1. Crop Cultivation				
(i) Maize cultivation	75.6	113.44	0.57	40.37
(ii) Millet cultivation	80.95	176.63		1.3
(iii) Paddy cultivation	66.62	77.35		14
Total	222.73	367.45	0.57	55.67
2. Livestock Raising				
(i) Fodder collection	11.73	82.91	19.71	
(ii) Looking after livestock at home	31.29	90.52	11.37	
(iii) grazing livestock	37.28	34.57	75.50	
Total	80.3	208.00	106.58	
3. Houshold Activity	32.85	229.95	16.69	
4. Collecting firewood	8.34	23.46	6.26	
5. Casual wage earning activity	61.01	56.84	-	
6. Other activity	152.78	63.61	40.15	
Grand Total	558.01	949.31	170.25	55.67

A number of qualifications, however, should be made. Estimates of labour inputs to only the major crops were made. It was not possible to get accurate information on minor crops from sufficient farmers in the sample. Thus, the figures in Table 4.9 would slightly understate the importance of crops. However, it was shown earlier that the labour inputs to fodder collection could be understated, thereby counter-balancing, at least in part, the understatement of crop labour.

Secondly, women appear to work almost twice as long as men on a yearly basis. Male labour is usually concentrated into the peak seasons when crops must be planted and harvested. Females not only work hard during this time, but are also responsible for housework and raising livestock, continuous work throughout the year. Furthermore, farm work is divided in such a way that the work done by females is less heavy but more time consuming than that carried out by men.

4.4 Use of the Forest

In previous sections, the important role of livestock in the farming system was described. It was shown that a significant proportion of work time was spent raising livestock. Collecting fodder was one of the most important jobs involved in raising livestock, particularly for females. This is one of the important interactions between the farm and the forest.

The second significant interaction between farming and the forest is through firewood collection. Both these interactions are described in turn in this section.

4.4.1 Fodder

In the sample, all 33 farmers who owned buffaloes stall fed them throughout the year. Buffaloes are allowed to graze only around the farm houses.

Among these people, 58% explained that the reason for stall-feeding is that buffaloes cannot graze on sloping land. Because of their heavy build they are unstable on the slopes and are likely to fall if allowed to graze there.

About 15% of the farmers gave two reasons in addition to the instability of buffaloes on slopes. One reason was that they did not have grazing land because the small land area they owned was needed for crops. The other reason was that they did not have enough family members to supervise the grazing of livestock. The remaining 27% of farmers gave only one reason for stall-feeding buffaloes, namely, the lack of grazing land.

Only four farmers stall-fed cattle. Two of them stall-fed cattle throughout the year, and the other two stall-fed them only during the summer. Three of these farmers claimed that they stall-fed them because of a lack of grazing land, and the other blamed a shortage of family members for the supervision of grazing. However, even the farmers who did not stall-feed cattle collected fodder to supplement grazing.

Goats were not stall-fed, but were allowed to graze freely during the day. As a supplement they were also given a small quantity of fodder that was collected.

The average family in the sample collected fodder on 4.78 of the 10 days of the intensive survey, or roughly every alternate day. On these days, 1.18 loads (16.05 kg) were collected on average. However, in the 10 days an average of 0.564 loads (7.67 kg) of fodder per day was collected.

More than 74% of this fodder was collected from the forest, while just over 24% came from private land. The remaining 1.42% came from communal land (Table 4.10). The fodder collected during the survey period was green fodder - grass from the forest and largely green leaf fodder from private land.

However, at that time the farmers claimed that only 25% of total livestock feed was contributed by this green fodder. The bulk of the diet of large animals like cows, bullocks and buffaloes consisted of paddy and millet straw. This is consistent with the findings of a study of farmers in the Phewa watershed area (Shah, 1980).

Table 4.10

Green Fodder Collected by an Average Family in 10 Days[1]

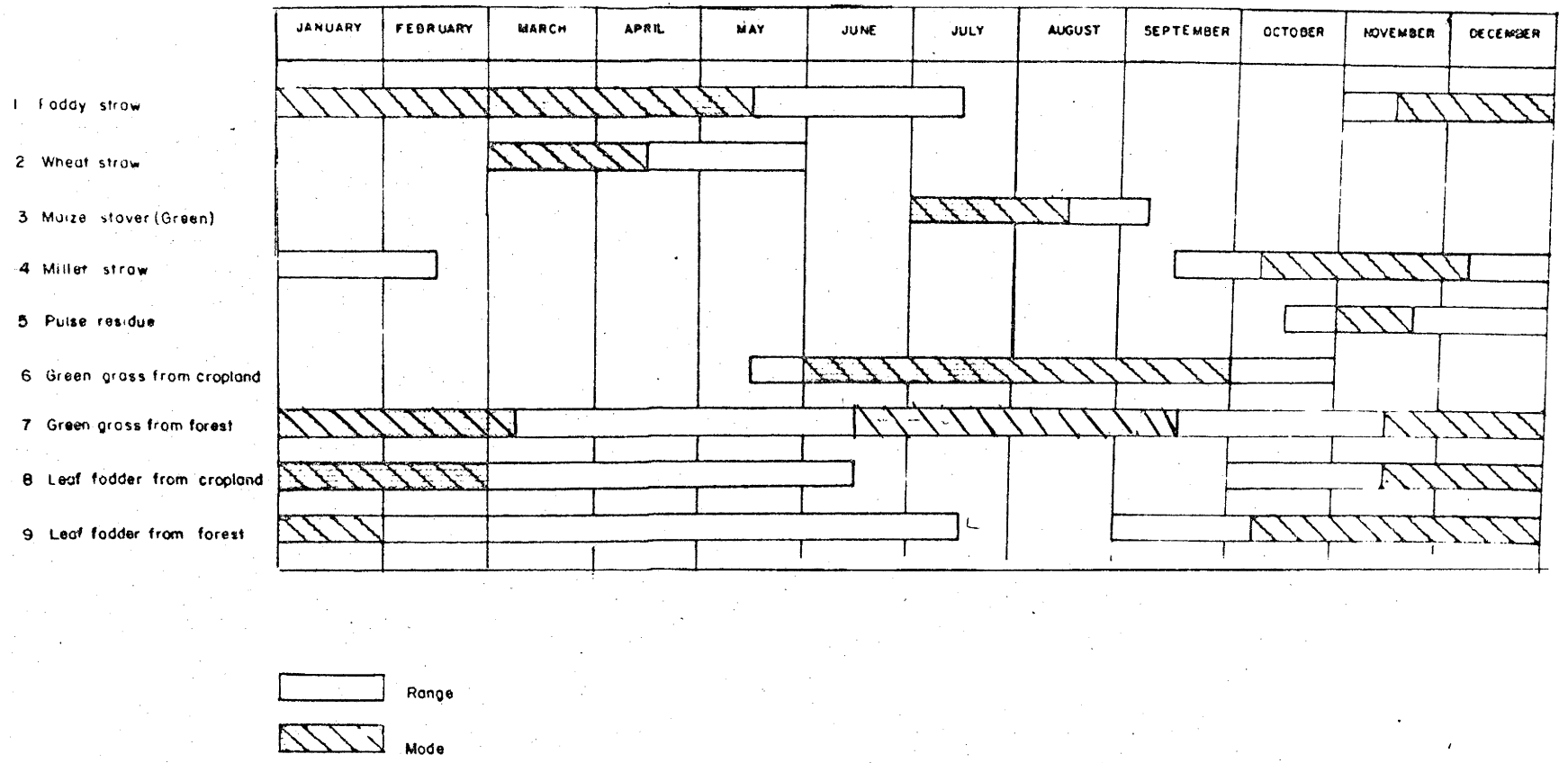
Fodder Collected	Source of Green Fodder		
	Private Land	Communal Land	Forest
Load[1]	1.38	0.08	4.18
Per Cent	24.44	1.42	74.31

[1] Conversion rates were given in Chapter 3.

There are some problems, however, in using the figures derived from the intensive questionnaires to estimate the amount of fodder the average family collects from the forest in a typical year. The survey was undertaken in winter and evidence from the Phewa watershed suggests that the availability of different types of fodder varies over the year (Shah, 1980). This is illustrated in Figure 4.2. Green fodder is plentiful on both private lands and in the forest during the summer Monsoon period, viz., from June to September. However, it is scarce in the winter months, from November to April, when dry straw is the most important source of feed. During this period animals are often undernourished.

The impact of this on the amount of fodder collected from the forest is not clear as evidence is scarce. Stone (1980) observed that farmers in the Tinau watershed in the western hills collected about the same amount of fodder from the forest in summer as in winter, but they collected more from their own land in summer. Shah (1980) also noted an increase

FIGURE 4.2 - PERIODS OF FODDER AVAILABILITY



Source: Based on Shah (1980)

in the availability of green grass fodder on private lands in summer. These findings are consistent with the Chautara farmers' claim that they collected more or less the same quantity from the forest throughout the year.

If this is true, it implies that the average family takes 152.57 loads (2075 kg) of fodder from the forest over a year. However, this estimate should be treated with care for the reasons mentioned above. The only way to obtain an accurate estimate of this figure is to conduct a survey over a much longer period.

4.4.2 Firewood

As explained in Chapter 3, firewood is very scarce in the survey area. During the intensive survey period of 10 days, only 1.73 loads (38.06 kg) were collected. This implies that only 0.17 load (3.81 kg) of firewood was collected per day (Table 4.11). The table also shows that a majority of this fuel was collected from private land with the forest as the second most important source.

Table 4.11

Firewood Collected by an Average Family in 10 Days[1]

Firewood Collected	Source of Firewood			
	Private Land	Communal Land	Forest	Total
Load[1]	0.91	0.09	0.73	1.73
Per Cent	52.60	5.20	42.20	100

[1] Conversion rates were given in Chapter 3.

These figures could be used to estimate the average family's consumption of firewood during a typical year if it could be assumed that consumption patterns were similar in summer and winter. As there is a shortage of

firewood it is more likely to be used primarily for cooking, with very little used for heating. Though some extra firewood would probably be collected in winter, it is unlikely to be much more than that collected in summer. Cooking requirements vary little over the year.

Assuming a constant rate of consumption, the average quantity of firewood collected over a year would have been 1390 kgs. Only 587 kgs of this would have come from the forest. This is the equivalent to 223 kgs per family member each year, slightly less than the 277 kg per person quoted in Griffin (1982, p.3) for a sample taken in the same area.

Thus, families in Chautara rely on the forest for both fodder and firewood. According to the data collected during the intensive interviews, farmers use the forest to a greater extent for fodder than for firewood.

4.5 Output from Livestock

In previous sections it was shown that farmers in Chautara spent a significant proportion of their time looking after livestock. The reasons the farmers gave for keeping livestock were discussed, the most important being for animal labour, manure and milk production, and as an investment which can be converted to cash if necessary. These outputs from livestock are considered in turn in this section. At the end, an attempt is made to compare the outputs with the costs of raising livestock.

4.5.1 Production of Milk

During the ten intensive visits the average milk production per household was 4.63 litres, or 0.463 litres per day. The farmers stored 0.18 litres of this for making ghee and other milk products. The rest was consumed immediately.

According to the farmers in the survey area, milk production is low in winter due to the unavailability of green fodder and the lack of other

nutritive feed. This is supported by the findings of other studies (Shah, 1980). The summer Monsoon ensures that there is plenty of green grass and livestock are well fed. Farmers in the survey area claimed that milk production in the peak season of feed availability is double the winter production.

On this basis, a rough estimate of the yearly milk production per household can be made. Given the lack of data on seasonal variations in milk production, an assumption is made that there are six months of lean production in which the figures outlined above would apply. Then there are six months of peak production at twice the winter level. Of course, this is not entirely accurate as production is likely to build up gradually over spring and decline gradually during autumn, but it is probable that these variations would average out over a year.

Another problem relates to the fact that only a half of the female bovine livestock owned by sample households were lactating at the time of the survey. If this proportion changed over the year, the estimate of yearly production would be incorrect. Shah (1980) has shown that both buffaloes and cows calve fairly regularly throughout the year in Nepal, suggesting that the assumption of a constant 50% lactation rate would be roughly accurate.

These assumptions are the best possible in the circumstances. The average milk production, assuming 0.463 litres per day per household for six months and 0.926 litres per day for the remainder of the year, would be 253.49 litres. If this milk had been purchased on the local market at Rs 3.50 per litre, it would cost the average household Rs 887.22[1].

[1] Rs 13.20 - US$1.00 at the time of the survey.

4.5.2 Purchase and Sale of Livestock and Livestock Products

Farm families in Chautara cannot afford to eat meat very often. Questioning revealed that the sample families ate meat about once a month on average. However, this does not follow a regular pattern. If there is heavy farm or construction work going on they try to eat meat more often.

Sometimes meat is purchased from the market and at other times an animal is killed and shared by a few families. Occasionally milk, goats and chickens are sold, and if the farmer is desperately in need of cash, a larger animal is sold. Bullocks, in particular, are sometimes also sold if a farmer has more than the necessary number for ploughing. During the intensive surveys, the average household purchased Rs 2.75 of animal products per day. The average sale was worth Rs 5.05 per day.

If it could be assumed that meat purchases and sales followed an even pattern over the year, the average family would make purchases of RS 1003.75 and sell Rs 1825 worth each year. This results in a net surplus from keeping livestock of Rs 821.25. This figure should be treated with care, however. The net surplus is very much an average. Some families had significant deficits. Moreover, patterns of meat consumption depend on festivals and events of major importance such as weddings. The assumption of continuity throughout the year is not strictly true. The figures can therefore be treated as a rough guide only.

4.5.3 Manure

Farmers in the Chautara region do not as yet use chemical fertilizer in significant quantities. They rely mainly on manure to fertilize their fields, and accordingly manure is regarded as the most important reason for keeping large animals. In the three very detailed questionnaires on labour requirements for maize, millet and paddy described earlier, questions were asked about typical manure applications to each crop. These revealed that the average family applied a total of 203.97 loads

(2744 kg) of manure each year to crops. There is no market for manure in the area. So the entire quantity must have been produced by animals owned by the farmers.

The lack of a market makes it very difficult to value this manure in money terms. The only way to do this would be to estimate the marginal value product of manure in crop production - this would require extensive data which, however, are not available. This is perhaps an important area of further research.

4.5.4 Bullock Labour

Earlier in this chapter it was estimated that the average family needed to apply 55.67 bullock days to prepare and harvest the three major crops. However, only 19 families in the sample owned bullocks so the other 21 had to hire bullocks for these tasks.[2] Thus, the labour provided by the bullocks owned by the families in the sample amounted to 1057.73 days.

On the local market, a pair of bullocks costs Rs 8 to hire per day (or Rs 4 per bullock). This is for bullocks without the driver. At this rate, the 1057.73 bullock-days can be valued at Rs 4230.92, which averages at Rs 105.77 for each of the forty households.

The 19 farmers who owned bullocks were also questioned about the number of times they had rented their animals to other families during the 1981 season. These farmers rented out a pair of bullocks for a total of 110 days, i.e. for 220 bullock days. At Rs 4 per bullock per day, this income amounted to Rs 880. If this figure is averaged over the 40 families, the average sample household received a cash income of Rs 22 per year from renting out bullocks.

Bullocks were used for no other purposes. Thus, the average household gained labour worth Rs 105.77 and cash worth Rs 22 per year from the

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[2] One family owned only one bullock. This family would have had to hire bullocks to work in the farm, so was included in the 21.

bullocks they owned. These are the figures that appear in Table 4.12.

Table 4.12

Estimated Annual Output from Livestock Per Average Family

Category of Output	Quantity
Milk	253.49 litres (Rs 887.22)
Sale of livestock or livestock product	Rs 821.25
Manure (used for paddy, maize and millet in an average farm by an average family)	203.97 loads
Bullock labour	
- on own farm	26.44 days (Rs 105.77)
- hiring out	Rs 22.00

4.5.5 Costs and Benefits of Keeping Livestock

Earlier it was estimated that the average family spent 80.30 man-days, 208.00 woman-days and 106.58 child-days a year rearing animals. During the time of the field survey, unskilled male labour earned Rs 6 per day for farm work in the local region, while women performing similar work were paid Rs 4 per day. (Rates were higher for skilled work such as masonry and carpentry). No clearcut labour market for children under 15 years existed as the hiring of children was almost non-existent. However, an imputed opportunity cost of their time of Rs 2.50 per day would seem appropriate. Work, however, was available mainly during the peak season of the agricultural cycle. This lasted for about 7 months of the year. During the slack season, household members had a much lower chance of

finding work and the shadow wage rate would therefore be lower. It is assumed that during the peak season, anyone who wished could find work. The market wage rate therefore represented the opportunity cost of time. It is further assumed that the probability of finding work during the slack months was only 20%. The shadow wage rate then would only be a fifth of the market rate. On these assumptions, the opportunity cost of the time the average family put into livestock amounted to Rs 1053.50 per year.

4.5.6 Opportunity Cost of Capital Invested in Livestock

The farmer had an alternative use for the capital invested in livestock. He could have sold the animals and invested the returns at the local bank at 8% per annum. Using the information provided in Appendix 3 this would have provided an average return of Rs 320 per year. This can be regarded as a cost to the family of keeping capital in the form of livestock.

Other costs of raising livestock were negligible. Families had little equipment and the straw fed to animals had few other uses. Thus the average yearly cost (labour plus the cost of capital) was Rs 1373.50.

4.5.7 Costs vs Benefits

In the previous section it was shown that the animal output which could be valued averaged Rs 1836.24. Manure production was an extra benefit which could not be valued in monetary terms. Thus the returns from animals would appear to significantly outweigh the costs involved in rearing livestock.

This attempt to compare costs and benefits is, of necessity, fairly rough. Many relatively arbitrary assumptions had to be made because of the short period of time available for fieldwork. However, it represents a first attempt to consider the relative magnitudes of the costs and benefits of livestock raising in the survey area. The findings of this analysis

strongly suggest that raising livestock is profitable from the farmer's point of view, despite the time involved in collecting fodder and looking after the livestock. This is contrary to the general belief in Nepal that it is unprofitable, that people keep livestock for social reasons or because of tradition.

However, for the economy as a whole, there are undoubtedly large social costs involved in raising livestock. Nepal has one of the highest livestock populations per unit of land area in the world. The current stocking rate is nine times larger than the present carrying capacity of the hill forest (Rajbhaudary and Shah, 1981). This has led to deforestation and consequent soil erosion.

If livestock were kept purely for social reasons or because of tradition, it might be possible to solve the problems of overstocking and deforestation by trying to change attitudes to livestock. This will not work, however, where raising livestock is a profitable activity.

Some other solution must be found. Some suggestions follow:

(i) Alternative profitable activities could be introduced. This is difficult in a hilly area where land is relatively barren and the average land holding is small;

(ii) The quality of livestock could be improved by introducing new breeds or by cross-breeding with improved breeds. Care would have to be taken that total feed requirements do not increase;

(iii) Cattle are owned basically because of the need to provide bullocks for ploughing during relatively short peak seasons. At other times they are under utilized. Cattle do produce milk and manure as a side benefit, but buffaloes are preferred for this purpose. Co-operative ownership of cattle might ensure that only those livestock required for the peak season are kept, thereby reducing cattle numbers.

However, a problem remains in that it is virtually impossible to dispose of unproductive cattle in Nepal. It will be very difficult to solve the problem of overstocking until an answer to this question is found;

(iv) Greater efforts could be made to grow fodder and forage crops. These could be grown on terrace rises and bunds, and on the land which is left fallow in winter. Technical guidance would obviously have to be provided and extensive research may be necessary;

(v) The shortage of fodder could be alleviated to some extent if a greater proportion of fodder trees were planted under reforestation programmes. Farmers in Chautara were highly critical of reforestation programmes which planted trees that were not useful for fodder. To do this would require much more co-operation between the Ministries of Agriculture and Forestry than is the case at present. Paradoxically, the results of the next chapter suggest that this may in fact encourage households to keep more livestock, so the net effect on deforestation is unclear;

(vi) Existing attempts to encourage farmers to plant more fodder trees on private land are valuable. However, this probably requires either greater research or increased extension effects. This is because farmers in the area believe strongly that more trees would shade the land excessively, and tree roots would compete with crops, thereby reducing crop yields.

(vii) The previous suggestions involve attempting either to reduce livestock numbers or to increase the available fodder. The final suggestion is an example of the former. Animals are kept predominately for manure which is mixed with leaves and used as fertilizer. The use of compost pits would probably make this manure more efficient as a form of fertilizer, thereby reducing the demand for animals. Extension officers would need to advise farmers on the best method.

4.6 Summary

In this chapter it was shown that livestock take up a considerable proportion of the labour time applied by farm families in Chautara. Much of this time, particularly by women, was spent collecting fodder.

This fodder was one of the most important ways in which farm families interacted with the forest. The other important way was in the collection of firewood.

The evidence presented in this chapter suggested that households did not keep livestock for purely social reasons or because of tradition. Livestock appeared to be profitable from the farmer's viewpoint. This means that efforts to reduce the social costs of livestock - deforestation and soil erosion - will not be successful if they simply try to change attitudes. Various alternative policies were suggested.

CHAPTER 5

THE EFFECT OF REFORESTATION ON LIVESTOCK NUMBERS

5.1 Introduction

Other studies (The Rockefeller Foundation Team, 1976) have shown that livestock raising is a fundamental component of the farming system in Nepal. This fact is supported by the sample data presented in the previous chapter. A relatively high proportion of the average household's labour input was devoted to livestock raising, an activity that seemed to be profitable from the farmer's viewpoint. These data also revealed the strong interaction between the farming system and the forest in Chautara. This involved collecting fodder for livestock and wood for fuel.

This interaction with the forest has led to serious problems of deforestation and erosion in Chautara and elsewhere in Nepal. It was one of the major reasons for starting the NAFP. Although its main aim was to reforest public land, it also intended to encourage farmers to plant fodder and other types of trees on private land.

Generally, in planning projects of this nature, the impact on farmers can only be surmised, in view of the limited information that is available. An important impact of the NAFP may be on livestock. The number of livestock farmers keep may have been restricted in the past by a lack of fodder. By making more fodder available, reforestation projects may encourage families to keep more livestock. Thus, use of the forest would be higher than expected once the project was established, something with important implications for forest management.

In this chapter an attempt is made to examine this question empirically. This involves trying to discover if there is any evidence suggesting that peoples' desires to keep livestock will be influenced by reforestation.

5.2 The Effect of Reforestation

No detailed farm level data concerning Chautara households are available in time series form. The analysis must rely on the cross-sectional data that could be collected during a relatively short time of fieldwork. These data were described in earlier chapters.

From this information, it is possible to test the relationship between the number of livestock in the sample households and two variables related to reforestation. The variables are:

(i) the number of fodder trees on a farmer's private land; and,

(ii) the time it typically takes a family member to collect a load of fodder from the forest.

With the first variable, it is postulated that a positive relationship exists between the number of fodder trees a family owns and the number of livestock it keeps. If this is confirmed, it suggests that the effects of the NAFP to introduce more privately-owned fodder trees will lead to an increase in the livestock population.

Secondly, reforestation on public land would make fodder more readily available. This should reduce the time necessary to collect a load of fodder. It was shown earlier that looking after livestock was relatively labour intensive and it is possible that the number of livestock kept by a family had been limited by labour availability in the past. Thus, reducing the time necessary to collect fodder could also encourage households to keep more livestock.

This hypothesis can also be tested using cross-sectional data. Some families in the sample lived relatively close to the forest and took less time than other families to collect fodder. If these families are found to keep more livestock than others, the hypothesis can be supported.

In testing these hypotheses, two problems of specification arise. The first is to discover the other variables that are likely to affect the number of livestock kept by a household. The second is to determine the

appropriate functional form. These problems will be discussed in turn.

5.3 Factors Influencing the Number of Livestock

It has been postulated that the number of privately owned fodder trees, and the time it takes to collect fodder, influence the number of livestock owned by a family. Other studies of this nature are very scarce. Park (1979) noted that in Korea livestock are kept mainly for manure and draught power, but there are different reasons for keeping different types of livestock. Draught cattle, for example, produced comparatively low rates of cash income for the farmer, but were essential to crop production. Hogs and poultry, on the other hand, were kept largely for cash returns. This meant that farm resources employed for draught cattle were less responsive to relative price changes for feed and livestock products than those allocated for hog and poultry production.

It was shown earlier that people in Chautara kept different types of livestock for different reasons. This is consistent with the findings of Park, and implies that regression equations for the different types of livestock should be estimated separately. Three different categories of livestock will be used - buffaloes, cattle and goats. In all cases, the independent variable is in the number of livestock units.[1]

Park (1979) for Korea, Moore (1978) for India, and Shah (1980) for Nepal, emphasized the importance of two factors in determining the number of livestock kept by a household. They were the availability of labour and the availability of land.

Accordingly, land holding per household, measured in hectares, is used as an explanatory variable in this study. The effect of this variable

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[1] The weights given by Sharma, R. (1982) were used in determining the number of weighted livestock units. Cattle were taken as the base unit (equal to 1.0). Buffaloes were weighted at 1.25, calves at 0.5 and goats, sheep and pigs at 0.25.

is expected to be positive because the greater the land, the more the crop residue available for fodder, and the greater is the grazing available in the fallow season.

Similarly, the availability of labour is expected to have a positive effect. However, there are some difficulties with labour, as some types of jobs are sex and age specific in Nepal. For example, collecting fodder from the forest is almost entirely undertaken by women. Males and children collect fodder only occasionally. They supervise goats while they are grazing and look after the buffaloes on the farm. They appear to do similar tasks with these animals. However, in the case of cattle, males are required to do the ploughing while children supervise their grazing.

Shortages of different types of labour could therefore have different effects on the number of livestock. With cattle, for example, a shortage of women would mean less fodder collected, a shortage of men means no ploughing could be undertaken and a shortage of children would make it difficult to supervise grazing cattle. There is no reason to expect that the marginal effect of these three types of labour on cattle numbers would be the same, so each must be included as a variable with separate influences on the number of cattle. On similar grounds, female labour must be included separately for goats and buffaloes, but male and child labour can be combined into a composite variable because they undertake similar tasks.[2]

These are the only explanatory variables identified in other studies. However, discussions in Nepal suggest that others should also be included. Firstly, as separate regressions will be estimated for the three groups of livestock, the possibility of substitutability or complementarity between groups should be considered. Therefore, a variable representing the number

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[2] Children were observed to work almost as effectively as adult males while supervising livestock. Thus, they were given a weight of 0.8 of an adult male when forming the composite variable.

of other animals owned by a household was included in each equation. This variable is different for each equation. For example, in the cattle equation it measures the number of goats and buffaloes the family owns (in livestock units), while in the buffalo equation it measures the number of goats and cattle. If different types of livestock are substitutes, this variable would be expected to have a negative sign. On the other hand, families with cash surpluses in the past may have acquired livestock of all types, in which case, a positive relationship would be expected.

Secondly, people from different religions may have different attitudes to livestock. This might be especially important with cattle which are sacred to Hindus. Thus a dummy variable for religion is included, though it is not clear what its impact on livestock numbers will be.

Other variables, such as levels of past cash surpluses or remittances, could also be important. They could not be included due to a lack of data. The variables that were included, and their expected signs, are summarized in Table 5.1

Table 5.1

Expected Signs of Independent Variables

Variable	Expected Signs Cattle	Buffalo	Goat
Number of Fodder Trees	+	+	(not included)
Average time taken by a family member to collect a load of fodder	-	-	-
Number of Females	+	+	+
Number of Males	+	+	+
Number of Children	+	+	+
Land Holding	+	+	+
Number of Other Livestock	+ or -	+ or -	+ or -
Religion (Dummy)	?	?	?

5.4 Functional Form

Rao and Miller (1971) argue that if the theory indicates unambiguously that the linear form is an adequate representation of the true relationship, then the researcher need go no further. On the other hand, a theory may not sufficiently indicate which functional form should be used, and then other types of equations must be considered.

Very few empirical studies have been done in this area. Most of those that exist have used the linear form. For example, Shah (1980) estimated

$$Y = 1.477 + 0.34X, \qquad \ldots\ldots (5.1)$$

where,

Y = livestock units/family

X = cultivated land holding/family.

Similarly, Moore's (1978) equation was

$$Y = 0.025 + 0.038X_1 + 0.0001X_2 \qquad \ldots\ldots (5.2)$$

where,

Y = village averages of the number of milch animal units per standard land unit,

X_1 = the ratio of non-cropped to cropped land within the village boundaries, and,

X_2 = the percentage of village households defined as 'small farmers'.

An exception to these studies was Vaidyanathan (1978) who used the quadratic form. He tried to discover a relationship between human and bovine densities. The equation he estimated was

$$Y = -0.2149 + 0.317X - 0.1323X^2 \qquad \ldots\ldots (5.3)$$

where,

Y = total bovines/hectare,

and X = rural population/hectare.

He found that in general, states with a relatively high density of human population also tended to have a high density of bovine population.

None of these studies, however, provide convincing reasons for their choice of functional form, and there is no established theory about the preferred functional form. In this study, help was taken from the theory of production, which is closely related to the present area of interest.

The problem with the linear form in production theory is it does not allow for any interactive effects between explanatory variables, or for increasing or decreasing marginal product ranges. This could also be relevant to the present study. Firstly, a linear function would suggest the marginal impact of females on livestock number, for example, is independent of the number of males or children in the family. This may not be true when there is some duplication of tasks, though it is small. Similarly, it suggests that the marginal effect of fodder trees is independent of the availability of labour to cut the fodder.

Secondly, a linear function implies that the marginal impact of fodder trees is the same regardless of how many fodder trees a family owns. It is possible that a situation similar to 'decreasing returns' exists where the marginal product falls as the number of trees increases.

In this study, a linear function is estimated as a point of reference. However, for theoretical reasons, there was also a need to consider a function which allowed for cross effects between the variables, and for increasing or decreasing marginal products. In production theory two such types of functions are commonly used - the power function, of which the most common is the Cobb-Douglas function, and the quadratic function.

5.4.1 Cobb-Douglas or Power Function

The power function is usually used in the form

$$Y = a \prod X_i^{bi} \qquad \ldots\ldots (5.4)$$

where Y is output, the X_i is variable inputs, and a and the bi's

are constants (Π = 'the multiplication of'). The function is estimated in logarithmic form.

The exponents or b_i coefficients are elasticities of production. The advantage of this specification over the linear form is that the function can have constant, increasing or decreasing returns to scale depending on whether the sum of the b_i's is equal to, greater than, or less than unity in turn. Moreover, marginal productivities are dependent on the quantities of other inputs being used, so the cross effects ignored by the linear form can be incorporated (Heady and Dillon, 1961).

However, a major problem with this specification is that it implies all inputs are essential - i.e. if one input is not used, output is zero. The use of the Cobb-Douglas form to explain the number of livestock in Nepal would therefore involve a serious theoretical error. It would imply, for example, that a family with no available child labour would not keep any cattle.

5.4.2 Quadratic Functional Form

The simple quadratic equation is

$$Y = a + bX - cX^2 \qquad \ldots\ldots (5.5)$$

Where Y is output and X is the variable input.

Extension of this equation to two inputs gives the following:

$$Y = a + b_1X_1 + b_2X_2 - b_3X_1^2 - b_4X_2^2 + b_5X_1X_2 \qquad \ldots\ldots (5.6)$$

Diminishing marginal returns exist for either factor alone, but there is a positive interaction between the two factors. A negative or zero interaction may also exist where diminishing marginal returns hold true for both factors at the same time (Heady and Dillon, 1961). Certain levels of output can be attained from the input of X_1 alone (with X_2 at zero level) depending on the magnitudes of a, b_1 and b_3. Similarly, certain levels of output can be attained with zero inputs of X_1. This is in contrast to the Cobb-Douglas function as described above.

5.5 Results

On theoretical grounds, the quadratic functional form would appear to be the most applicable to the present study. It allows for cross-effects, for the impact of different variables to differ depending on the quantity, and it does not assume all inputs are essential. In practice there were very serious problems with multi-collinearity with the cross-effect variables and the squared terms, so all three functional forms were estimated. The best equation was chosen on a mixture of theoretical and statistical grounds.

However, the statistical fit of the Cobb-Douglas form was very poor, and it was impossible to interpret the results. For example, the signs of coefficients were constantly opposite to those expected, and at variance with the results of the linear and quadratic forms. Therefore, the results of the Cobb-Douglas equations are not reported.

Due to multi-collinearity, all squared terms had to be omitted from the quadratic form. This implied that the range of independent variables that was observed was not very great, and therefore the chances of having increasing or diminishing marginal effect was low. The only remaining theoretical advantage of the quadratic over the linear form thus was its ability to consider cross-effects. Similarly, some cross effects had to be omitted due to collinearity. The best equation from the remaining variables was chosen as the one with the highest adjusted R^2.

The best linear equation also was selected on this basis, using a step-wise regression package. Results for each of these groups of livestock are discussed separately. A key, explaining all variables appearing in the equations is found in Table 5.2.

Table 5.2

Explanation of Variables Appearing in Equations

Variable	Description
X_1	Fodder trees/household
X_2	males/household
X_3	children/household
X_4	males + children/household
X_5	Females/household
X_6	Land area/household
X_7	Average time taken by a family member to collect a load of fodder/household
X_8	Other livestock units/household
D	Dummy for religion = 1 for Buddhists = 0 for Hindus
Y_1	Buffalo units/household
Y_2	Goat units/household
Y_3	Cattle units/household

5.5.1 Buffaloes

The best linear and quadratic equations for buffaloes are summarized in Table 5.3. The quadratic equation shows that X_6, X_5X_7 and X_6X_7 are highly significant and all other variables are significant at least at the 0.10 level. The $\bar{R}^2$ is higher than in the linear form.

Though this equation is statistically better, some variables such as X_5, X_5X_7, X_6X_7 are difficult to explain. The sign of X_5 (available female labour) is negative. It is not clear why the number of females would be negatively related to the number of buffalo units. Similarly, the marginal effect of land on buffalo units is negative, on average, which is hard to explain.

Table 5.3

Results of Regression Analysis - Buffalo Units

Constant	Linear	Quadratic
Constant	0.80	1.12
X_1	0.05*** (0.02)[1]	0.05** (0.02)
X_4	0.18*** (0.10)	
X_5		-0.58** (0.24)
X_6	0.70 (0.61)	4.06*** (1.25)
D	-0.72*** (0.31)	-0.60* (0.31)
X_5X_7		0.18*** (0.06)
X_6X_7		-0.99*** (0.32)
R^2	0.33	0.46
$\bar{R}^2$	0.24	0.36
F	4.40***	4.67***

[1] In all subsequent tables

Figures in parentheses are standard deviations, and

*** significant at 0.01 level

** significant at 0.05 level

* significant at 0.10 level

The marginal effect of X_7 in this equation is negative for the average family, as expected. However, the negative sign of X_6X_7 implies that it is even more negative if the family has a lot of land. The opposite interaction would be expected in that families who owned more land would

have to rely less on the forest and would thus not be affected so much by the time it takes to collect fodder.

The linear equation is easier to explain than the quadratic. All the signs are consistent with expectations and the magnitudes of coefficients seem reasonable. For example, X_1, X_4 and X_6 are positively correlated with buffalo units. This implies that the more the fodder trees, male and child labour and land per household, the more buffalo units the family will keep. The negative sign and high significance of the dummy variable shows that Buddhists tended to keep fewer buffalo units than Hindus. The F test for the overall equation is statistically significant at the 0.01 level.

The R^2 and $\bar{R}^2$ are not very high. However, in an equation of this nature R^2 cannot be expected to be high. The number of livestock kept by families is influenced strongly by attitudes and traditions in addition to the variables included in the equation. Attitudes and traditions cannot be measured and therefore could not be included. The variation in Y_1 explained by the regression will not therefore be high.

This is not, however, of great importance. The purpose of the exercise was to determine if there was a significant relationship between the two variables influenced by the NAFP (X_1, X_7) and the livestock units. The linear equation showed that buffalo units were positively related to the number of privately owned fodder trees. Weak support can be taken from the quadratic equation. This implies that the effects of the NAFP to increase the number of trees on private land could encourage farmers to acquire more buffaloes.

The linear equation did not reveal any relationship between X_7 and buffalo units. The evidence of the quadratic form by itself must be rejected. This does not necessarily mean that the reforestation of public land will have no effect on buffalo units. However, the cross-sectional analysis

provides no support for the hypothesis that it will.

5.5.2 Goats

In the case of goats, the quadratic form is again slightly better from the statistical point of view (Table 5.4). Again some variables, especially X_5X_6 are difficult to interpret. It implies firstly that the marginal effect of females is negative and secondly that the cross effect of females

Table 5.4

Results of Regression Analysis - Goat Units

	Linear	Quadratic
Constant	-0.34	-0.42
X_4	0.18*** (0.07)	0.25*** (0.08)
X_7	-0.06 (0.05)	-0.15** (0.07)
X_8	0.17*** (0.04)	0.20*** (0.05)
D	0.44** (0.21)	0.49** (0.21)
X_5X_6		-0.30 (0.21)
X_6X_7		0.26* (0.15)
R^2	0.43	0.47
$\bar{R}^2$	0.36	0.38
F	6.51***	4.92***

with land is negative. The latter indicates that although the marginal impact of land on goats is positive on average, it is less so when there are a lot of females in the family. Both these implications are difficult to justify.

In this case, the linear model is not only easier to explain, but also it is only slightly inferior from the statistical viewpoint. The positive and highly significant coefficients of X_8 and X_4 imply that the more other livestock owned by the household, and the more the male and child labour available, the greater is the number of goat units owned by the household. There is some evidence that the time taken to collect a load of fodder is negatively related to the goat units. The dummy variable shows that Buddhists kept more goats than Hindus. The overall equation is highly significant, according to the F test. Again the linear model would appear preferable to the quadratic.

Again, there is evidence that the NAFP could have an impact on the number of goat units through the variable X_7 - the time it takes to collect a load of fodder. The linear equation provided weak evidence supporting the hypothesis of a negative relationship between time spent in collecting fodder and goat units. Moreover, the sign of this variable in the quadratic equation is as expected. Taken together, the implication is that a reduction in the time involved in collecting fodder could lead to an increase in the number of goat units.

5.5.3 Cattle

The best linear and quadratic equations are found in Table 5.5. Both equations in this case have a very poor statistical fit. Moreover, in both cases, most of the signs cannot be explained. For example, in the linear model only one variable, X_8, is significant. Both X_3 and X_7 have unexpected signs, implying that the more children a family has, the fewer cattle it will keep, and that the more time it takes to collect a load of fodder, the more cattle it will keep.

In the quadratic model X_1, X_3 and X_1X_2 are the only significant variables. Both X_3 and X_1X_2 have negative signs which seem inconsistent with reality. Neither model, therefore, explains the number of cattle units

Table 5.5

Results of Regression Analysis - Cattle Unit

	Linear	Quadratic
Constant	0.27	-0.16
X_1	0.06 (0.04)	0.21** (0.10)
X_2		0.87 (0.57)
X_3	-0.40 (0.26)	-0.71* (0.39)
X_7	0.16 (0.14)	
X_8	0.46** (0.22)	0.39 (0.24)
X_1X_3		0.05 (0.06)
X_1X_2		-0.10** (0.05)
X_3X_5		0.16 (0.16)
D		-0.70 (0.60)
R^2	0.26	0.35
$\bar{R}^2$	0.17	0.19
F	3.05*	2.11*

kept by the family. Thus, no evidence suggesting that the NAFP will have an impact on the cattle units in Chautara could be found.

The equations used in this section imply a form of optimizing behaviour on the part of farmers. They imply that the farmer will adjust the number of livestock to his circumstances. These are strong reasons why this is

not possible with cattle, and why, therefore, the equations were useful with buffaloes and goats but not with cattle. Cattle are considered sacred in Nepal. The slaughter of cows, bulls and bullocks is prohibited. Unproductive cattle therefore have no market value. Thus, once cattle become unproductive, farmers have to keep them. They cannot adjust the number of cattle they own on economic grounds. This is not true for the other animals.

5.6 Conclusion

In this chapter an attempt was made to discover if there is any evidence suggesting that people's desire to keep livestock will be influenced by reforestation. Only cross-sectional data were available. Two variables which were likely to be affected by the NAFP were included as explanatory variables in the regression analysis, with the livestock units kept by a family as the independent variable. These two variables were:

(i) number of fodder trees on the farmer's land, and

(ii) the time it took a family member to collect a load of fodder.

Both variables varied over the sample.

To specify a regression equation, the correct functional form must be chosen, and all the major factors likely to affect the independent variable should be included. Other important variables emphasized by other studies were included along with some identified after discussions in Nepal. It was, moreover, shown that people keep different livestock for different reasons, so equations were estimated separately for three categories of livestock - cattle, buffaloes and goats.

Three functional forms were tried. The statistical fit and explanatory power of the Cobb-Douglas form was very poor, so only the results of the linear and quadratic forms were reported.

Discussion of the results was limited largely to the two variables related to reforestation. Reasons why other variables were significant or insignificant were not discussed in detail. This does not mean they are not important. For example, because females do most of the fodder collection it is widely thought that a lack of female labour would limit the number of livestock kept by the household. This relationship did not, however, emerge from any equation. This might be because the range of females per household observed in the sample was too small for the regression to consider, rather than because no relationship existed.

However, the major purpose of the chapter was to examine the likely impact of the NAFP on the number of livestock units. No evidence could be found suggesting that the number of cattle will be affected. However, the project could result in an increase in the number of buffaloes by encouraging farmers to plant more fodder trees, and an increase in the number of goats through its impact on the time involved to collect fodder. Implications of these results are considered in the next chapter.

CHAPTER 6

CONCLUSION

In the Nepalese hills, livestock rearing is an integral part of the farming system. Private farms and traditional grazing areas, however, are too small to provide enough feed to support the animal population, and farmers have to rely heavily on the forest. The rural population also depends on the forest for virtually all their fuelwood and timber requirements. This dependency has led to large scale deforestation and soil erosion.

Despite the apparent significance of livestock as a cause of deforestation, there are very few studies on the role of livestock in the farming system of Nepal. Very little is known, for example, about the reasons why livestock are so important to farmers. Even basic information, such as what resources are devoted to livestock and the amount of output they provide, is not available.

The first aim of this thesis, therefore, was to document the relative importance of livestock to a group of farmers who are affected by a reforestation project. This also involved determining the extent to which farmers depended on the forest.

A sample of 40 farmers from the Chautara region was chosen. Chautara is the centre of field operations of the Nepal Australia Forestry Project.

To examine the relative importance of livestock in the farming system, it was necessary to consider the entire cropping system. Labour inputs to the three main crops, to livestock raising and to the other activities performed by the sample households were estimated.

It was found that livestock ranked second only to crop production in terms of the average household's allocation of labour. Women, in particular,

devoted a great deal of time to livestock. Much of this involved collecting fodder. In fact, families took more from the forest for fodder than for fuelwood.

The section on labour inputs indicated that livestock are important to hill families, but very little information on the reasons why animals are so important exists. In fact, farmers keep much more livestock than the land can support, which is one of the major causes of deforestation (Rajbhandary and Shah, 1981). A common belief in Nepal is that social reasons and tradition, rather than economic reasons, determine the number of livestock that families wish to keep. The data collected for this thesis allowed this view to be examined.

The private costs and benefits to the sample households of raising livestock were estimated. The estimates were fairly rough as a number of arbitrary assumptions had to be made. Moreover, one of the major benefits, the manure used for fertilizer, could not be measured in monetary terms.

The calculations showed that the yearly cost of raising livestock for the average sample family was Rs.1374. This was lower than the estimated monetary benefit of Rs.1836 (which did not include the value of manure). These findings suggest that livestock are kept neither for purely social reasons nor for traditional ones only. Livestock raising seems to be profitable from the farmer's point of view.

This result has important implications for attempts to overcome the problem of deforestation. Attempts to change attitudes independent of the economics of livestock rearing, are unlikely to reduce livestock numbers significantly. A two-sided approach is essential. Attempts must be made to reduce the number of livestock (by affecting the economics of livestock raising) on the one hand, and to increase the availability of fodder on the other. Detailed suggestions about both approaches were made in Chapter 4

and need not be repeated. However, a practical implication is that it will be necessary for the Ministries of Agriculture and Forestry to work closely together.

It is possible, however, that there could be some conflict between the two types of policies. It was suggested that reforestation projects could, in fact, encourage families to keep more livestock. Thus, in the second part of the thesis, a regression analysis was undertaken in an effort to discover if there was any evidence suggesting that the farmers' decision to keep livestock would be influenced by reforestation.

Time series data were not available. The only source of primary information was a field survey, conducted over a month, which provided cross-sectional data. The effects of two variables which would be affected by reforestation were examined. They were the number of fodder trees on privately owned land, and the time taken by a family member to collect a load of fodder.

The analysis suggested firstly, that an increase in the number of privately owned fodder trees may result in an increase in the number of buffaloes. Secondly, a reduction in the time involved in collecting fodder may increase the number of goats. However, no relationship between these variables and the number of cattle could be discovered, perhaps because of the importance of religious restrictions, which meant that farmers could not limit the number of unproductive cattle they owned.

An aim of the NAFP was to increase the number of fodder trees planted on private land. The regression analysis implied that this may result in an increase in the number of buffaloes. Moreover, projects which make more fodder available on public land would reduce the time taken to collect fodder, thereby increasing the number of goats.

Policy implications are important. Estimates of the rate of reforestation necessary to meet projected demands have generally been based on current levels

of use. The results of the regressions suggest that these estimates could be too low. It is imperative, therefore, that equal importance be given to the policies designed to reduce the number of livestock, as to those designed to increase the available fodder.

This thesis has been based on a limited amount of data collected during a relatively short period. As such it is a first attempt to answer some questions which are crucial to the future of Nepal. Clearly, however, there is a need for a great deal more research.

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APPENDIX 1 QUESTIONNAIRES

PART A

Preliminary Visit Questionnaire[1]

Socio-Economic

1. Farm Number _____

2. Panchayat _____ Ward No. _____

3. Details of all people who usually live in the household (Put name of the household head first)

Name	Relation to Head	Sex M/F	Approximate Age	Living at Home Yes/No	Attending School Yes/No	Highest Education Standard

4. Farm Details

	Owned & Farmed by farmer		Rented		Rented Out	
	Khet	Pakho	Khet	Pakho	Khet	Pakho
(Land in Hectare)						

5. Rent Details in Previous Year

Received	Paid

[1] This questionnaire was used on the first visit.

6. Details of Crops Grown Now or in Previous Year

Crop	Land in ha.	Time Planted	Time Harvested	Size of Harvest	Stocks Held on Farm Now

7. Details of Trees Owned by Household

	Type and Number
Fruit trees	
Fodder trees	
Firewood trees	
Fodder/firewood	

8. Details of Animals Kept at Present

Type		Number	Number Bred on Farm
Cow			
Calf			
Bull			
Bullock			
Buffalo	- mature female		
	- mature male		
	- young		
Goats	- mature female		
	- mature male		
	- young		
Sheep	- mature female		
	- mature male		
	- young		
Chicken (approximate)			

Preliminary Visit Questionnaire (Cont)

9. Details of Stall Feeding (only list animals that are stall fed at some time during the year).

Animals	Months of year stall fed	Type of feed when stall feeding

10. Sources of Stall Feed

Animal	Approximate Percentage			
	Private Trees	Communal Land	Forest	Any Other

11. Reason for Stall Feeding

Animal	Reason

12. Stocks Held on Farm

Firewood	Straw	Dung	Milk Products (Ghee)

13. Rough Sketch of House in Relation to Farm Plots

APPENDIX 1

PART B

Intensive Questionnaire[1]

LABOUR RECORD

Farm No. _____

Panchayat: _____ Ward No. _____

Name of Head: _____

Day & Date	Crops or Enterprises	Field No.	Operations (farm & non-farm)	Name of Family Worker	M or F 8	A or C 9	Leave Free	Hours worked from awake to asleep 6	Name of Hired Worker	M or F 13	A or C 14	Leave Free	Sub-Total	Hours worked during daylight (6 am - 7 pm) 11	Sub-Total 15	Total 16
1	2	3	4													

[1] This questionnaire was put to each family every alternate day totalling 10 times.

ANIMAL LABOUR RECORD

Farm No. _____

Panchayat _____ Ward No. _____

Name of Head _____

Day and Date	Crops or Enterprise	Operations	Type of the Animal	Animal Hours Used

ANIMALS KILLED AND MILK PRODUCTION

Farm No. _____

Panchayat: _____ Ward No. _____

Name of Head: _____

Day and Date	Animal or Animal Product	Quantity		How much milk was made into ghee or any other product?
		No.	Unit	

Intensive Questionnaire (Cont)

FODDER COLLECTED

Farm No. _____

Panchayat: _____ Ward No. _____

Name of Head: _____

Day and Date	Quantity			Use Percentage Fed to Different Animals (List)	Type of Fodder Most Collected at Present
	Own Land	Communal	Forest		

Intensive Questionnaire (Cont)

FIREWOOD AND DUNG

Farm No. _____

Panchayat: _____ Ward No. _____

Name of Head: _____

Day and Date	Item Firewood/Dung	Quantity			Approx % Stored	Firewood What type of tree?	Dung Uses		
		Own Land	Communal	Forest			% Burned	% Fertilised	Others

RECEIPT AND DISPOSAL OF ANIMALS AND ANIMAL PRODUCTS

Farm No. _____

Panchayat _____ Ward No. _____

Name of Head _____

Day and Date	Animal or Product	Quantity Purchased	Total Amount Paid	Quantity Sold	Total Amount Received	Quantity Given Away by Household

Note: Need to consider meat, animals, milk, if necessary consider firewood fodder and dung.

APPENDIX 1

PART C

Paddy Questionnaire

1. Name:
2. Size of Field:

	Labour in person days			
	Man	Woman	Children	Animal days
Seed Bed				
3. Carry and spread manure and/or quantity				
Spread chemical fertilizer quantity				
4. Ploughing and digging seed bed				
human labour				
animal labour				
5. Smoothing seed bed and spreading seed				
6. Digging channels for irrigation				
7. Rolling, bundling and transporting seeds				
Main Planting				
8. Ploughing and stumping				
9. Digging and making wall				
10. Planting seeds				
11. Weeding				
12. Manure				
After ploughing				
Quantity				
After weeding				
Quantity				
13. Chemical fertilizer				
After planting				
Quantity.....				
After weeding				
Quantity				
14. Harvesting				
15. First threshing, collecting carrying and storing paddy				
16. Second threshing, carrying straw back to house and piling.				

APPENDIX 1

PART D

Millet Questionnaire

Pakho

1. Size of Field:

Seed Bed

	Labour in Person Days			
	Man	Woman	Children	Animal Days
2. Spreading manure Quantity				
3. Digging and smoothing seed bed, and planting				
hand				
animal				
4. Manure used after planting				
Quantity				
5. Harvesting and making bundles				

Main Planting

	Quantity	Type	Man	Woman	Children
6. Digging					
7. Planting					
8. Fertilizer/Manure					
9. Weeding					
10. Harvesting					
11. Threshing and storing					

APPENDIX 1

PART E

Maize Questionnaire

1. Name:
2. Size of Field:

	Khet/Pakho								Labour in Animal Days	
	Labour in Person Days									
	Man		Woman		Children		Total			
	Khet	Pakho	Khet	Pakho	Khet	Pakho	Khet	Pakho	Khet	Pakho
3. Ploughing:										
- first										
- second										
- third										
- fourth										
- fifth										
4. Manure carrying and spreading after first or second ploughing										
5. Breaking soil after first ploughing										
second ploughing										
6. Drilling and planting										
7. Hiring in Bullock:										
- Ploughing										
- Planting										
8. Weeding										
9. Piling soil										
10. Harvest and carrying stalk										
11. If stalks were all harvested at once - how much load										

12. To which animal they give stalks:

Type of of animal	Quantity or no. of loads/day

APPENDIX 1

PART F

Miscellaneous Questionnaire

Bullock

1. How many times they rent out bullock during:

	Times and Days
Maize planting	
Rice Planting	
Millet planting	
Wheat planting	

2. If they sell animals what price would they get:

	Price
Cow (milking)	
Calf	
Bullock (ploughing)	
Buffalo - male	
- female	
- young	
Goats - male	
- female	

3. During last year how many livestock were:

	Type	Price
Bought		
Sold		
Killed		
Died		

4. What are the main reasons for keeping animals:

5. Would you like to keep more animals?

What type	Reason why they don't keep more

6. Whether they know anything about reafforestation project:

Miscellaneous Questionnaire (Cont)

7. What they think of reafforestation project, whether it is beneficial or not?

8. If yes, what are the benefits?

9. Will they be able to keep more animals after a few years when the reafforested fodder trees will be grown up?

10. Do they feel the need of planting trees?

11. Have they started planting trees:
    - private land
    - communal land

APPENDIX 2

Estimates of Annual Labour Inputs to the Three Major Crops

The following tables summarize the information provided by farmers who answered the questionnaires in Appendix 1, Parts C, D and E in turn. The figures are the average time the respondents took to complete each activity on the equivalent of 0.1 hectares of land.

PART A - PADDY
(0.1 hectare)

Seed Bed	Days		
Activities	Man	Woman	Bullock
Carrying and spreading manure (Average Quantity - 18.49 loads) Chemical fertilizer used Quantity 0.62 kg	0.12	3.60	
Ploughing and digging	2.23	1.74	1.49
Smoothing seed bed and spreading seed	1.74	1.05	
Digging channels for irrigation	2.30		
Rolling, bundling and transporting seeds	3.47	6.08	
Total	9.86	12.47	1.49
Main Planting			
Ploughing and preparing the field	11.41		7.2
Making bunds	1.36		
Planting seeds		22.58	
Weeding	17.49	17.62	
Manure			
Manure before planting (after ploughing) (Average quantity 11.17 loads)		2.61	
Chemical Fertilizer			
After weeding (Average quantity 16.75 kg)	0.40	.25	
After planting (Average quantity 3.72 kg)	0.12		
Harvesting	7.44	7.32	
First threshing and carrying and storing Paddy collecting (by women)	7.44	1.61	
Second threshing and carrying straw back to house and storing	7.44		2.98
Total	45.66	51.99	10.18
Grand Total	55.52	64.46	11.67

PART C - MAIZE
(0.1 hectare)

Activities	"KHET" DAYS			"PAKHO" DAYS			
	Man	Woman	Bullock	Man	Woman	Children	Bullock
First Ploughing	3.60		7.21	2.89			5.78
Carrying and spreading manure - Average quantity 43.78 loads	1.80	7.21		Average quantity 43.04 loads 2.22	9.04		
Second ploughing	1.89		3.78	1.48			2.96
Third ploughing	0.27		0.54				
Breaking soil after first ploughing	6.31	8.11			8		
after second ploughing	2.79	3.15			4.15		
Drilling and planting	1.62	1.62	3.24	1.19	1.56	0.22	2.81
Weeding	6.04	6.04		5.04	6.15		
Piling soil	4.14	2.61		3.48	2.67		
Harvesting and carrying stalks (average quantity of stalk 14.50 loads)	5.14	4.50		3.56	3.11		
Total	33.6	33.24	14.77	19.86	34.68	0.22	11.55

APPENDIX 3

OPPORTUNITY COST OF CAPITAL INVESTED IN LIVESTOCK

The average household in the sample owned 7.37 animals excluding chickens. The different types of animals and the approximate price each would have raised at the local market are provided below.

Animal	Cow	Calf	Bull	Bullock	Buffalo			Goat			Others
					He	She	Young	He	She	Young	
Number	0.75	0.3	0.03	1.05	0.13	0.85	0.58	0.65	2.05	0.85	0.13
Approximate Price in Rupees	625	225	750	750	1000	1850	400	340	220	50	50

Thus, if the average household sold its animals, it would have obtained about Rs.4,000. This money would have earned a return of 8 per cent when invested at the local bank. Thus, the opportunity cost of capital invested in livestock was Rs.320 per year.