MANAGING PUBLIC LANDS IN A SUBSISTENCE ECONOMY: THE PERSPECTIVE FROM A NEPALI VILLAGE

by

JEFFERSON METZ FOX

A thesis submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
(Development)

at the

UNIVERSITY OF WISCONSIN—MADISON

1983

TABLE OF CONTENTS

Chapter		Page
I	THE PROBLEM, THEORETICAL FRAMEWORK, AND OBJECTIVES	1
	A. The Problem	1
	B. Theoretical Framework	4
	A Brief History of Public Lands in Nepal	4
	Local Participation and Land Use Management	8
	Constraints on Local Participation	11
	Competition for Land	11
	Present Needs	12
	Distribution of Benefits	13
	Labor Requirements	14
	C. Objectives	15
	D. Outline of this Thesis	17
II	THE SETTING, METHODS, AND DEFINITONS	19
	A. Setting	19
	The Middle-Hills	19
	The Daraundi Watershed	20
	The Village	22
	Physical Features of the Village	24
	Cultural Features of the Village	28
	A Short Walk Through the Village	31

B. Methods • 35

The Physical Environment 35

Land Use and Land Area 35

Forest Inventory 37

Demands for Forest Products 37

Sample Population 37
Daily Recall Survey 38
Time Allocation Survey 38
Weight Survey 39
Census Survey 39
Assistants 40
C. Definitions • 40

Farm-Size 41
Forest-Type 42

III FIREWOOD 45

A. Introduction 45
B. Forest Resources 46
C. Firewood Collecting Patterns 56
D. Firewood Collecting Labor Patterns 62
E. Firewood Demand and Consumption Patterns 68

Firewood Consumption Rates 69
Factors Affecting Firewood Consumption Rates 71

Family Size 72
Caste 73
Farm Size 74
Season 76

F. Village Firewood Requirements 80
G. Firewood Supplies versus Firewood Demands 80
H. Conclusions 83

IV FODDER AND GRAZING 86

A. Introduction 86
B. Livestock—Kind and Number 87
C. Livestock Feed Demands: Actual and Optimal 89
D. Tree and Grass Fodder Collecting Patterns 98
E. Grazing Patterns 107
F. Fodder Collecting and Grazing Labor Requirements 112

Fodder Collecting 112
Grazing 115

G. Foddep and Grassland Resources 119

Private Lands 119
Public Lands 120

H. Conclusions 122

V THE IMPORTANCE OF PUBLIC LANDS TO BHOGTENI'S ECONOMY 125

A. Introduction 125
B. On- and Off-Farm Income 126

On-Farm Income 126

Animal Husbandry 126
Agricultural Crops 130
Gathering Activities 134

Off-Farm Income 136

Total Household Income 137

C. Efficiency of Labor Use 140
D. Value of Public Lands 142
E. Conclusions 145

CHAPTER I

THE PROBLEM, THEORETICAL FRAMEWORK, AND OBJECTIVES

A. The Problem

Over 240 million cubic meters of soil are estimated to be eroded from the hills of Nepal annually (USAID, 1978). The human and environmental costs of this erosion are staggering. In upland areas, landslides kill humans and livestock and destroy crops; tons of fertile top soil are lost; and the water regime is seriously disrupted. In valleys and flood plains, streams are choked with sediment, raising flood stages, shortening the lifespan of dams and other water impoundments, killing fish, and degrading water quality.

Geology and climate account for much of the erosion in Nepal. Yet natural erosion rates are being accelerated by man's use of these hilly lands for agriculture, animal husbandry, and forestry. The chief cause of accelerated erosion in Nepal, as in many Asian, African, and Central American nations, is the large number of people and livestock dependent on fragile hill lands for their existence. In these countries the force behind land degradation is the drive for survival. Forests are cut, hillsides are plowed, and pastures are overgrazed in order

to meet the food, fuel, and shelter needs of the human population.

Subsistence farmers in the Nepali hills are dependent on the fertility and stability of their agricultural lands, and on the quality, quantity, and constancy of their water supplies. Few environments on earth are as unstable for agriculture as the Himalayas. Considering the steepness of the slopes and shallowness of the soils, Nepali farmers have done an outstanding job of making these lands suitable for agriculture. Without the extensive terraces they have built, these lands could not begin to support the number of people that live here. Even so, the size of the population, 14 million people (1980) and growing at 2.4% per year, is severely stressing the capacity of the agricultural system to produce sufficient food.

The main source of soil erosion in Nepal, however, does not appear to be terraced agricultural lands; rather, it is public lands—unterraced forests, scrub lands, and pastures. The Resource Conservation and Utilization Project paper (APROSC, 1980) states: "Ecologically damaging land use practices are primarily conducted on public lands which are now legally owned by the government, lack systematic management, and for which the benefits from individual restraint (e.g., overgrazing ,overlapping) or investment (e.g., fencing, plantation) are insecure and

ambiguous." Fleming (1978) states that in the Phewa Tal watershed near Pokhara, "Grazing land is the most critical erosion category . . . because it includes most of the landslides, gullies, and splash/sheet/rill erosion area." Mulder (1978) measured erosion rates on an overgrazed grassland at 34.7 tons/ha/year. This is approximately twice the suggested tolerable soil loss in Nepal of 10 to 20 tons/ha/year (Laban, 1978) .

Subsistence farming in Nepal is based on a man-land-cattle-forest relationship. Forests and grazing lands are essential to this system because they provide tree and grass fodder for livestock feed, leaf litter for roofing and composting, wood for fuel, timber and poles, and various medicinal and food plants. Farmers' needs for these products are major causes of land degradation in Nepal.

Nepal can afford neither the environmental costs of allowing its forests and grazing lands to be wasted nor the loss of forest products from the subsistence farming system. The public forests and pastures of Nepal need to be managed so as to minimize the destructive forces of deforestation and soil erosion, and to maximize the amount of forest products available for consumption by farm households .

B. Theoretical Framework

1. A Brief History of Public Lands in Nepal

Mahesh Regmi, Nepal's leading land tenure expert, claims (personal communication, 1981) that prior to 1957 the official right to forest products (especially those of economic value) was reserved for the government and its designated representatives (Birta, Jagir, Guthi and Kipat tenure holders).[1] Villagers (with the exception of Kipat tenure holders) had no legal right to collect forest products. Access to forest resources for such domestic needs as firewood, fodder and grazing, however, was less restricted than a legalistic interpretation of the state's ownership rights would suggest. Throughout the country, villagers enjoyed an unofficial right to collect forest products for domestic needs, but not for economic exploitation.

In 1957, all forests that had been alienated from the state by Birta, Jagir, Kipat, or Guthi grants were

---

[1]Birta is an assignment of income from state owned (Raikar) lands to an individual such as a priest, soldier, member of the nobility or royal family. While this income was inheritable its ownership was not assured. Jagir is an assignment of income from state owned lands to government officials, military men, etc. in exchange for their services. Guthi is a permanent form of Birta given to institutions such as temples, monasteries, schools, hospitals, etc. Finally, Kipat is a traditional form of communal land tenure. On Kipat lands, communal authority superseded any claim of the state on the basis of sovereignty.

nationalized by the Private Forest Nationalization Act. This act abolished private and community control of public lands. But since, with the exception of Kipat villages, most villagers had never had any official right to collect forest products, their legal standing with respect to forests was not changed. They continued unoffically or "illegally," to collect the forest products they needed to survive.

After nationalization, however, individuals and communities that had managed forest lands no longer had any any right or incentives for continuing to manage these lands, and the government, while now controlling these lands in name, did not have sufficient manpower or resources to manage them. Subsistence farmers were consequently able to expand their use of forests to lands previously closed to them by individuals or communities. Once the demands of subsistence farmers for forest products exceeded forest productivity, deforestation, soil erosion and land degradation inevitably resulted.

In response to this deforestation problem, His Majesty's Government first attempted to outlaw destructive land use practices (1961 Forest Act). But since the government still lacked the manpower and resources needed to enforce the law, the unofficial right of villagers to collect forest products was not affected. After several

other unsuccessful attempts to legislate controls on public land use (1967 Forest Protection Act, 1970 Forest Products Rules), the government amended the 1961 Forest Act to encourage local management of these lands. This was done by defining 4 categories of forests to be managed by panchayats, religious institutions, or individuals. The 1977 and 1978 amendments made it theoretically possible for 2.2 million hectares, over half of the nation's forest, to be managed at the local level.

The four new forest categories are: Panchayat Forests, Panchayat Protected Forests, Religious Forests, and Lease-Holder Forests. Panchayat Forests are degraded forests given to village panchayats for management. Panchayat Protected Forests are government forests given to village panchayats for protection and management. Religious Forests are forests of religious significance given to religious organizations for management, and Lease-Holder Forests are waste lands leased to individuals or communities for reforestation.

The 1977 and 1978 Forest Amendments revolutionized the way Nepal defines ownership rights to forest products. By these amendments the government recognized that local participation is necessary for solving the public land

management problem. The Sixth Five Year Plan (1980-1985) further highlighted the government's intention of making community management the solution to public land management problems. Policy guidelines as described in the plan (Manandhar, 1981) include:

1. To preserve, promote and develop forest and forest products and for this, the effort will be made to enlist maximum community involvement.

2. To give high priority to works related to soil and watershed conservation and scientific land use based on local participation.

3. National Environmental Protection Policy will be framed to maintain a long term balance between man and his environment and existing institutions will be reformed to give priority to environmental aspects.

In implementing these guidelines, the National Planning Commision mentioned in particular:

1. High priority will be given to the Community Forest development and afforestation programs, which are being carried out in the hills to meet the urgent needs of the people for forest products like timber, fuelwood and tree fodder for cattle and other domestic animals.

2. Priority will be given to' those projects that emphasize people's participation for protection and development of forest and forest products.

In recognizing the need to encourage local management of public land resources, His Majesty's Government followed the lead established by community forestry projects

in other parts of the world. For example, in relation to community forests in Africa, Hoskins (1982) states:

> Policy planners were now aware that the situation had changed. First, as wood and land resources became scarce in some areas, the traditional approach of keeping local people out of forestry reserves and of classifying new areas for reserves when needed, became less politically feasible. Second, foresters and others became increasingly aware that forestry skills and information were needed by local farmers in their struggle to provide basic human needs for their families. Third, resource problems foresters were asked to solve were so great, and forestry funds so limited, that local input and goodwill would be essential. Forestry policy makers were hopeful that projects could combine forestry expertise with community development methods to inspire local people to participate. Participation was not to be forced . . . nor limited to paid laborers since there were not enough funds. Rather by developing in participants interest in the value they would receive from the project the trees would become "theirs."

2. Local Participation and Land-Use Management

Before a policy of local participation in public land management can become a reality in Nepal, two major problems have to be addressed. First, this policy must be implemented by the Ministry of Forestry which, as Wallace (1981) in his survey of forestry institutions of Nepal states, "is still constrained by a lack of trained technical and administrative personnel, and which has a history of mediocre forest management." Wallace also points out that activities within the Ministry of forestry are not

well coordinated. For example, "Between 1975 and 1980, the area of Nepal's forest decreased by over 13,000 hectares as a result of the operation of the Ministry of Forestry. Less than 12,000 hectares of forest were planted and over 25,000 hectares were cut, not counting at least 17,000 additional hectares converted from forest to agriculture for resettlement (in the terai)."

The second problem that has to be addressed for a community oriented public land management policy to be implemented is that of how to solicit village participation in land management planning. Simply giving villagers the official right to use forest lands--if they agree to manage them—may not be sufficient to solicit local participation, particularly since villagers have traditionally used many of these lands anyway.

The first of these two problems, training technical and administrative personnel and reorganizing government institutions so as to implement land management programs efficiently, is difficult and will take many years to accomplish. The FAO's Community Forestry Project and USAID's Resource Conservation and Utilization Project have made significant commitments to helping His Majesty's Government solve this problem. A large number of donor nations and non-government agencies have also provided aid

and technical expertise for forestry and soil and water conservation projects.

The second problem, involving local people in public land management, is even less well understood and more difficult to accomplish. Little is known about developing, instituting and monitoring public land management plans in Nepali villages. However, where land has been misused for agricultural or grazing or because of ignorance of conservation principles, soliciting village support for land management programs may prove difficult (FAO, 1978).

A number of variables have been hypothesized to constrain the ability of subsistence farmers to cooperate with land management projects. Among the most noted variables are:

1) Competition for land (Bajracharya, 1980; FAO, 1978);
2) Present needs (Campbell, 1978; Hoskins, 1982; FAO, 1978);
3) Distribution of benefits (Odell, 1981);
4) Labor requirements (FAO, 1978).

These variables are discussed more thoroughly in relation to Nepal below.

3. Constraints on Local Participation

a. Competition for Land

The man-land-cattle-forest relationship that developed in Nepal through centuries of interaction among these variables remained relatively stable as long as each variable was constant. Population growth destroyed the equilibrium of this relationship. As the population grew from an estimated 9,753,378 people in 1961, to 11,289,000 in 1971 (Macfarlane, 1976), an increase of about 15%, the forest area in the middle-hills declined (rough estimates) from 4.6 million hectares in 1964 (Forest Resources Survey, 1973) to 3.1 million hectares in 1975 (Nelson, 1980), a loss of about 33% in little over a decade.

Once cultivatable forests were cleared, a conflict over whether to use forest remnants for grazing livestock or for wood production also became intense. This is because forest reproduction is inhibited by grazing livestock who consume the sprouts and bark of young trees. Trees cut for fuel and timber no longer grow back in heavily grazed forests.

A first priority for introducing controls on public lands is to understand the practices competing to use public lands and the relation of these practices to land degradation. Bajracharya (1980) examined a village in which fuel needs were assumed to be the major cause of

deforestion. An extensive study showed, however, that forests were being cut mainly to increase food production. Bajracharya concluded that in this village, a fuel wood production program would have been an inappropriate response to the deforestation problem. To the extent that public lands are misused to collect forest products (including grazing), the problem should be addressed by land management plans that increase forest productivity and control harmful land use practices. To the extent that public lands are misused to produce food, i.e., terracing marginal lands or slash and burn activities, the problem should be addressed by agriculture programs.

b. Present Needs

Historically, villagers became dependent upon forest products because the latter were abundantly available. As long as these products remained abundant, forest capital was exploited without concern for the long time required to reproduce it. Once these products became scarce, the time involved in growing them became an important constraint to land management. This is because, the time required to grow forest products is bound to conflict with the present needs of villagers for these products.

In subsistence economies particularly, present needs are likely to be imperative (FAO, 1978). Land, labor and other resources that can be invested in producing the

food, fuel, and income needed today cannot easily be diverted to the production of products that will not be available until several years in the future. Thus, Campbell (1978) writes with regard to soil and water conservation programs in Nepal: "Benefits (from these) projects tend to be realized only after a considerable lapse of time; and these projects may, in fact, require an initial reduction of the income presently generated from marginal agriculture and overgrazing. Thus, many farmers may perceive these projects as detrimental to their short-run interests."

Land management plans can be introduced at the community level only if they are sensitive to present needs. This requires information on the demand for and supply of forest products from public lands.

c. Distribution of Benefits

In addition to the costs of adopting land management programs (present needs foregone), the distribution of benefits from these programs will have a crucial bearing on farmer participation. Benefits include fuel, fodder, food, employment opportunities during project development, and secondary employment based on increased productivity.

Odell (1981) points out that relatively little is known about the distribution of forest products from panchayat forests, and particularly about how

disadvantaged groups might be affected by the introduction of management plans. If a local elite (farm-size, caste, etc.) controls how public lands are managed, conflict between village factions could prevent all or some farmers from cooperating with land management plans. As Odell states, "While equity is obviously desirable in terms of social justice, here the very fiber of community forestry is at stake, for how all segments of the community perceive project benefits will determine their support of the program."

d. Labor Requirements

Another barrier to village cooperation with land use management plans can be the insensitivity of these plans to village labor patterns. Traditional farming, grazing, and forest product collecting patterns are closely tied to the division of labor between the sexes and among age groups. These patterns are an integral part of the social structure. FAO (1978) states, "When crop growing is allocated to women or herd-minding to children, there is likely to be strong male resistence to more efficient systems that require some of the work to be transferred to men. Such features hinder the adoption of community forestry programs."

Land management plans that conflict with present labor patterns may be rejected by farmers. Before

villager cooperation with land management plans can be solicited, information is needed on the labor requirements of forest product collecting patterns.

C. Objectives

In his paper on community participation in conservation programs, Campbell (1978) cites a need for studying the socioeconomic factors affecting the implemention of village conservation programs. Towards this end, a few recent studies have examined how villagers use public lands and some of the factors controlling land use practices. Conlin and Falk (1979), Stone (1980), Macfarlane (1976), Hoffpauir (1978), and Wiart (1983) described public lands and land use practices throughout Nepal. Bajracharya (1980), Levenson (1979) and Kawakita (1979), studied firewood collecting and consumption patterns in villages in eastern and western Nepal. Dutt (1979) and Mathema and Van der Veem (1980) documented livestock raising and feeding practices in several villages. Labor patterns, including the time spent collecting firewood and fodder, and livestock grazing were documented in eight villages by Acharya and Bennett (1981). However, as Hoffpauir states: "(while) a number of writers have offered general comments on the agricultural and environmental problems being faced by the mountain villagers of Nepal, the details of the processes at work still need

elucidation. The agricultural ecology of the Himalayas is only known in its sketchiest outlines, and we know very little about the actual workings of the subsistence system, especially at the village level." Land use practices and the subsistence agricultural system need to be understood and documented better before land management programs can be designed to solicit village cooperation with controls on the use of public lands.

This study describes the public and private lands of a Nepali village and how they are used for meeting farm needs. The forest products that play the most significant role in the subsistence farming system and that are examined most closely are: firewood, fodder, and grazing. The specific objectives of the study are to: 1) document the practices (agriculture, grazing, and forestry) competing to use public lands and the relation of these practices to land degradation; and 2) determine if present needs, distribution of benefits, and labor requirements could influence the cooperation of farmers with controls on public land use. In meeting these objectives, the study attempts to answer the following questions:

1) What land use practices compete to use public lands, and what is the relationship between land use and land degradation?

2) How important are forest products from public lands to subsistence farmers?

3) Do farm-size groups have different interests in how public lands are used?

4) What are the labor requirements of collecting different forest products?

The answers to these questions are used to examine land management options for the study village and to comment upon national land management policies.

D. Outline of this Thesis

This thesis is arranged in the following manner: Chapter Two describes the study village—its lands, soils, climate, vegetation, crops, livestock strategies, history, caste groups, etc.; it outlines the methodology of the study, the choice of sampling design, and the data collected; and it defines terms used throughout the thesis.

Chapter Three describes forest resources, firewood collecting patterns, firewood collecting labor patterns, firewood demands and consumption patterns, and the balance of firewood supplies versus firewood demands.

Chapter Four describes the village's livestock, livestock feed demands, tree and grass fodder collecting patterns, grazing patterns, fodder collecting and grazing labor patterns, and fodder and grassland resources.

Chapter Five describes income generating activities in the village (animal husbandry, agriculture, gathering,

and off-farm wage labor) and the importance of public lands to household income.

In Chapter Six, results from Chapters Three through Five are summarized. These results are used to answer the four questions posed regarding land use practices.

Finally, in Chapter Seven, the implications of the study for public land use management in the village and the nation are discussed. A general strategy for designing village level land use plans is presented. Then the direction of future research on Nepal's land use problem is discussed in light of this study.

Nepali terms are used frequently throughout this thesis. For the most part these are underlined, the exceptions being key words that are used often and caste names, place names, and major religious festivals. Wherever possible the spelling follows R.L. Turner's (1965) A Comparative and Etymological Dictionary of the Nepali Language.

The superscript for area and volume abbreviations have been placed next to the abbreviation rather than above it. Consequently, square meter appears as (m2) or centimeter cubed as (cm3), etc.

Prices, wages, values of agriculture produce, etc. are given in Nepali rupees. In 1981, there were approximatley 13 Nepali rupees to a U.S. dollar.

CHAPTER II

THE SETTING, METHODS, AND DEFINITIONS

A. Setting

1. The Middle-Hills

The middle-hills of Nepal run from east to west across the center of the country, sandwiched between the low lying Gangetic plains (terai) and the snow-capped Himalayan mountains. These hills are the traditional home of the Nepali people. The mountains to the north are too steep and rugged, the climate too harsh and inhospitable to support life. The plains to the south were uninhabitable before malaria-bearing mosquitoes were eradicated in the 1960's.

Today about 60% of the nation's population lives in the middle-hills, which contain only 25% of the nation's cultivated lands. Most of these people are subsistence farmers. A World Bank (1973) report estimates that: "Population density (in the middle hills) per square kilometer of arable land is probably as high as 1,100, a concentration similar to that found in certain Asiatic deltas, but where, in contrast, the soil is more fertile and the climate allows two or three crops a year."

Altitudes in the middle-hills range from 300 m. in river valleys to 5,000 m. on hill tops. Lands between 300 m. and 1,200 m. are generally well supplied with irrigation water and are blessed with a climate suited for 2 or 3 crop rotations per year. Lands between 1,200 m. and 1,800 m. lack irrigation water but have sufficient rain and sun to produce 1 or 2 crops per year. Lands above 1,800 m. are increasingly less productive of agricultural crops. Between 300 m. and 1800 m. are found the highest population densities in Nepal. It is on these lands that man-induced environmental degradation problems are the most severe.

2. The Daraundi Watershed

Numerous rivers arise on the slopes of the Himalayas and flow south through the middle-hills. One of these rivers, the Daraundi, has its source on the slopes of Himal Chuli and flows through the hills until it joins the Trisuli River at Tribeni. Located about halfway between the eastern and western borders of Nepal, the Daraundi watershed receives neither as much rain as the east nor as little as the west. Stainton (1972) devised 7 "climatic and vegetational divisions for Nepal. The Daraundi watershed is in the largest of these divisions, the central midlands, and is representative of climatic and vegetational conditions in a majority of the middle-hills.

Little is known of the early history of the watershed, but in Nepal the Tibeto-Burman cultures and languages of the north have always mixed with the Indo-Aryan cultures and languages of the south. In the Daraundi watershed, the first settlers were probably from the north. These people, the ancestors of today's Magars and Gurungs, moved with their livestock from area to area, cultivating millet in slash and burn fields, and grazing forest pastures (Macfarlane, 1976; Messerschmidt, 1976; Hitchcock, 1973). People of Indian background (Brahmins, Chhetris, and untouchables) probably began migrating into the area in the 12th century when Muslims invaded the Indian plains. These refugees brought with them their Sanskritic heritage, Hinduism, and highly developed agricultural skills (Stone, 1980; Calkins, 1976).

It is generally believed that when the Indo-Aryans moved into the hills they took control of the river valleys. Here they built irrigation networks and cultivated rice. The indigenous hill tribes, who had grazed their livestock in the river valleys only in the winter, made arrangements to graze empty rice fields after the fall harvest. Today the Brahmin, Chhetris and untouchables still dominate the lands below 1,800 m. and the Gurungs, the lands above 1,800 m.

3. The Village

Since land degradation problems are most serious in densely populated areas, Bhogteni, the study site, was chosen among villages below 1,800 m. The village is situated on the eastern ridge of the Daraundi watershed at about 1,200 m. This elevation is a subtropical haven between the hot sultry climate of the river valley and the bitter cold winters further up slope." The village lies an hour's walk north of Gorkha, the administrative center of the district. Fig. 2-1 shows Bhogteni in relation to Nepal's boundaries.

Gorkha is also the ancestral home of the Shah dynasty of Nepali kings. From his palace at Gorkha, Prithvi Narayan Shah set out to conquer the Kathmandu valley. This conquest established the modern state of Nepal. Because of Bhogteni's close physical proximity to Gorkha, a number of villagers have always found work in Gorkha's government officies, school, temple, and military camp.

A motorable road has recently linked Gorkha with Kathmandu and Pokhara. At the time of this study, this road had had little impact on agricultural technology, cropping patterns, land use practices or even marketing schemes in the district.

In rural Nepal, the panchayat system is the keystone of all development activities. It is a three-tier system

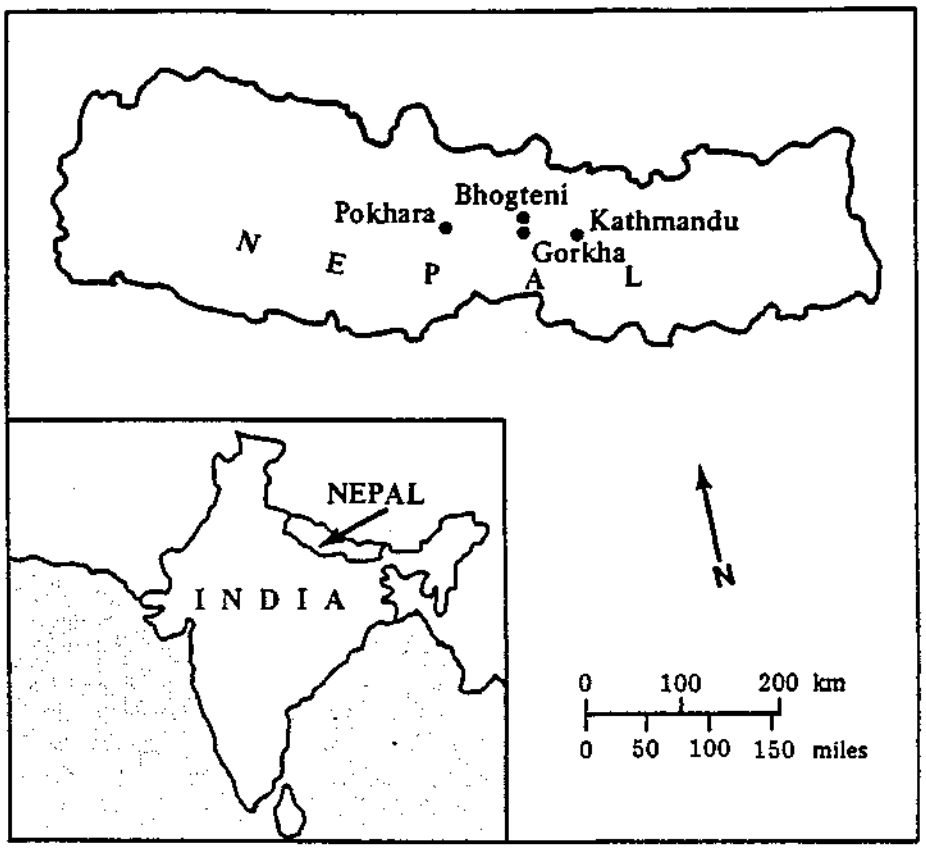


Figure 2-1. Bhogteni's Location in Relation to Nepal's Boundaries

composed of the village panchayat (council), the district panchayat, and the national panchayat. A village panchayat is the base level political as well as administrative unit. The area of each panchayat is based on physical terrain and population distribution (APROSC,

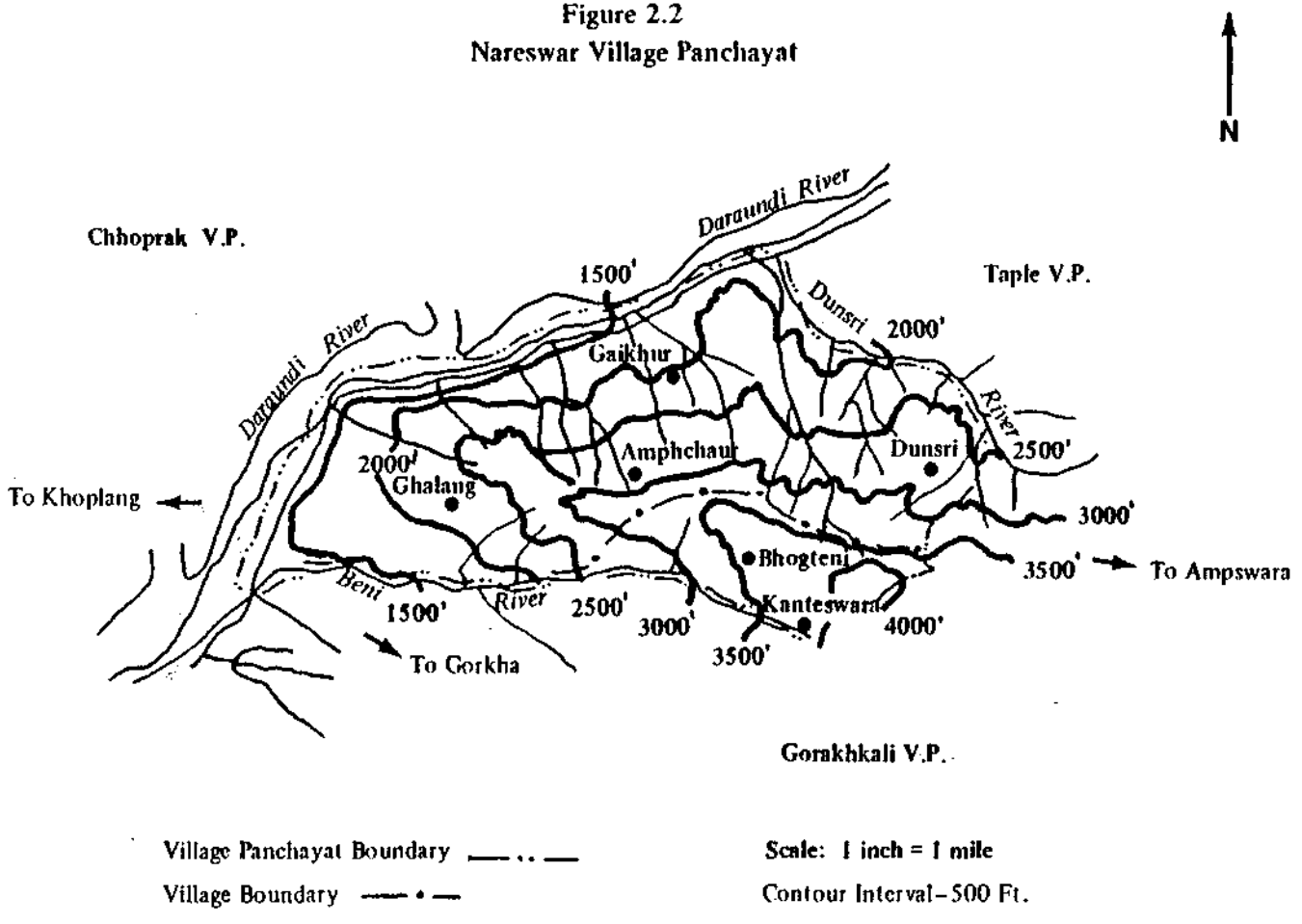
1977) . A village panchayat is divided into nine wards, each of which elects five members to form a ward committee. These ward members all participate in the village assembly and are responsible for electing the Pradhan Panch (chairman) and Upa-Pradhan Panch (vice-chairman) .

Bhogteni is the largest village in Nareswar panchayat, comprising 2 of its 9 wards. The panchayat's meeting house, its only upper level school, and the Pradhan Panch's home are found here. The village is shown in Fig. 2-2 in relation to the panchayat's boundaries and to neighboring villages.

a. Physical Features of the Village

The hill on which Bhogteni is located faces west and drops from a 1,200 m. ridge to the Daraundi River at 450 m. Village lands extend from the ridge down to about 900 m. Bedrock underlying the village and outcropping along its trails and streams is a phyllite composed of chlorite, sericite, and quartz. This rock weathers to produce a medium textured reddish clay loam to sandy loam soil, with weakly to moderately developed subangular blocky structure. According to soil taxonomy these soils can be classified as Inceptisols or Entisols.

Figure 2.2
Nareswar Village Panchayat



Soil analysis done at the Division of Soil Science at Khumaltar showed these soils to be highly acidic (pH = 4.2), low in organic matter, with low nitrogen (N < 1%), low to medium phosphorus (P_2O < 55 kg/ha), and medium potassium (K_2O between 110 and 275 kg/ha).

Average monthly temperatures and rainfall (1976-1980) in Gorkha, the meterological station nearest to Bhogteni, are shown in Fig. 2-3. The climate of the area is monsoonal, with 70% of the annual precipitation occurring between June and September. The mean annual precipitation is 1,400 mm. The average January temperature is 12.9 degrees centigrade, with the mean minimum dropping to 6.3 degrees centigrade. The July mean is 25.0 degrees centigrade, with a mean maximum of 27.3 degrees centigrade. According to rain and temperature, the following seasons are recognizable:

Cold	mid-December through February
Dry	March through mid-May
Monsoon	mid-May through mid-September
Fall	mid-September through mid-December

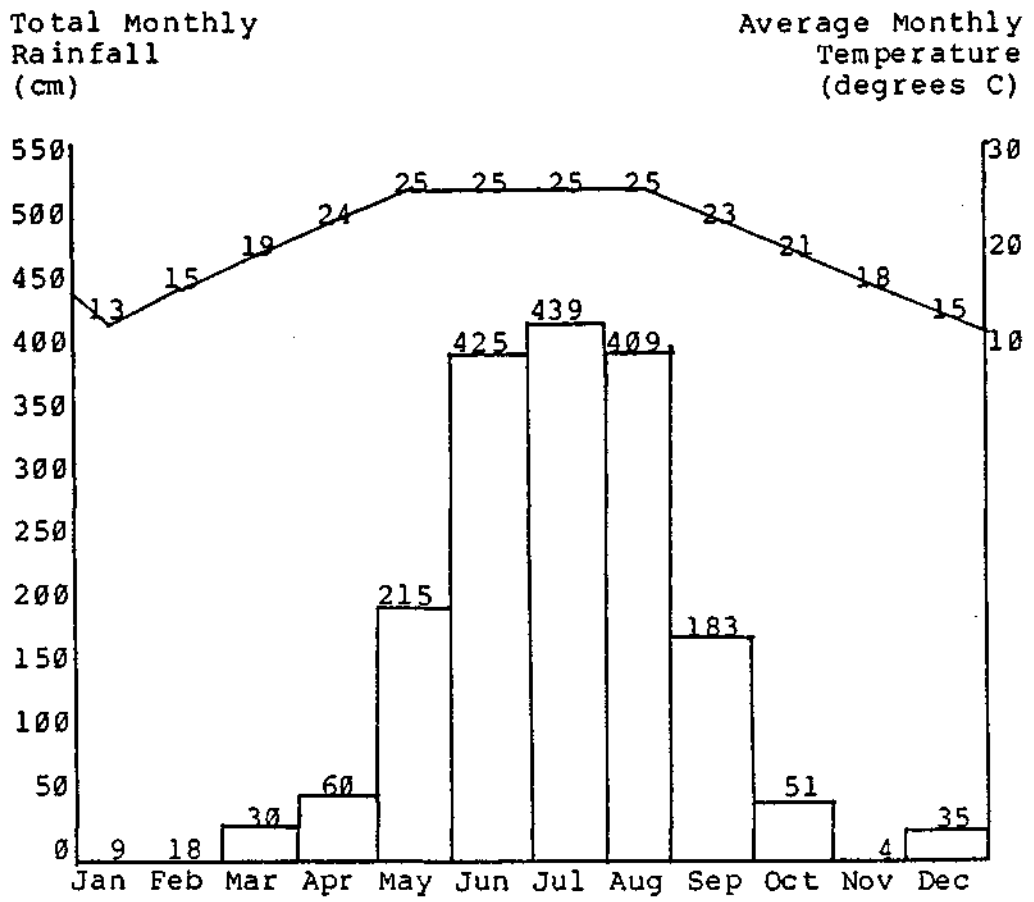


Figure 2-3 Average Monthly Temperature and Rainfall in Gorkha.

The natural forests in the village belong to Stainton's Schima-Castanopsis and Sal categories. Above 1000 m., Schima-Castanopsis forests are predominant. Most of these forests, however, were converted long ago to agricultural lands. The remnants are badly over-grazed and burned regularly. Tree densities range from less than 25 trees per hectare on communal lands to approximately

200 trees per hectare on private woodlots. More than 85% of the trees in these remnants are Schima wallichii (Nep. Chilaune). A few heavily cut Castanopsis indica (Nep. Katus) trees still stand as well. These forest remnants bear little resemblence to the natural forests of the area.

Below 1000 m., sal forest (Shorea robusta) predominate. Tree densities on these lands are approximately 746 trees per hectare. Stainton maintains that sal is better able to withstand harsh treatment from lopping and felling than are most other species. This may partially account for the higher tree density in the sal forest than in the Schima-Castanopsis forests. Trees in the sal forest, however, are still stunted and pole-like from being over lopped. Most of the tree species found in Bhogteni are listed in Appendix 1.

b. Cultural Features of the Village

The people living in Bhogteni are far from homogenous but they are overwhelmingly of Indo-Aryan stock. Of the 107 households in the village, 64% are Brahmin-Chhetri, 18% are Newar, 16% are untouchable (Kami, Damai, and Sarkai), and 2% belong to either Jogi or Magar caste groups.

The 1981 population of the village was 653 persons. The population per household ranges from 1 to 17 and

averages 6.1. Most families consist of a married man and women and their 2 to 4 children. Polygamy is acceptable in the society and a few men have 2 wives. There are also a few extended families where 3 generations (paternal lineage) live in the same household.

Villagers in Bhogteni own approximately 113 ha. of agriculture land, and have access to 73 ha. of *Schima-Castanopsis* scrub land and 39 ha. of sal forest. In relation to land resources, the population density is 318 persons per square kilometer, 577 persons per square kilometer of cultivated lands, or 583 persons per square kilometer of forests/scrub/grazing land. Table 2-1 shows population densities in other Nepali villages. Bhogteni's population density is higher than that cited in these villages.

Regardless of ethnic differences the livelihood of all villagers depends on subsistence agriculture. Commercialization of the economy is minimal. The primary objective of all households is to own sufficient land to meet food requirements.

Table 2-1. Population Densities in three Nepali Villages

Location	Land Use	Pop. density persons/ sq. km.	Year
Nepal	All	110	1981
	Arable	469	1981
Pangma Panchayat Eastern Nepal (1)	All	223	1980
	Arable	393	1980
	Forest/ Grazing	540	1980
Bhogteni Village Central Nepal	All	318	1981
	Arable	577	1981
	Forest/ Grazing	583	1981
Bhadaure Panchayat Western Nepal (2)	All	101	1979
	Arable	276	1979
	Forest/ Grazing	160	1979

1. Bajracharya, 1980
2. Levenson, 1979

c. A Short Walk Through the Village

In order to have a clearer perception of land use in the village, let us take a short walk across the side of the hill where Bhogteni is located. We begin at Nareswar bhyanjyang (pass) where the trail from the Daraundi river enters the village. The bhyanjyang is the heart of the village, the home of its school, panchayat house, and most popular tea-shop. From the bhyanjyang the trail follows the contour across the side of the hill towards Gorkha. Like the proverbial railroad track, the trail divides the village into poor and rich communities. Above the trail are the homes of the poor--Newars and untouchables. Below the trail are the homes of the rich—Brahmins and Chhetris.

The Newars and the untouchables above the trail are of two distinct groups. Newars are the indigenous people of the Kathmandu Valley. They are often traders and shopkeepers, but are also excellent farmers. The Newars in Bhogteni, most of which are small farmers, are not sure when or why their ancestors came to this village, but they believe they orginally came from Bhaktapur, a town in the Kathmandu valley.

The untouchables in Bhogteni (and in Nepal in general) belong to the blacksmith (kami) , cobbler (sarki) and tailor (damai) castes. Untouchables recognize Newars to

be their social superiors, but members of both groups often work together on parma teams (exchange labor) and their children play together. In Bhogteni, the household economies of both groups are similar, since they own small pieces of bari (unirrigated) land, little if any khet (irrigated) land, and have few household members employed in the school system, the government offices in Gorkha, or in the military. Another similarity between the two groups is that they both distill alcohol.

The Brahmin-Chhetri caste groups below the trail are usually considered to be one community. The Brahmins are the priests, and the Chhetris are the warriors in the Hindu caste hierarchy. As a community, these farmers are different from those above the trail because they generally own more land, both khet and bari, and many households have a member' with a full time job in the village or in Gorkha. Also, neither group distills alcohol.

The two halves of the village are clearly separable in terms of economic and caste variables. In most visual respects, however, the upper and lower halves are very similar. Most homes have one or two stories and are made of stone and mud. Walls are washed with red clay to give them an attractive rust color, and roofs are either thatch or baked clay tiles. All homes have a covered porch. One of the major differences between the homes of the

poor and the rich is that the porches on the latter have a comfortable seating area. In front of all homes, an apron of ground is kept clean and paved with a paste of clay and cow dung. Here the women of the household thresh, winnow, mill, and clean grains. Beyond this apron are the livestock sheds, the compost pit, and an elevated platform for storing straw. An average farmer owns a she buffalo, a couple of cows or oxen, 3 or 4 goats, and about 5 chickens.

Most homes are surrounded by home gardens (gharbari). A gharbari might include a vegetable plot, scattered fruit, fodder, and firewood trees, thatching grass, flowers, a few medicinal plants and spices, and some bamboo around the edges. Plants in the gharbari appear to grow randomly, but on closer examination are found to provide fuel, fodder, food, or some other source of income to the household.

Beyond the gharbari, but generally close to the house, are the bari lands. These are used to grow staple crops such as corn, millet, and dry rice as well as pulses, mustard, and linseed. An average farmer owns about .7 hectares of bari land including the gharbari. Small, medium and large farmers own about .5, .8 and 1.2 hectares, respectively. One or two crops are produced here annually. The main source of fertility for these

lands is dung dropped by grazing animals, and manure compost carried to the fields before the first crop is planted in March and April. Grasses and forbs that grow on terrace risers during the dry season are cut and incorporated into the soil as a source of organic material. Grasses and forbs that grow on risers during the wet season are cut for fodder. Firewood, fodder and fruit trees are allowed to grow on bari edges. Some of the fodder trees are leguminous and provide another source of soil fertility.

Khets are often 10 minutes to an hour's walk from the house. Rice is cultivated on khet land, but only one crop is planted a year because water supplies are insufficient for a second crop. An average farmer own about .4 hectares of khet land. Small, medium and large farmers own about .1, .5 and 1.2 hectares, respectively. Khets are also fertilized by grazing livestock, but compost is not usually carried to these fields from the homestead. As with bari lands, grasses and forbs that grow on terrace risers during the dry season are incorporated into the soil. Those that grow during the wet season are cut for fodder. Trees are seldom allowed to grow on the edges of khets because rice is too valuable a crop to shade.

Above the trail, unirrigated bari lands predominate; below the trail are found the irrigated khet lands. The

forest remnants above the trail are Schima-Castanopsis, whereas all but one of those below the trail are sal.

This description of the village is brief but, it is hoped, sufficient to make the data presented in the following chapters more meaningful. Bhogteni is typical of Brahmin-Chhetri middle-hill villages in terms of most economic and environmental variables. While some allowance must be made for the uniqueness of any place, this study is based on the assumption that some of the causes of land degradation in the middle-hills can be identified from this single village.

B. Methods

1. The Physical Environment

a. Land-Use and Land Area

The relevant land use categories in this study were considered to be: 1) arable lands, 2) sal forests, and 3) Schima-Castanopsis scrub/grazing lands. To determine the area in each category a piece of clear mylar was placed on top of two over-lapping (60%) aerial photographs (1:50,000). With the help of a stereoscope, land use categories were marked on the mylar with a pencil. The mylar was then placed on top of a grid of dots and the area of each category obtained by counting the dots.

The area of forest and scrub/grazing lands was checked by mapping sample sites with a compass and tape

measure. The coordinates obtained were plotted to scale on graph paper and the area determined by counting the squares.

The area of agricultural lands was estimated from tax records. Land taxes in Nepal are levied in a variety of ways. In Bhogteni, a bari is assessed on the amount of seed that it takes to sow the land. The official conversion is l mana (approximately 0.40 kg.) of corn seed per .25 ropani (125 square meters). This is not a true measure of area, since seed input depends on many things, such as soil fertility. In order to convert tax records to land area, a sample of bari lands was measured in a manner similiar to that used for forest lands. In Bhogteni, l mana of seed is equal to .4 ropanis of land. Tax records for village bari lands were converted to area at this rate.

On khet lands, taxes are assessed on the basis of the amount of land (mato) required to produce 1 muri (about 48 kilograms) of unhusked rice. Officially, 1 muri mato is equal to .25 ropani. By measuring a sample of khet lands, it was determined that in Bhogteni l muri mato is equal to .5 ropanis. Tax records for village khet lands were converted to area at this rate.

b. Forest Inventory

The panchayat's forests were sampled with the tree centered quarter method (Cottam and Curtis, 1956). In each of the two forest communities, 4 forest/scrub lands were randomly chosen. On each of these 8 pieces of land, 16 points were randomly selected. The tree closest to the point was then chosen as the base tree. In each compass quadrant from the base tree, the distance to the nearest tree, the tree species, and its diameter at breast height (d.b.h.) were recorded. The frequency, density, and dominance of tree species were then determined.

2. Demands for Forest Products

a. Sample Population

Data on village demands for forest products were collected from December, 1981 through December, 1982. A stratified sample of households was chosen by compiling a census of village households with village informants. Five informants of different caste and wealth were asked to rate all these households on a scale of 1 to 5, with 1 considered to be very poor and five to be very wealthy. The responses agreed well and were averaged to produce 5 categories of household wealth. Eight households were randomly selected from each group by children in the village tea-shop who pulled names out of a box. Each household chosen was approached in the order in which it

was drawn. The first 6 households that agreed to be interviewed weekly for a year composed the final group. In the poorest group, 7 households were contacted by mistake. Since all 7 households wanted to participate, the total sample was 31 households.

b. Daily Recall Survey

The 31 chosen households were interviewed on a randomly selected day, weekly for a year. Questions were asked about forest product collection and utilization patterns, agriculture crop expenditures and production, livestock expenditures and production, wage labor, etc. Since most questions asked respondents to recall something from the previous day the study is called the Daily Recall Survey. The questions are in Appendix 2.

c. Time Allocation Survey (TAS)

A TAS (Acharya and Bennett, 1981) was conducted in all of the sample households. All individuals older than 5 years were observed at 3 randomly selected times each week. Their activities were recorded on a form listing most of the jobs and leisure activities in the village. The results from this survey make it possible to estimate accurately the amount of time devoted to different tasks each day. The activities are listed in Appendix 3.

d. Weight Survey

Four times between August and December, 1981, firewood was weighed at the sample households. On the day measurements were made, the research team visited each farmer at dawn and requested that he or she set aside the amount of firewood that would be burned that day. The wood was weighed and left by the door of the house with instructions given to burn only the wood in that pile or, if any extra wood was needed, to remember how much extra wood was burned. On the following day the research team returned to each household and weighed any remaining wood or the amount of wood estimated to have been added to the original pile. This survey was not started until the study had established good relations with each household because of the amount of cooperation it required. Tree and grass fodder supplies were also weighed frequently at each household.

e. Census Survey

The 76 households not included in the Daily Recall Survey were interviewed once in the fall of 1981. This interview provided a check on the representativeness of the sample households. Questions were asked on the number of people in the household, land holdings, livestock numbers, firewood and livestock feed collection and utiliza-

tion patterns, and crop expenditures and production rates. The questions are in Appendix 4.

f. Assistants

Four young men from village households, who had passed at least tenth class, were hired as assistants. Two assistants helped the author do Daily Recall Survey interviews, weigh wood, identify, count, and measure trees, and do other tasks. One assistant was given complete responsibility for doing the TAS. Another assistant coded interviews onto a summary sheet. Although the study required a lot of work and attention to detail, accurate data were obtained because of the assistants' diligence and the villagers' responsiveness. The numbers in this study, however, should be interpreted as indicative of land use trends rather than as precise measurements.

C. Definitions

Before proceeding further, two categories often referred to need to be defined. These are farm-size and forest-type.

1. Farm-Size

As stated, village households were stratified according to wealth by informants ranking each household on a scale of 1 to 5. Informants used their own judgement on how to define wealth, but they were told to include variables such as the amount of land owned, the number of livestock owned, loans given and taken, and income from off-farm employment. Later, once the amount of land owned by different households was determined, it became apparent that the 5 groups could be described accurately in terms of 3 farm-size groups. Small farmers own between 0.1 and 1.2 hectares of land, with a mean of 0.6 hectares. Medium-size farmers own between 0.9 to 2.5 hectares, with a mean of 1.3 hectares. Large farmers own between 2.1 and 3.3 hectares, with a mean of 2.5 hectares. Because farmers were classified according to their wealth and not just the amount of land they own, there is some overlap between farm-size groups. Table 2-2 shows the number of farm households in each group in the village and in the sample.

In the rest of this study, these 3 groups are referred to as small, medium, and large farms. One of the objectives of this study is to determine differences in demands for forest products and in land use practices among the farm-size groups.

Table 2-2. Number of Farm Households by Farm-Size Groups

Population	Small	Medium	Large	Total
Sample	13	12	6	31
Village	51	43	13	107
%	48	40	12	100

2. Forest-Type

Forest lands can be divided into type according to cultural or physical characteristics. Relevant cultural characteristics include who owns the land, who uses it, and who manages it. Relevant physical characteristics include tree species, soil, aspect, and slope. Bhogteni's forests have already been described in terms of Stainton's dominant communities. Since the ultimate objective of this study is to understand land use practices, public lands must also be classified according to ownership and/or control.

The Forest Nationalization Act of 1957 declared all forest lands "inclusive of waste lands, streams, ponds, and paths" (Regmi, 1978) to be state property. Individual ownership of forests was permitted on lands less than 2.5 ropanis (1.25 hectares). All lands adjoining forests and left fallow for two years were also declared to be state property by the Forest Act of 1961. Clearly, most of the

non-agricultural lands in Bhogteni are the legal property of the state.

Villagers, however, perceive forest ownership differently. They classify forests as being: 1) government owned (sarkari); 2) privately owned (vyatigat); or 3) community owned (sarvajanik). These categories are associated with their traditional right to use these lands.

Prior to 1957, all of the panchayat's sal forests were privately owned. The Forest Nationalization Act made these lands state property. Since the access of villagers to these lands had hitherto been restricted by private owners, villagers were quick to recognize these lands as government property.

On the other hand, Schima-Castanopsis remnants grew adjacent to the agricultural fields of villagers. Local landowners claimed these and paid taxes on them so as to be able eventually to clear them and increase the size of their fields. Other Schima-Castanopsis remnants growing on lands too steep or shallow to be cultivated were heavily used for firewood and fodder collecting and for grazing. Since most villagers have always used these lands, they were not as quick to perceive that the Forest Nationalization Act affected these as well as the sal forests. Villagers still con-eider Schima-Castanopsis forests to be either private or community property.

In this study, forests are classified according to villagers' perceptions. Those lands villagers consider to be private are classified as private forests. Firewood and fodder trees grown in gharbaris and on the edges of bunds are also included in this category. Those lands that the village feels are communal are classified as communal forests. Finally, those lands the village considers to be goverment property are classified as government forests. For convenience, communal and government forests are combined in a category called public lands.

This study now proceeds to consider who uses the different lands, who controls them, who manages them, and what kind of arrangements can be made to improve management on public lands.

CHAPTER III

FIREWOOD

A. Introduction

Firewood is indispensable to Nepali farmers because it provides the energy needed for cooking and drying food, space heating, distilling alcohol, and making charcoal. Ninety-five percent of the energy consumed in the hills comes from firewood (Energy Resources Group, 1976). A large portion of this wood comes from public forests.

Unmanaged cutting of firewood destroys the productivity of forest, and exposes fragile hill soils to erosive monsoon rains. The long term stability of farming and ecological systems in the hills requires that public forests be managed. Management plans, however, have to be sensitive to the needs of both the forest and the farmer.

To solicit farmer cooperation with management plans that affect current firewood collecting practices, information is needed about those practices. This includes knowing how much firewood is available, where it is collected, who collects it, how long it takes to collect, the season in which it is collected, how much wood is consumed, and what factors affect consumption.

What follows is an attempt to portray firewood collecting and utilization patterns in Bhogteni. More specificially, this chapter describes the village's 1) forest resources; 2) firewood collecting patterns; 3) firewood collecting labor patterns; 4) firewood demands and consumption patterns; and 5) balance of firewood supplies versus firewood demands.

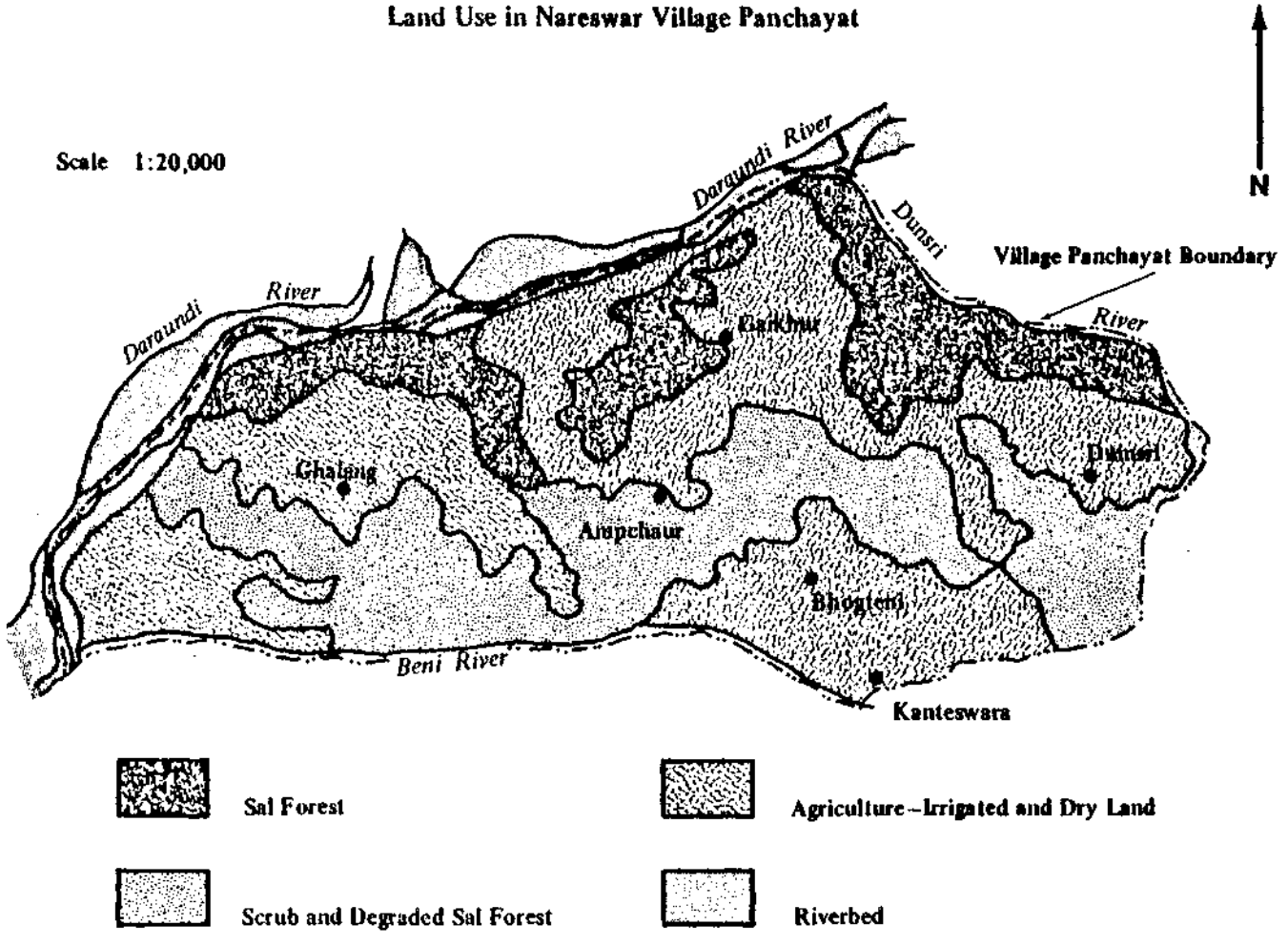
B. Forest Resources

As described in Chapter 2, Bhogteni's forest resources consist of 1) private woodlots, including trees grown in home gardens, along terrace risers and trails, etc.; 2) communal *Schima-Castanopsis* scrub lands; and 3) sal forest. These forests are all located within a short walking distance of the village. At a further distance, but still in Nareswar panchayat, are other sal forests that the village could utilize. Because of their distance from the village,these forests, all located along the Daraundi and Dunsri rivers, have not traditionally been used for fuel wood. Fig. 3-1 is a land use map showing forest, scrub, and agricultural lands in Nareswar panchayat.

Statistics describing the different forest types are shown in Table 3-1. Private woodlots have 179 trees per hectare, 92% of which are *Schima wallichii* and 8% miscellaneous species (primarily *Castanopsis indica*) . The basal

Figure 3.1

Land Use in Nareswar Village Panchayat



area of an average tree is 562 cm2. Communal scrub lands have less than 26 trees per hectare, primarily Schima wallichii, with an average basal area of 474 cm2 per tree. The village's sal forest has 746 trees per hectare, 95% of which are sal. In contrast with private and communal forests, the sal forest has a much higher density (trees/hectare) but is made up of smaller trees (232 cm2 per tree). The total basal area (m2/ha), however, is higher in the sal than in the private or communal forests. In the panchayat's sal forest, there are 583 trees per hectare, with an average basal area of 710 cm2 per tree. The total basal area per hectare for this forest is more than twice that of the sal forest in Bhogteni.

Wood volume was estimated using the Forest Resource Survey's (1973) volume tables. These tables, however, do not include the volume of trees below 12.5 cm. in diameter, or tree tops below 10 cm. in diameter, or branch wood. All three of these are excellent sources of firewood. Consequently, following Bajracharya (1980), this study approximated the volume of small trees and tree tops by extending the calibration curve (d.b.h. vs. volumn) to 5 cm. d.b.h. The corresponding value of .02 m3/tree was taken as the volume for trees below 12.5 cm. d.b.h. and tree tops below 10 cm. d.b.h. The contribution of branches to wood volume was assumed to be 50% of timber

Table 3-1. Statistics describing Bhogteni's Forest Resources

Forest	Species	Density	Relative Density	Mean Basal Area per Tree	Total Basal Area
		trees/ha	%	cm2	m2/ha
Private	Schima	165	92.3	575	9.49
	Sal	0	0.0	0	0
	Misc.	14	7.7	372	.52
	Total	179	100.0	562	10.01
Communal	Schima	23	87.4	496	1.14
	Sal	0	0.0	0	0
	Misc.	3	12.6	353	.11
	Total	26	100.0	474	1.25
Bhogteni's sal forest	Schima	13	1.7	877	1.14
	Sal	709	95.0	219	15.59
	Misc.	24	3.3	249	.60
	Total	746	100.0	232	17.31
Panchayat's sal forest	Schima	62	10.7	1157	7.17
	Sal	474	81.3	615	29.15
	Misc.	47	8.0	1078	5.07
	Total	583	100.0	710	41.39

volume for trees less of than 12.5 cm. d.b.h., 20% for trees between 12.5 and 30 cm. d.b.h., and 10% for trees above 30. cm. d.b.h. (Levenson, 1979).

The mean annual increment of wood volume was also estimated by the method suggested by Bajracharya. Trees larger than 30 cm. d.b.h. were assumed to have a 2% growth rate, those between 13-30 cm. to have a 5% growth rate, and those less than 13 cm. to have a 7% growth rate. It is important to note, however, that because such environmental factors as climate, slope and soil vary so widely across the middle-hills, production studies done elsewhere may not be applicable in Bhogteni.

Table 3-2 shows tree volume estimates for the 3 forest categories. Timber volumes in Bhogteni range from 7 m3/ha on communal lands to 71 m3/ha in the sal forest. These figures compare well with those from a survey conducted by USAID (APROSC, 1979) in 4 hill catchments in Nepal. That study found timber volumes ranging from 26 to 72 m3 per ha.

The sal forest covers 39 hectares (25% of the village's forest lands) and contains 54% (4,134 m3) of its standing wood volume. Private woodlots, including trees grown on bunds, etc., cover about 42 hectares (27% of the village's forest lands) and contain about 40% (3,132 m3) of its wood. Communal lands total about 73 hectares (47%

of the village's forest lands) and contain only 8% (648 m3) of its standing wood. Combined, all of Bhogteni's forests contain about 7,913 m3 of wood.

Table 3-3 shows per hectare mean annual increment (MAI) values for the 3 forest categories. Literature values indicate a wide range of forest growth rates in Nepal. A Tribhuwan University study (Energy Research Group, 1976) estimates growth in forest remnants near villages to be .2 m3/ha/year. AID'S hill survey (APROSC, 1979) estimated forest growth rates to range from .4 to 1.1 m3/ha/year. The Work Bank (1978a) estimates annual increments at 2 m3/ha/year. Bajracharya, whose method of including tree tops and branches in volume and increment calculations was used in this study, estimated wood growth in the forests of a panchayat in eastern Nepal to be 4.85 m3/ha/year. Other studies have found growth rates as high as 10 to 15 m3/ha/year (Levenson, 1979; Wormald, 1976). These larger estimates appear to be due to differences in elevation, climate, and forest type. In this study, wood volume on private woodlots is calculated to be increasing by 2.5 m3/ha/year. On communal lands the rate is .31 m3/ha/year, and in the sal forest the rate is 4.3 m3/ha/year. The average MAI for all forest lands is 1.85 m3/ha/year. This rate is a static picture of a changing situation. If forests are over-lopped, over-cut and over-grazed, this rate

could decrease in the near future. If forests are protected and managed in a scientific manner, this rate could increase.

Table 3-2. Wood Volume Estimates

DBH cm.	Timber m3/ha	Small trees & tops m3/ha	Branch-es m3/ha	Total m3/ha	# of ha	Total m3
Private						
< 13	--	.28	.28	.56	42	23.52
13-30	23	3.00	6.00	32.00	42	1344.00
> 30	37	1.00	4.00	42.00	42	1764.00
Total	60	4.28	10.28	74.56	42	3131.52
Communal						
< 13	--	.04	.04	.08	73	5.84
13-30	3	.40	.85	4.25	73	310.25
>30	4	.10	.45	4.55	73	332.15
Total	7	.54	1.34	8.88	73	648.24
Bhogteni's Sal Forest						
< 13	--	4.74	4.74	9.48	39	369.72
13-30	36	9.00	11.25	56.25	39	2193.75
> 30	35	1.24	4.00	40.26	39	1570.14
Total	71	14.98	19.99	105.99	39	4133.61
Grand Total						7913.37

Table 3-3. Wood Volume Mean Annual Increments

DBH cm.	Volume m3/ha	Growth Rate m3/m3/year	MAI m3/ha/year
Private			
< 13	.56	.07	.04
13-30	32.00	.05	1.60
> 30	42.00	.02	.84
Total	74.56	---	2.48
Communal			
< 13	.08	.07	.06
13-30	4.25	.05	.21
> 30	4.55	.02	.09
Total	8.88	---	.31
Bhogteni's Sal Forest			
< 13	9.48	.07	.66
13-30	56.25	.05	2.81
> 30	40.26	.02	.80
Total	105.99	---	4.27
Average all forests			1.85

Wood volume and mean annual increments are converted to weight units when multiplied by the specific weight of wood, which in Bhogteni is estimated to be 700 kg/m3 (25% moisture dry weight). Consequently, the weight of wood in Bhogteni's forests is about 5.5 million kilograms. Twenty-six percent (1.4 million kilograms) of this wood is in small trees, tree tops, and branches, materials not generally considered in timber volume surveys.

The annual increment of wood available for fuel is the sum of wood growth and deadwood generation. Again following Bajracharya, annual deadwood generation is estimated to be 3% of total wood. Table 3-4 shows that the sustainable yield of Bhogteni's forests is approximately 371,264 kilograms per year.

Table 3-4. Annual Firewood Supply by Forest Type

Forest	Annual Increment (kg/year)	Deadwood (kg/year)	Total Wood (kg/year)
Private	72,648	65,551	138,199
Communal	15,795	13,613	29,408
Sal	116,868	86,789	203,657
Total	205,311	165,953	371,264

Sal trees are valued for lumber and villagers do not usually fell them for for firewood, although they do collect dead branches, fallen trees, etc. for fuel purposes. In addition, since the time of this study, USAID's Resource Conservation and Utilization Project has started a forestry project in this area and prohibited the cutting of trees in Bhogteni's sal forest. Consequently, if the village's firewood supply is considered to be dead wood in the sal forest, and new growth and dead wood on communal and private lands, then 34% of the village's firewood supply is deadwood from the sal forest, 12% is wood from communal scrub lands, and 54% is wood from privately owned lands. The total available supply of firewood in the village is 253,406 kilograms; of this 116,197 kilograms is from communal and sal forests.

Table 3-5 shows the amount of fuelwood available on private lands by farm size groups. Small, medium, and large farm groups can cut 15,975, 65,806, and 56,417 kilograms of firewood on private lands per year, respectively.

Table 3-5. Firewood Production on Private Lands by Farm-Size Groups.

Group	Annual Increment (kg/year)	Deadwood (kg/year)	Total Wood (kg/year)
Small	8,397	7,578	15,975
Medium	34,588	31,219	65,806
Large	29,663	26,754	56,417
Total	72,648	65,551	138,198

C. Firewood Collecting Patterns

Firewood is classified in this study according to the three categories designated by Bajracharya (1980): freshly cut wood (kacho daura), dead branches and twigs (dar-sukay daura); and crop residues, old fencing, etc. (jhikra). These woods differ in weight per unit volume because of differences in density, form, amount of air space, and moisture content. The distinctions are useful because collecting the different materials has different effects on the forests and because the kind of wood that can be collected from a forest depends on who "owns" the forest.

In terms of what effect collecting the different types of wood has on the forest, cutting kacho daura results in deforestation if the amount of wood cut exceeds the incremental growth of the forest. Collecting

dar-sukay daura clears the forests of dead wood ing the amount of organic material returned to the and, if extensive amounts of green branches are cut, stunting forest growth. Collecting jhikra removes valuable organic litter from both the forest floor and crop lands.

In terms of what types of firewood can be collected where, only the owner or those with permission can cut trees for kacho daura on private lands, but dar-sukay daura is collected on these lands freely by all villagers. In the sal forest, trees cannot be cut without the permission of the forest department, but villagers collect dar-sukay daura. In communal forests, villagers cut both kacho and dar-sukay daura. Removing organic materials from the forest floor by collecting dar-sukay daura and jhikra has an important cumulative effect on soil fertility and could effect tree growth rates in the future and current soil erosion rates.

Kacho daura is collected on private lands from February through April. This is a good period for cutting firewood, since it corresponds with a lull in agricultural activity, and farmers have time for non-agricultural chores. The hot weather of March and April is also useful for drying freshly cut wood. During this time trees are cut, chopped into burnable size logs, dried in the sun,

carried to the house, and stacked under a roof. is burned during the rainy months, mid-June through September.

Dar-sukay daura is collected on private and public lands all year long. From February through April, the amount of dar-sukay daura collected is only a small fraction of the total firewood being collected. From May through January, however, almost all firewood collected is dar-sukay daura from public lands. This wood is burned almost as quickly as it is gathered.

Villagers consider Schima wallichii and Castanopsis indica to be the best firewood species. Sal is also considered to be a good firewood species but it is seldom cut for fuel.[1] Other trees cut regularly for firewood include: Budhairo (Lagerstromia parviflora), Kaaphal (Myrica esculente), and Katyo (Grevillea robusta). Fraxinus floribunda (laakurii), Ficus bengalensis (bar),

---

[1]The reason for this is not clear but appears to be due to several factors. First, sal is valued for its lumber and villagers are somewhat reluctant to use it for fuel. Second, sal is a very hard wood, difficult to chop into useful size logs. Third, the sal forests are located at a greater distance from most farms than Schima-Castanopsis forests and consequently farmers have to walk further to collect sal. Finally the Nepali government has banned farmers from cutting sal trees since the 19th century (Regmi, personal communication). While the government has not been able to enforce this ban often, it may have enforced it sufficiently that the firewood cutting habits of Bhogteni's farmers have been effected.

and Ficus religiosa (pipal) are not cut for fuel because they are considered sacred. Villages are also reluctant to cut fruit trees such as mango (Mangifera indica), and walnut (Junglans regia) for fuel.

In the Daily Recall Survey sample households were asked weekly for a year how much wood they collected that week and where the wood was cut. Large farmers reported collecting 96% of their firewood on their own land. A majority of this wood is collected in March, with a little wood collected in September. Minimal firewood is collected during the rest of the year. Medium-size farmers reported collecting 81% of their firewood on their own land. Like large farmers, they collected most of their wood in March, with some wood collected in September. Among medium-size farmers, however, the wood collected in the fall is mainly from public lands. Small farmers reported collecting 54% of their firewood on private lands. Most of this wood is collected between December and April. The remaining wood supplies of small farmers (46%) are collected on a daily basis from public lands. Figs. 3-2, 3-3, and 3-4 illustrate firewood collection patterns on small, medium, and lar,ge farms throughout a year.

When results from the daily recall survey are calculated for the whole village, 72% of its firewood supply is

found to come from private lands, and only 28% from public lands. Of the firewood cut on public lands, small, medium, and large farmers collect 67%, 31%, and 2%, respectively.

Firewood collecting patterns were not only documented by the survey, but also observed closely during the course of this study. Observations support the conclusion that a large majority of the village's firewood comes from privately owned trees. In addition, since forest officials have expressed little interest in Bhogteni's public forests, there was little or no incentive for villagers to underestimate the amount of firewood collected from public lands. Nevertheless, it is possible that some farmers, particularly small farmers, reported firewood supplies as coming from private lands that in reality came from public lands.

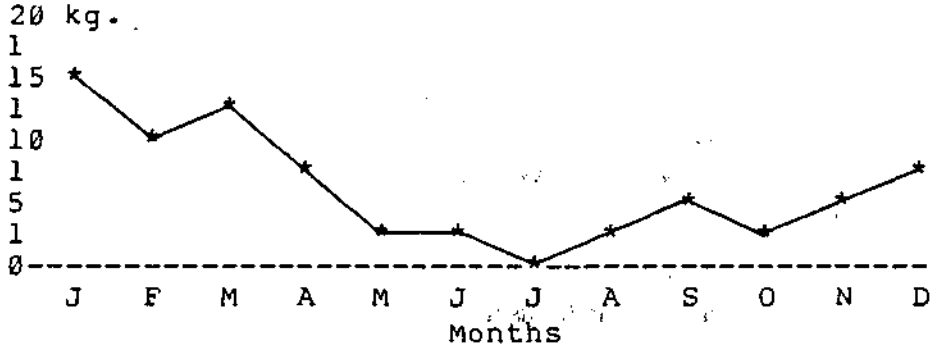


Fig. 3-2. Small Farmer Firewood Collecting Patterns (kg/individual/week) by month

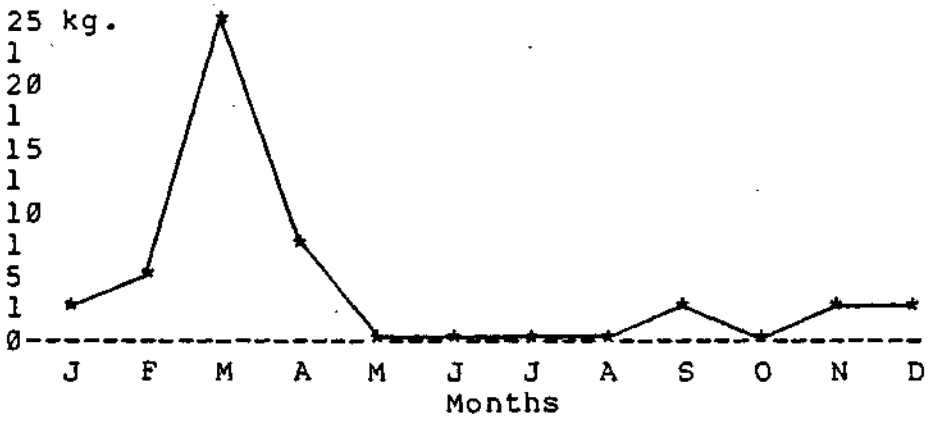


Fig. 3-3. Medium-Size Farmer Firewood Collecting Patterns (kg/individual/week) by month

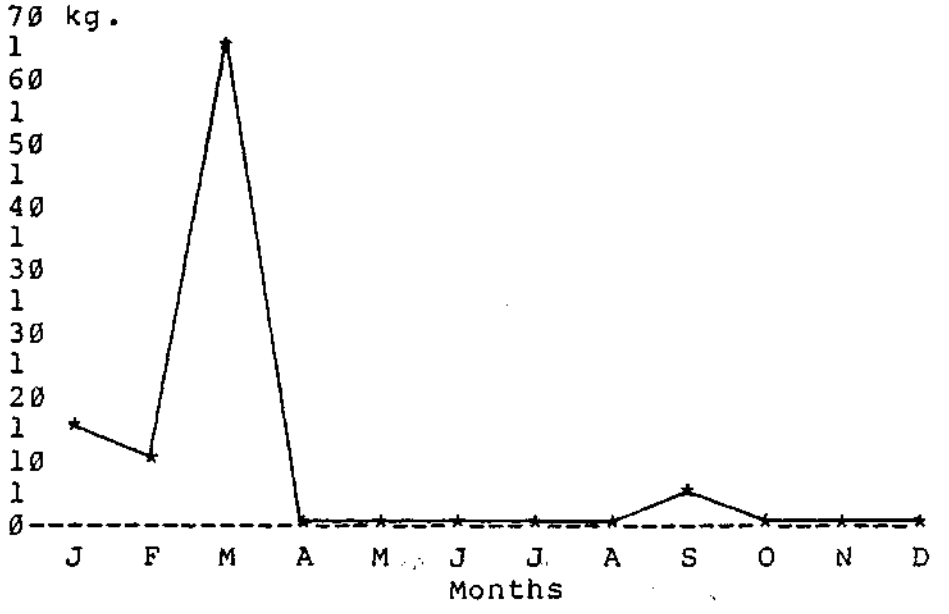


Fig. 3-4. Large Farmer Firewood Collecting Patterns (kg/individual/week) by month

D. Firewood Collecting Labor Patterns

Since it may be difficult to implement land management plans that require drastic increases in the amount of labor needed to collect firewood, or require labor inputs that conflict with other household or agricultural chores, or require changes in the distribution of labor among household members, it is important to understand current firewood collecting labor patterns. This includes knowledge of seasonal variations in labor patterns, the total amount of labor required, and sex and age groups associated with firewood collecting.

In Bhogteni, a village with scarce firewood supplies, an average household spends 32 minutes per day collecting firewood, an equivalent of 7 minutes per day per individual. Adult women spend the most time, 13 minutes per day; adolescent girls spend 6 minutes per day; and adult men and adolescent boys spend only 5 minutes per day.

The findings of this study contrast drastically with reports by Eckholm (1976), Abell (1981), C.E.D.A. (1975) and others, that firewood collecting requires 15 to 40 hours per week per household. These reports are based on subjective judgements or on recall surveys in which participants (without watches) were asked to estimate the amount of time they spend collecting firewood per day. While it cannot be doubted that firewood labor require-

ments vary across the country, unduly dire reports have to be considered suspect until documented in a more scientific mannner. The findings of this study agree well with Bennett's (1981) findings in Bakundol, a similiar medium-hills Brahmin-Chhetri village. Bennett, using the same TAS methodology as in this study, found that adult women spend .18 hours (11 minutes) and adult men .06 hours (4 minutes) per day collecting firewood.

The average time spent collecting firewood per day per individual is shown in Table 3-6. This table is broken down by source (private and public land), farm size (large, medium, and small), age, and sex groups.

Women contribute to firewood collecting by doing the time-consuming job of foraging for dar-sukay daura, and consequently spend 8 minutes per day on public lands and minutes per day on private lands. The contribution of men to firewood collecting is largely limited to the physical labor of cutting trees, chopping wood, and carrying bundles of k5cho daura from the field where it is cut to the homestead. The time men invest in firewood collecting is spent mainly on private lands, 3.5 minutes, as opposed to 1.5 minutes per day on public lands. Women, 15 years and older, contribute 63% of the total time invested in

Table 3-6. Firewood Collection Labor Patterns--Exclusive of Hired Labor (minutes/day/individual)

Group Sex, Age & Farm Size	Private Forest	Public Forest	Total
Boys (5-9)			
Small	1.0	1.0	1.0
Medium	0.0	0.0	0.0
Large	0.0	0.0	0.0
Girls (5-9)			
Small	0.0	0.0	0.0
Medium	0.0	0.0	0.0
Large	0.0	0.0	0.0
Boys (10-14)			
Small	2.5	3.4	5.9
Medium	5.1	0.0	5.1
Large	0.0	0.0	0.0
Girls (10-14)			
Small	4.4	8.9	13.3
Medium	0.0	0.0	0.0
Large	5.9	0.0	5.9
Men (>15)			
Small	3.4	2.9	6.1
Medium	4.7	0.3	5.0
Large	0.0	0.0	0.0
Women (>15)			
Small	7.2	10.7	17.9
Medium	4.5	6.4	10.9
Large	1.5	3.0	4.5
All Classes			
Small	4.3	5.5	9.8
Medium	3.4	2.5	5.9
Large	0.8	1.0	1.8
Total	3.4	3.5	6.9

collecting firewood. If young girls, 5 to 14 years are included, women account for 70% of the firewood collecting time. Firewood collecting is clearly a chore performed by adult women.

When firewood collection times are summed for individuals on small, medium, and large size farms, an average farm family is found to spend 38, 30 and 10 minutes per day collecting wood, respectively. The difference between small and medium-size farms is not significant (Pr > .1). The differences between small and large, and medium-size and large farms, however, are significant (Pr < .05), These differences are due to two factors. First, large farms hire labor to collect firewood. family members, therefore, spend less time per day collecting wood. Second, collecting wood on public lands is considerably less efficient than collecting it on private lands. On public lands farmers have to forage to find small twigs, branches, etc. On private lands firewood is collected by cutting trees or chopping up large branches. While the average time spent per day collecting wood on private lands is equal to the time spent on public lands, 3 times as much wood is collected on private lands as on public lands. m other words, collecting wood on private lands is 3 times more efficient than collecting it on public lands. Large farmers, who collect most of their wood on

private lands, need to spend less time collecting wood than other farmers. Small farmers, who collect the most wood on public lands, have to invest the most labor in firewood collecting.

Figs. 3-5, 3-6, and 3-7 illustrate the average time spent per day per individual collecting firewood by members of small, medium, and large farms, respectively. Small farmers spend about 15 minutes per day collecting firewood from February through April. About 4 minutes per day are spent collecting wood throughout the rest of the year, with the exception of September. For one week in September an average small farmer spends 38 minutes per day (4.4 hours per week) collecting dar-sukay daura. This labor is needed to replace wood burned during the monsoon and to prepare for Desain and Bhai Tika festivals. Large farmers, on the other hand, spend an average of 4 minutes per day from February through June collecting wood; they do not spend any time collecting wood from July through December.

Almost all firewood is collected within a short walking distance of the village. The longest trip recorded is 2 hours.

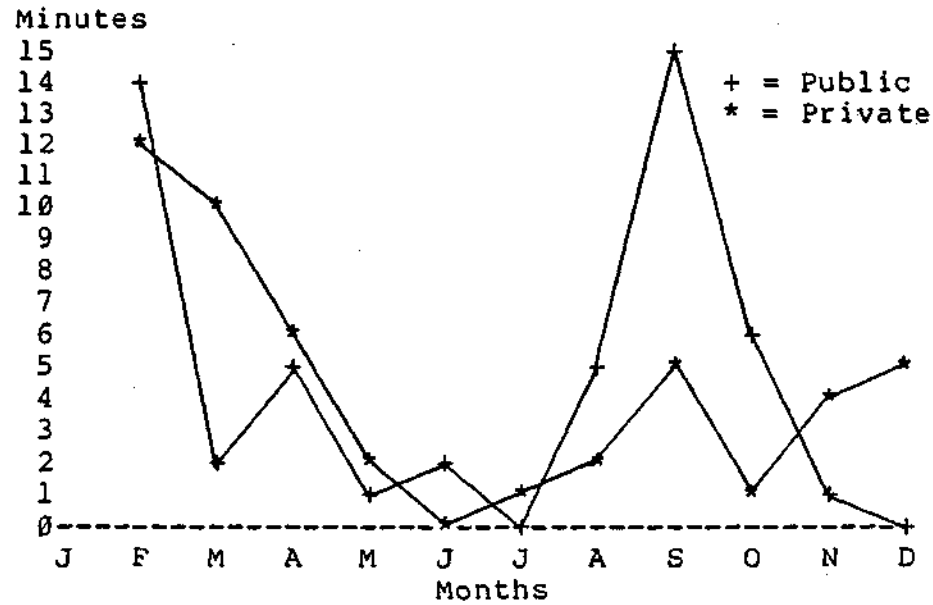


Fig. 3-5. Small Farmer Firewood Collecting Labor Patterns (average minutes/day/individual) by month

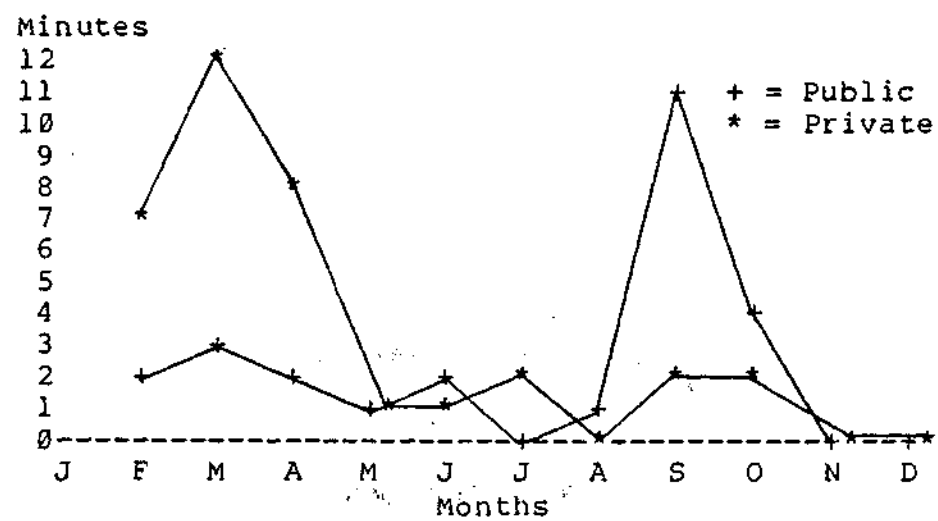


Fig. 3-6. Medium-Size Farm Firewood Collecting Labor Patterns (average minutes/day/individual) by month

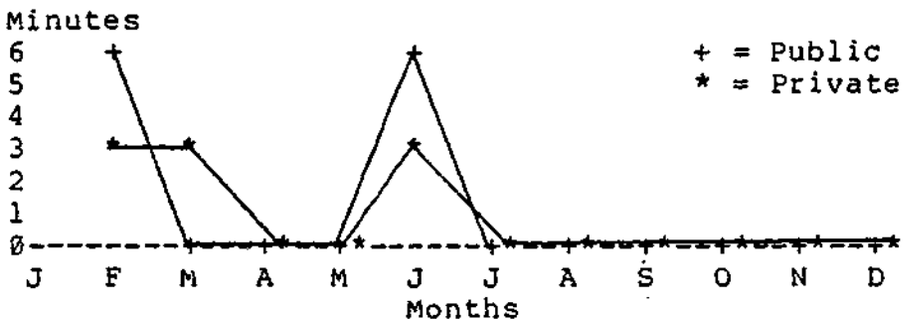


Fig. 3-7. Large Farmer Firewood Collecting Labor Patterns (average minutes/day/individual) by month

E. Firewood Demand and Consumption Patterns

Firewood is used mainly for cooking meals (bhat) and snacks (khaja) ; for preparing a mash of water, flour, and bran (kodo) for working oxen and lactating animals; for distilling alcohol (jaad and raksi) ; for space heating; for making charcoal for the blacksmiths' metal forges; and for doing laundry. It is difficult to assess the amount of wood used in each of these tasks, because many of them take place on the same fire. For example, in the late afternoon a fire is often lit for making khaja and kodo, and for providing heat.

In Bhogteni, all households were asked how much wood they burn for specific purposes. While more fuel is undoubtedly used for cooking food than for any other pur-

pose, major differences in amounts used by different groups were not anticipated, and hence, amounts used for cooking were not determined. Of the remaining uses, responses indicated that 81% of the fuel burned is for kado, 9% is for charcoal, 9% is for alcohol (because distilling alcohol is illegal, respondents probably underestimated the amount of firewood burned for this purpose), and 1% is for laundry.

1. Firewood Consumption Rates

The firewood consumption rate is the amount of wood burned per individual per year. If farmers burn as much wood as they like, the firewood consumption rate is equal to firewood demand. In Bhogteni, firewood consumption rates were measured by the Daily Recall Survey and by the Weight Survey. The Weight Survey was considered the more accurate estimate (Fox, n.d.), and its results are used for determining the average firewood consumption rate and for discussing most variables that affect firewood consumption.

Mean monthly firewood consumption rates (kg/capita/day) for the four months firewood was weighed were: 1.75 (August), 1.49 (September), 1.75 (October), and 0.96 (November). Based on these results, 1.57 kg/capita/day, or .81 m3/capita/year, is the mean figure for firewood consumption, and 1.75 kg/capita/day, or .91

m3/capita/year, is the maximum figure for firewood consumption, in the village. (Volume figures are based on the assumption that 1 m3 of wood at 25% moisture capacity (dry weight) weighs 700 kilograms.) The mean and maximum firewood consumption values are equivalent to 573 and 633 kilograms per year. These values have standard deviations of 355 and 444 kilograms.

These firewood consumption rates are slightly lower, but close to, the rate reported by Donovan (1981), who, after reviewing available literature on the question stated, that firewood consumption data cluster around 1 m3 per capita per year. The lower figure in this study is due primarily to the fact that Donovan used a specific gravity of 600 kilograms per cubic meter.

Donovan, however, also suggests that the 1 m3 figure is probably too low and indicates that 1.4 m3 per individual more accurately reflects actual consumption. She supports this higher estimate by reports of Bajracharya (1980), Kawakita (1979), and Levenson (1979), all of whom report after prolonged residence in a specific study area, firewood consumption rates in excess of 1 m3 per person. The higher firewood consumption in the cited studies than in the present study might be attributable to greater availability of firewood and lower population densities in the areas studied. The region studied by Levenson had

access to 880 hectares of forest land with a mean annual growth increment of 12.5 m3 per hectare, while Bajracharya's study panchayat had access to 328 hectares of forest and 96 hectares of woodland, providing an annual growth increment of 4.8 m3 per hectare. These forest resources may be contrasted with the 73 hectares of scrub land and 39 hectares of degraded forest with a mean annual growth increment of 1.85 m3 per hectare per year in Bhogteni. Moreover, Bhogteni has a much higher population density than either of the other study sites, 318 persons per square kilometer compared to 223 reported by Bajracharya and 101 by Levenson. These figures suggest that firewood is a much scarcer commodity in Bhogteni than in the other villages studied. Thus, it is not unreasonable to conclude that due to the greater availability of firewood from public lands and the lower population densities, firewood consumption was actually greater in the Bajracharya and Levenson studies than in the present study.

2. Factors Affecting Firewood Consumption Rates

Firewood consumption rates were studied in relation to family size, caste, and farm size. Since these factors appeared to be interrelated, correlation coefficients were calculated to determine the degree of the relationship. Caste and farm size were correlated (0.60), and farm size

and family size, to a lesser extent (0.45). This suggests that Brahmin-Chhetri households have larger farms than do untouchable households, and households of large farms have more family members than do households of small farms. Nevertheless, the correlations were low enough to warrant investigation of the independent effects of these factors.

a. Family Size

Butkas (Earl, 1975) notes that per capita firewood consumption was less in Tharu households (a caste indigenous to the terai) than in other caste households. He hypothesizes that this was because Tharu families are usually larger than those of other castes. If economies of scale exist in relation to firewood consumption, family size will influence per capita firewood consumption rates. In this study, it was hypothesized that large families (9-20 members) burn less wood per capita than do medium-size families (5-8 members) or small families (1-4 members).

Small, medium, and large families were found to burn 2.44, 1.4, and .93 kilograms per capita per day respectively. These values are significantly different from each other ($Pr < .001$). Large families burned significantly less wood per capita than did medium or small size families. Medium-size families burned significantly less wood per capita than did small families.

b. Caste

Firewood consumption was studied in relation to caste, since caste affects type of food eaten, method of food preparation, type of stove used, whether or not alcohol is distilled, number of animals for whom food is prepared, and number of holidays celebrated, all factors that affect energy needs.

Table 3-7 presents the previously mentioned estimates of the amount of firewood consumed for different purposes according to caste- Kudo preparation accounts for the major portion of fuel wood demand in all 3 caste groups. Newar households require 2.89 kg/capita/day of firewood for making kudo, compared to 2.30 in Brahmin-Chhetri and 1.41 in untouchable households. These findings are consistent with the livestock holdings of the caste groups: 3.5 to 4.5 livestock units[2] for Brahmin-Chhetri and Newar households, and only 1.5 to 2 livestock units for untouchable households. Charcoal production necessitates fuel use only in the untouchable group, since charcoal is made only by blacksmiths. Newars and untouchables both report needing approximately 0.35 kg/capita/day of fuel for alcohol production, while Brahmin-Chhetris use no fuel for this purpose. Total fuel use is approximately 1

---

[2]A buffalo = 1 Livestock Unit (L.S.U.)/ a cow or ox = .7 L.S.U., a sheep or goat = .1 L.S.U.

kg/capita/day higher for Newars than for either of the other caste groups, due to the greater use of fuel for kudo by this group and their use of fuel for alcohol production .

Table 3-7. Average Firewood Demand by Caste and Task. (census survey--whole village)

Task	Brahmin-Chhetri	Newar	Untouchables
	(kg/capita/day)		
Alcohol	0.00	0.38	0.35
Kudo	2.30	2.89	1.41
Laundry	0.05	0.05	0.03
Charcoal	0.00	0.00	0.69
Total	2.35	3.32	2.48

This hypothesis was tested by analyzing the weight survey results according to caste. Weighed firewood measurements for the three caste indicated that Newars, Brahmin-Chhetris, and untouchables burn 2.4, 1.4, and 1.4 kg per capita per day, respectively. Newars burned significantly more wood ($Pr < 0.05$) than did either Brahmin-Chhetris or untouchables. No differences in firewood consumption was found between Brahmin-Chhetris and untouchables.

c. Farm Size

Cecelski (1979) suggests that farm size (income) will not affect firewood consumption, because the demand for fuel at subsistence levels is inelastic. This hypothesis

seems doubtful in the environmentally stressed hills of Nepal. As has been seen, large farmers collect most of their firewood on private lands. Small farmers, on the other hand, collect 44% of their firewood on public lands. Because of differences in availability and ease of collecting wood on private lands, it is hypothesized that large farmers burn more firewood per capita than do medium or small size farmers.

By the Weight Method small, medium, and large farmers are found to burn 1.66, 1.46, and 1.56 kilograms per capita per day, respectively. These values are not significantly different from each other (Pr > .35). Contrary to the hypothesis, differences in firewood consumption rates between farm size groups are not significant. Small farmers collect 11 times more wood from public lands than do large farmers, and spend 4 times more labor collecting wood. In spite of the extra labor required to collect firewood on public lands, small farmers burn as much wood per capita as do large farmers. The demand for firewood is inelastic. Per capita firewood requirements remain the same regardless of the availability of firewood.

Per capita firewood consumption rates, however, do not tell the whole story. Farm size and family size have a correlation coefficient of .45. Small, medium and large farmers have average family sizes of 4.7, 6.7, and 7.8

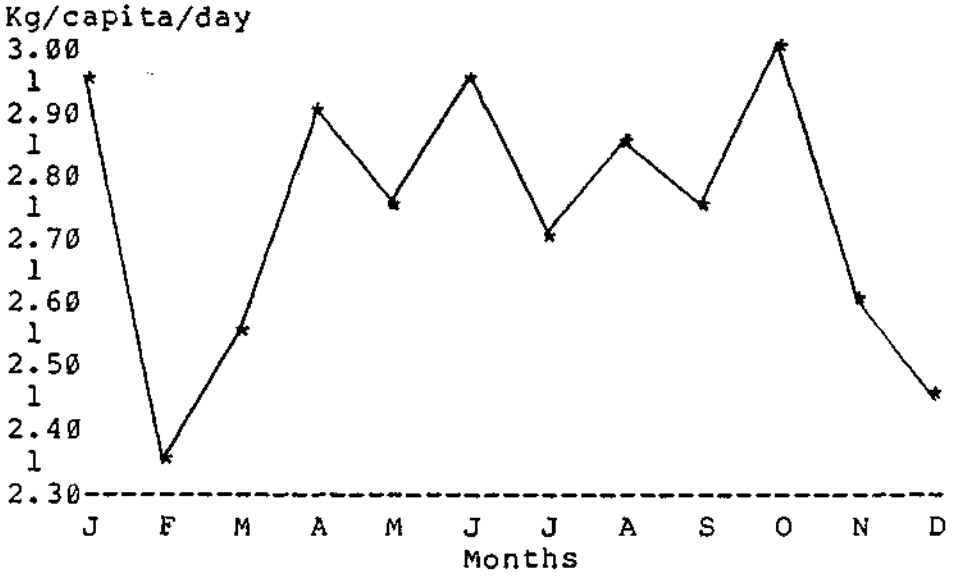
individuals, respectively. These differences are significant (Pr < .1). Furthermore, economies of scale exist with regard to firewood consumption. Large families need to consume less firewood per capita than do small families to meet the same energy needs. Therefore, even though no difference exists in per capita firewood consumption, large farmers have more energy for meeting household needs than do small farmers, simply because they have larger families.

d. Season

Firewood consumption data were also evaluated according to season of the year, since weather fluctuations and holidays occurring at various times of the year were expected to influence fuel consumption. Data used for this purpose were obtained with the Daily Recall Survey, since this was the only method that was used throughout the year. Firewood consumption estimates (kg/capita/day) for each month are presented in Fig. 3-8. While it is recognized that amounts of firewood estimated in this manner exceed actual use, there is no reason to suspect seasonal bias in these data; hence, they would appear to offer a valid basis for seasonal comparison.

The data indicated that firewood consumption was high in January, low during February and March, rose to a fairly high but unstable level from April through September, peaked in October, and dropped again in November and December.

Fig. 3-8. Firewood Consumption Per Month (Daily Recall Survey)



The high firewood consumption in January and October finds ready explanation in lower temperatures and in holiday celebrations, respectively. In 1981, January temperatures averaged 3.4 and 3.6 degrees centigrade lower than December and February temperatures. October was the month of the two major Nepali festivals, Desain and Bhai Tika. Desain requires extra firewood for animal sacrifices, and both festivals involve the entertaining of guests. Large amounts of corn cob and stalk residues were burned after

the harvest in November and December. This accounted for low firewood consumption during these months.

Fluctuations in firewood consumption during the spring and summer months are more difficult to explain. Since moisture content of the wood most likely affects the amount that is burned, the relationship between amounts of weekly rainfall and amounts of firewood consumed was examined. A plot of these figures indicated that high rainfall was indeed associated with high firewood consumption.

A chi square test was used to compare expected and actual firewood consumption data in periods of below average and above average rainfall. A chi square value of 3.57 was significant at the .062 level, suggesting that only 6.2% of the time would differences of this magnitude have occurred by chance. When data from January and October, months when wood consumption was high but not related to rainfall, were deleted, the chi square value was 6.0 ($Pr < 0.015$).

Results of the Daily Recall Survey indicated that on the average, 2.91 kg/capita/day of wood was burned during wet weeks and 2.51 kg/capita/day during dry Weeks. A crude measurement[3] of the moisture content of firewood

---

[3]Twigs, 5 to 8 cm. long and .75 to 1 cm. in diameter, were weighed and then dried in a dekchi oven placed over a slow burning kerosene stove. The twigs were weighed every hour until their weight remained constant for 3 readings.

during 4 weeks of high rainfall produced values ranging from 21% to 63% dry weight, with an average of 32%. During the dry season wood is assumed to have a moisture content of approximately 20% dry weight. The National Academy of Science (1980) estimates that drying wood to a moisture content of 20% to 25%, reduces the amount of wood needed for a given heating requirement by 20% or more. This suggests that the high firewood consumption rates recorded during the wet season were due to farmers burning more wood in order to achieve a constant energy level, and further, that measures to protect firewood from moisture during rainy seasons would reduce firewood consumption.

This study of factors hypothesized to increase variance in firewood consumption rates provides a better understanding of why different households use different amounts of wood. These results may have some implications for forest management. For example, in distributing firewood from public lands, special attention may have to be given to small farmers. On a per capita basis, their households need as much wood as do those of large farmers; yet the small farmer has fewer private trees from which to

collect wood, and less labor for collecting wood on public lands.

F. Village Firewood Requirements

Data from previous sections suggest that the 620 residents of Bhogteni burn about 352,000 kilograms of firewood per year. Seventy-two percent of this wood, 253,500 kilograms, comes from private lands and 28%, 98,500 kilograms, from public lands. Small, medium, and large farm groups account for 145,234, 153,528, and 53,395 kilograms of firewood consumption per year, respectively. The amount of firewood burned by farm size groups is shown in Table 3-8.

Table 3-8. Annual Firewood Demand by Farm-Size Groups (kg/year)

Group	# of households	# ind./household	kg/ind/day	Firewood consumption kg/year
Small	51	4.7	1.66	145,234
Medium	43	6.7	1.46	153,528
Large	12	7.8	1.56	53,295
Total	106	5.9	1.57	352,057

G. Firewood Supplies versus Firewood Demands

Table 3-4 shows that 371,264 kilograms of firewood are available annually in Bhogteni's forests. If all this

wood were cut, it would meet the village's firewood requirement of 352,000 kilograms per year. However, a portion of this wood is in the sal forest, where villagers have traditionally not cut trees for wood (although they have collected dead wood and tree fodder, and have grazed livestock there) and where cutting is now prohibited by the Resource Conservation and Utilization Project. Since this wood cannot be cut it must be subtracted from the supply of wood available in Bhogteni forests. This leaves 253,000 kilograms of wood per year, or only 72% of the village's firewood requirement.

In spite of the fact that available fuel wood supplies do not meet firewood requirements, firewood collecting on public lands does not presently exceed annual incremental growth. The supply from public lands is 116,197 kilograms, and the demand is only 98,500 kilograms per year. This is slight comfort in view of the fact that communal forests have already been rendered waste.

The situation is more complex on private lands. Firewood supplies on private lands are estimated in Table 3-5 by farm size groups. Large farmers collect 96% of their firewood (51,164' kilograms per year) on their own land. This amount can easily be met by their supplies (56,417 kilograms per year*) . Medium-size farmers collect 81% of their firewood (124,300 kilograms per year) on

their own land: this is about twice the rate of wood growth on these lands. If medium-size farmers collected as much wood as they claimed, they reduced the volume of wood on their lands by 6% in the year of this study. At this rate, medium-size farmers' private firewood supplies will be exhausted in 15-20 years, or faster if continued cutting reduces the annual growth rate.

Similarly, small farmers collect 46% of their firewood (145,234 kilograms per year) on private land—about 5 times the rate of wood growth there. If small farmers reported accurately and if they collected this wood on their own land, they reduced the volume of wood on their lands by 25% in the year of this study—a rate that will exhaust their private firewood supplies in just a few years.

H. Conclusions

The major conclusions made in this chapter are as fo11ows:

I. Firewood Resources

A. The average mean annual increment in the village's forests is 1.85 m3 per hectare per year.

B. The total supply of fuel wood in the village is 371,263 kilograms per year, but only 253,406 kilograms are available to be burned. Of this wood, 46% comes from public forests, and 54% from private woodlots.

II. Collecting Patterns

A. The village collects 28% of its firewood on public lands.

1. Small farmers collect 67% of the wood collected from public lands. Firewood from public lands makes up at least 46% of their total firewood supply.

2. Medium size farmers collect 31% of the wood collected from public lands. Firewood from public lands makes up 19% of their total firewood supply.

3. Large farmers collect only 2% of the wood collected from public lands. Firewood from public lands make up 4% of their total firewood supply.

III. Labor Patterns

A. An average household spends 32 minutes per day collecting firewood. This is equivalent to 7 minutes per day per individual .

1. An average adult woman spends 13 minutes per day collecting firewood. This is mostly spent collecting dar-sukay daura. Women account for 70% of the time spent in the village on firewood collecting chores.

2. An average adult man spends 5 minutes per day collecting firewood, primarily kacho daura.

3. Collecting firewood on public lands is much less efficient (hours/kilogram) than on private lands.

4. Small and -medium-size farmers spend significantly more time collecting firewood than do large farmers.

IV. Firewood Consumption Patterns and Firewood Requirements

A. An average individual burns .9 m3 per year of firewood.

1. Economies of scale exist in relation to firewood consumption rates. The larger the family size, the less firewood consumed per capita.

2. Newar caste group members burn more firewood per capita than do other caste group members. This is hypothesized to stem from the Newars' use of large amounts of firewood preparing kūdo and from their alcohol distillation activities.

3. Farm size does not affect per capita firewood consumption levels. However, because of differences in family sizes and because of economies of scale, large farms have more energy for meeting household needs than do small farms.

4. Seasonal variations in firewood consumption exist. These are attributed to differences in temperature, festival observance, and rainfall.

B. The total village firewood requirement per year is 352,000 kilograms. Of this, 253,500 kilograms comes from private land, and 98,500 from public lands.

V. Firewood Supplies vs. Firewood Demands

A. Available firewood supplies are being burned faster then they are grown.

1. The amount of wood collected on public lands appears to be sustainable. This situation could change if farmers increase their cutting or if the forest's productivity falls because of low soil fertility, soil erosion, etc. Many public lands have already been reduced to scrub lands.

2. Small and medium size farmers are burning their private wood supplies at rates considerably faster than they are regenerating.

In summary, the annual amount of wood cut on public lands does not exceed incremental growth. On private lands, more wood is cut per year than is grown. This problem is most serious among small farmers, but it also affects medium-size farmers. Large farmers have sufficient firewood supplies on their own lands. While the firewood supplies of medium-size farmers are sufficient to meet their needs for the 10-15 years needed to establish a successful reforestation program, small farmers' firewood needs will have to be met from public lands within a few years. The implications of these conclusions for management plans are discussed in Chapter 7.

CHAPTER IV

FODDER AND GRAZING

A. Introduction

Livestock are an integral part of the hill farming system. Their manure is the only source of fertilizer for most croplands. Their milk and meat products are a vital source of protein and nutrients for farm families and can also be sold in local markets for cash income. Oxen provide draft power for plowing and harrowing fields, and for threshing crops. Cows, male goats, male buffaloes, and chickens are required for many religious ceremonies. Finally, since livestock can be sold for cash in times of disaster, they provide some security against crop failures and other unexpected events.

Livestock feed consists of agricultural residues, fodder, and grazing. The World Bank (1978a) estimates that three-quarters of all livestock feed comes from the forest. In order to design forest management plans that are sensitive to village needs for fodder and grazing, information is needed on how public lands are currently used for these purposes.

The major objective of this chapter is to describe the relationship between public lands and livestock feed.

To do so, it is necessary to consider livestock feed requirements (demand) and fodder and grassland resources (supply). More specifically, this chapter describes Bhogteni's 1) livestock—kind and number; 2) livestock feed demands—actual and optimal; 3) tree and grass fodder collecting patterns; 4) grazing patterns; 5) fodder collecting and grazing labor requirements; and 6) balance of fodder and grassland supplies versus demands.

B. Livestock—Kind and Number

The first item to consider on the demand side of a feed balance sheet is the number of livestock. The World Bank (1978a) estimates that a typical hill family owns 4.4 head of buffalo and cattle. The Resource Conservation and Utilization Project (APROSC, 1979) reports that in the Daraundi watershed, a hill family owns 1.6 head of buffalo and 3.7 head of cattle. In Bhogteni (part of the Daraundi watershed) an average family owns 1.3 buffalo and 2.0 head of cattle. Table 4-1 shows the average number of livestock owned per household in the watershed and the number owned in Bhogteni.

Farmers in Bhogteni own fewer buffalo, cattle, and chickens, more pigs, and about the same number of goats as do their counterparts in the watershed. Altogether there are 138 buffalo, 223 cattle, and 297 goats in the village. This is equivalent to 489 livestock units.

Table 4-1. Average Number of Livestock Owned per Household in the Watershed and in Bhogteni.

Group	Buf-falo	Cow	Oxen	Goats	Pigs	Chick-ens	Total
Water-shed	1.6	2.1	1.6	2.6	.1	2.7	10.7
Bhogteni	1.3	1.3	.8	2.8	.3	5.0	11.5

Table 4-2 shows the average number of animals owned per household by different farm size groups in Bhogteni.

Table 4-2. Number of Animals Owned per Household by Farm Size Group

Group	Buf-falo	Cow	Oxen	Goats	Pigs	Chick-ens	Total
Small	.5	1.1	1.0	1.7	0.6	5.0	9.9
Medium	1.8	1.7	0.4	3.7	0.0	4.0	11.6
Large	2.5	0.8	1.0	4.3	0.0	7.3	15.9

Small, medium, and large farmers own 2.6, 3.9, and 4.3 head of cattle and buffalo, respectively. Small farmers own significantly fewer ($Pr < .05$) buffalo than do medium-size and large farmers; this is because buffalo are expensive to buy and keep. In 1981, the average price of a milch buffalo was 1800 rupees; a milch cow was 800

rupees, and an ox was 700 rupees. Buffalo also require about twice as much feed as cattle (Lumle/ 1975).

On the other hand, an average small farmer owns more oxen than does a medium-size farmer (Pr < .11). This is because oxen are valued by small farmers as a source of cash income. As a plowman, a farmer can earn 8-10 rupees per day for himself and another 8-10 rupees per day rental on his oxen. Medium-size farmers reduce the expense of keeping oxen by sharing animals between households, and by renting the oxen of small farmers. Large farmers often hire plowmen to do their plowing, but prefer to own their own oxen in order to insure availability when it is time to plow their fields.

C. Livestock Feed Demands: Actual and Optimal

Livestock feed demands are discussed in terms of both optimal consumption levels and the amount of feed farmers actually give their livestock. The amount of feed consumed by stall-fed livestock is hard to estimate. In this study, farmers were asked weekly for a year how much they had fed each of their animals on the previous day. Answers were given in loads (bhari) and bundles (agalo). A large number of different types of loads and bundles were weighed to determine conversion factors for these units. The results are consistent between different farm size groups, and agree well with the limited number of

studies that have been done on livestock feeding. While an intensive effort was made to insure that farmers reported feeding levels accurately, and to check that reported levels made sense, the results undoubtedly contain error.

Livestock are fed in two ways: stall feeding and grazing. Stall feeding entails collecting grass or tree fodder or such crop residues as corn stalks and cobs, wheat, rice and millet straw, husk, etc, and feeding the animal in its stall. Grazing entails taking livestock to a field or forest and allowing them to eat stubble, grass, and leaves. Feed supplies are distributed according to the value of the animal to the household. Milking buffalo and cows receive first priority, then working oxen, and finally remaining cows and goats. As a result, buffalo are stall fed while most cattle and goats are grazed, although they receive some stall feed daily.

Figs. 4-1, 4-2, and 4-3 show the amount and type of stall feed received by an average buffalo, goat, and cow or ox per day throughout a year.

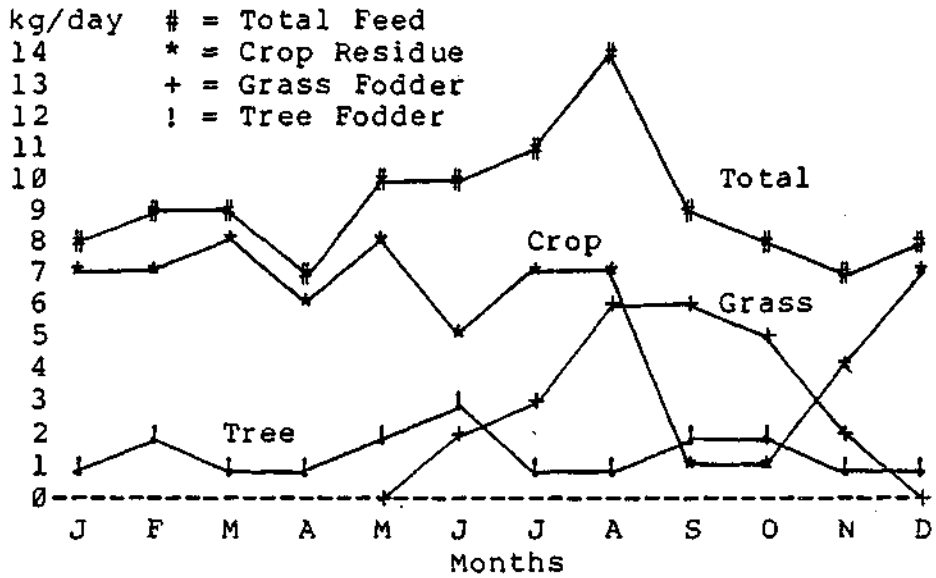


Fig. 4-1. Buffalo Feed (kg/day) by month and type of feed

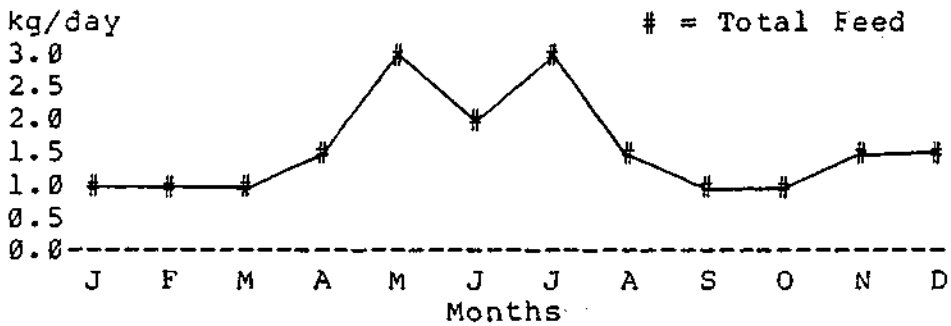


Fig. 4-2. Goat Feed (kg/day) by month and type of feed

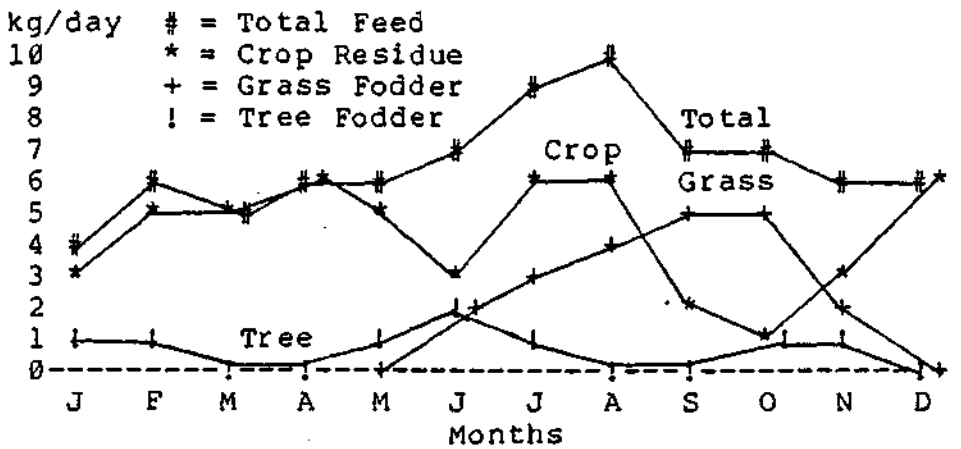


Fig. 4-3. Cattle Feed (kg/day) by month and type of feed

Buffalo are stall fed an average of 9.4 kilograms, cattle 6.8 kilograms, and goats 1.6 kilograms per day. In order to keep these figures simple, kudo supplies were not included. Buffalo, cattle, and goats receive an average of .35, .11, and .02 kilograms kudo per day, respectively. Because goats receive only a small fraction of stall feed supplies, they are not considered further in the discussion that follows.

For most of the year, crop residues are the major feed of stall-fed cattle and buffalo. Fall crops, rice and millet, are harvested in November; their residues provide livestock feed through late April or early May. Farmers who do not have enough straw can usually purchase some or earn some in exchange for labor. Winter crops, corn, millet and dry-rice, are harvested in late June and

early July. Residues from these crops are usually consumed by the end of August. Grass fodder harvesting begins in May; it peaks in August and September, and is completed by the end of November. Grass fodder is an important livestock feed from June through October. Tree fodder is collected all year long, but most heavily in April through August, and September through December. Tree fodder is an important source of livestock feed in June, September and October.

Table 4-3 shows the percent of stall feed that comes per year from crop residues, grass fodder, tree fodder, and kudo.

Table 4-3. Percent of Total Livestock Feed from Different Feed Sources.

Livestock & Feed	Small Farms %	Medium-size Farms %	Large Farms %	All Farms %
BUFFALO				
Crop Residues	40	52	64	54
Tree Fodder	14	14	13	14
Grass Fodder	43	30	18	28
Kūdo	3	4	4	4
CATTLE				
Crop Residues	52	58	65	56
Tree Fodder	12	13	5	11
Grass Fodder	35	27	26	31
kūdo	1	2	4	2

According to Table 4-3, a year's buffalo or cow feed consists of about 54%-56% crop residue, 42% tree and grass fodder, and 2%-4% kūdo. Of course, the relative amount of crop residues and fodder in the diet varies enormously by season. From November through May, crop residues make up 75% of all cattle and buffalo feed. In June, livestock feed is composed of about 40% to 50% crop residue, 25% tree fodder, and 25% to 35% grass fodder. In July and August, residues from winter crops constitute about 60% of livestock feed, the remainder being grass fodder. In September and October, livestock feed is 70% grass fodder, 15% to 20% tree fodder, and 10% to 15% crop residue. Table 4-4 shows the breakdown of livestock feed by season.

Table 4-4. Livestock Feed by Season (%)

Month	Season	Feed	Buffalo %	Cow or Ox %
November through May	Winter & dry season	1. Residue	78	80
		2. Grass	5	6
		3. Tree	13	12
		4. kūdo	4	2
June	End of dry season	1. Residue	48	37
		2. Grass	25	33
		3. Tree	25	28
		4. kūdo	2	2
July through August	Wet season	1. Residue	56	62
		2. Grass	35	34
		3. Tree	6	3
		4. kūdo	3	1
September through October	Fall	1. Residue	9	18
		2. Grass	67	68
		3. Tree	18	13
		4. kūdo	6	2

Buffalo and cattle feed supplies are most scarce from November through May. During this period, feed consumption consists of about 8.5 and 5.3 kilograms of millet and rice straw per day, respectively. In the remaining months, tree and grass fodder are available, and average feed consumption is 10.4 and 8.0 kilograms per day, respectively.

On an annual basis, buffalo and cattle receive about 3.5 and 2.5 tons of feed per head, respectively. Table 4-5 shows the total amount of crop residues and fodder fed

per year per buffalo and per cow in Bhogteni by farm size groups.

Table 4-5. Buffalo and Cattle Feeding Levels in Bhogteni (kg/head/year) by Farm Size Groups

Livestock and Farm Size	Trees & Shrubs (kg/year)	Grass & Crop Residues (kg/year)	Total (kg/year)
Buffalo			
Small	516	3,124	3,640
Medium	387	2,435	2,822
Large	639	4,257	4,896
Total	466	2,966	3,432
Cattle			
Small	334	2,392	2,726
Medium	260	1,707	1,967
Large	169	3,174	3,343
Total	284	2,199	2,483

Studies have been done at the British Gorkha agricultural farm at Lumle (Lumle Agricultural Center or LAC) that begin to document optimal feed consumption levels for Nepali buffalo and cattle. These studies (1975) report that when fed to replenishment, stall fed lactating Nepali buffalo and cattle require 17 and 9.2 tons per head per year, respectively. Since a percentage of this is waste, buffalo and cattle are reported to consume 15 and 7.8 tons per head .

In comparison with livestock at Lumle, buffalo and cattle in Bhogteni are fed .2 to .25 the suggested

replenishment level, or .23 to .32 the suggested consumption level. The data from Bhogteni are average feeding levels for all buffalo and cattle, regardless of condition or age. If only lactating animals were considered, feeding levels would be higher but would still be less than 50% of the recommended levels. Simeon (quoted by FAO/World Bank, 1979) estimates that the total digestible nutrient intake of cattle in Nepal is about 540 kilograms per head per year, or 3 tons of fodder (on the basis that 50% is supplied as fodder and 50% as crop residues). This figure compares well with results from this study. Both sets of results suggest that hill livestock are fed about 30% of LAC optimum feeding rates.

Even during the wet season, when feed supplies appear to be plentiful, buffalo and cattle in Bhogteni are on a starvation diet. Tree and grass fodder are not surplus feed on top of a steady diet of crop residues. They are, instead, essential sources of stall feed. Without tree and grass fodder in the months when crop residues are not available, i.e., June, September, and October, livestock would not survive. This study, therefore, considered how these supplies are collected. Particular attention was paid to the relationship between public lands and fodder supplies.

D. Tree and Grass Fodder Collecting Patterns

Grass fodder (ghas) is a general terra used to describe all non-woody herbaceous plants cut for fodder. It includes members of the grass and sedge families, a variety of legumes, and other broad leaf plants. Most grass fodder is cut during the rainy months, June through October, when vegetation grows most quickly. This fodder is generally collected from terrace risers, home gardens, and trail right-of-ways.

Fig. 4-4 shows average kilograms of grass fodder cut per household per day from private and public lands during the course of a year.

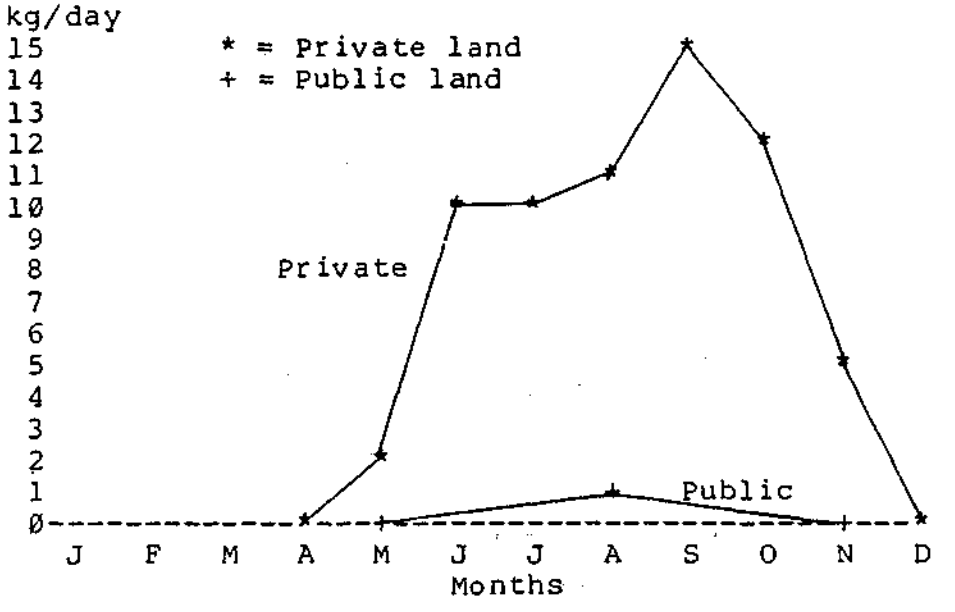


Fig. 4-4. Grass Fodder Collecting: Private and Public Lands (kg/day/household)

An average village household cuts 7.6 kilograms of grass fodder per day, of which 7.3 kilograms comes from private lands. Large farmers cut 12.5 kilograms of grass fodder per day, 99% from their own land. Medium-size farmers cut about 9.1 kilograms per day, 98% from their own land, while for small farmers the figures are about 5.1 kilograms and 94%.

The total of the grass fodder collected in Bhogteni is about 295,000 kilograms. Only 3%, or about 9,250 kilograms, of this fodder comes from public lands. Of the fodder cut on public lands, small farmers collect about 5,850 kilograms, or 63%. Even for small farmers, however, grass fodder from public lands is only 6% of the total supply. Table 4-6 shows total kilograms of grass fodder collected per year from private and public lands by different farm size groups.

Table 4-6. Total Kilograms of Grass Fodder Collected per Year by Farm-Size Group

Farm Size Group	Private kg/year	(%)	Public kg/year	(%)	Total kg/year
Small	91,525	(32)	5,842	(63)	97,367
% of group supply	(94)		(6)		
Medium	140,153	(49)	2,860	(31)	143,013
% of group supply	(98)		(2)		
Large	54,115	(19)	547	(6)	54,662
% of group supply	(99)		(1)		
Total	285,793		9,249		295,042

From Fig. 4-4 and Table 4-6, it is clear that public lands are not important to grass fodder collecting, either in terms of the amount produced or as a seasonal source of livestock feed.

Tree fodder (rook ko ghas) comes from over 20 species of trees found in Bhogteni. The most common fodder species include Bauhinia longifolia (Nep. Taki) , Litsea monopetala (Nep. Katmero) , Albizzia mollis (Nep. Rato Siris) , Bauhinia variegata (Nep. Koirala) , and Grevillea robusta (Nep. Kolyo). Many of these trees are planted by farmers for fodder production.

Privately owned fodder trees are lopped carefully so as not to interfere with next year's leaf production. Fodder trees on public lands are often ruthlessly trimmed to the trunk. Farmers like to cut large twigs and branches while cutting fodder on public lands because this provides firewood as well as fodder.

An average household in the village cuts 3 kilograms of tree fodder per day; 2.22 kilograms, or 72%, of this comes from private lands. Most tree fodder is cut on public lands from April through June and on private lands from June through December. Fig. 4-5 shows tree fodder collecting patterns through a year.

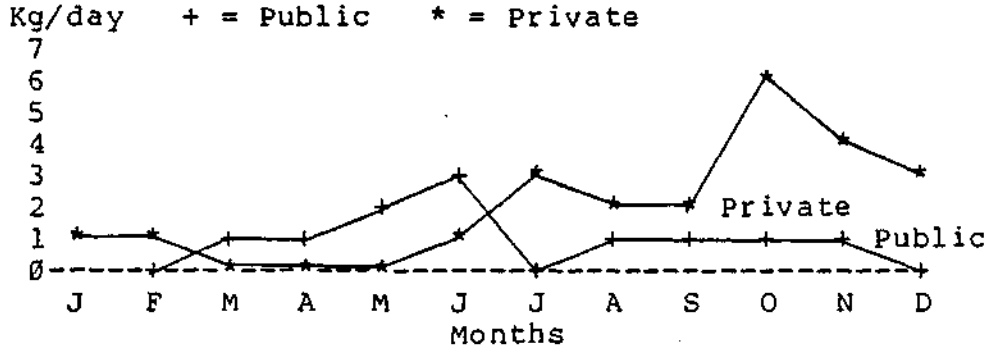


Fig. 4-5. Average Tree Fodder Collecting Patterns on Private and Public Lands (kg/day by month)

Tree fodder collecting on public lands occurs primarily at the end of the dry season (May and June). During this period, crop residues from the preceding fall have

been exhausted, and grass fodder has not yet started to grow. This is a livestock feed shortage period, during which tree fodder from public lands provides a needed feed supply until grass fodder becomes sufficient. The tree fodder collected in the fall (October and November) is from private fodder trees, and serves as a useful resource for farmers during a period when grass fodder is at the end of its growing season and crop residues are not yet available.

Figs. 4-6, 4-7, and 4-8 show kilograms of tree fodder cut on private and on public lands by small, medium, and large farmers during the course of a year.

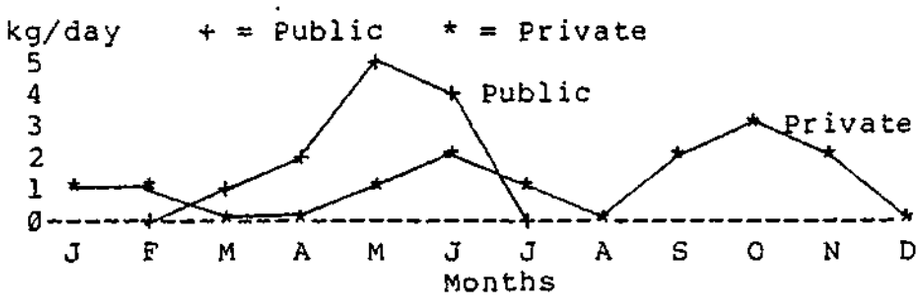


Fig. 4-6. Small Farm Tree Fodder Collecting Patterns on Private and Public Lands (kg/day by month)

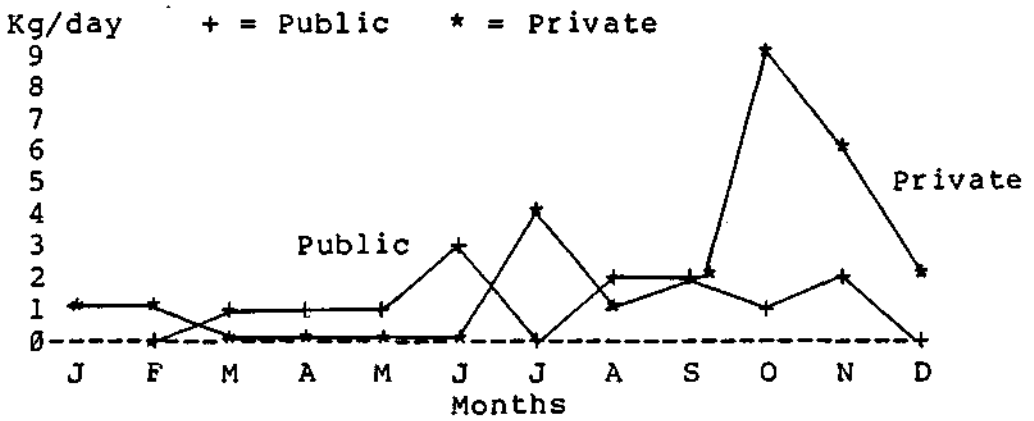


Fig. 4-7. Medium-Size Farm Tree Fodder Collecting Patterns on Private and Public Lands (kg/day by month)

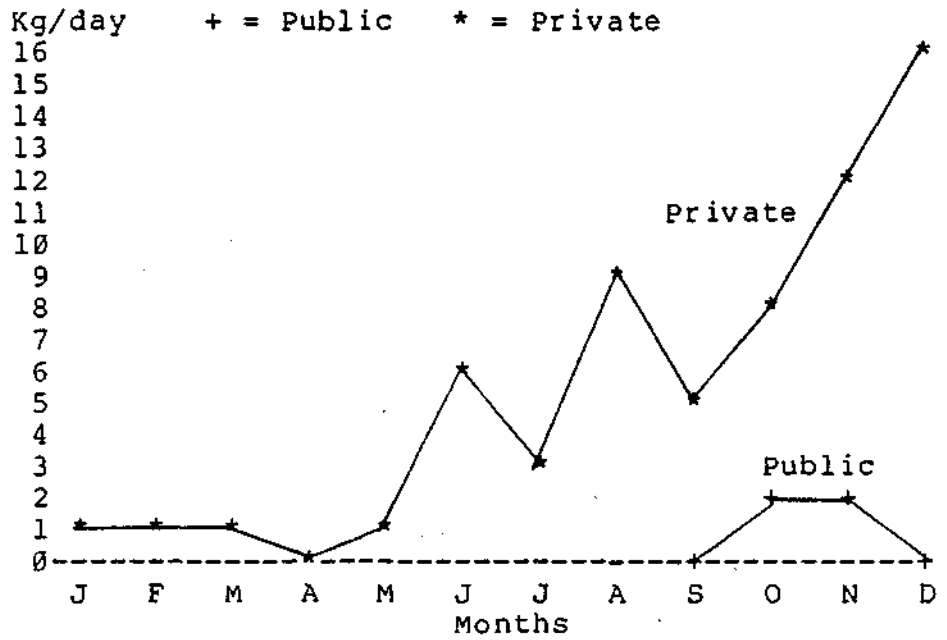


Fig. 4-8. Large Farm Tree Fodder Collecting Patterns on Private and Public Lands (kg/day by month)

The importance of tree fodder from public lands to small and medium-size farmers can be illustrated clearly by a review of the stall feeding patterns of village buffaloes. Figs. 4-9 and 4-10 show that in June, 35% of a buffalo's feed in small and medium-size farm households is tree fodder. A review of the tree fodder collecting patterns in these households (Pigs. 4-6 and 4-7) shows that most of this fodder comes from public lands. In June, without tree fodder, small and medium-size farmers would feed their buffalo only 5.5 and 6 kilograms per day, respectively. This is the lowest level all year, and is only 15% of recommended feeding levels.

Fig. 4-11 shows that tree fodder is important to the feeding of buffaloes in large farm households all year long. In October, tree fodder constitutes 35% of the feed supply. A review of tree fodder collecting patterns (Fig. 4-9), however, shows that only 17% of this tree fodder comes from public lands.

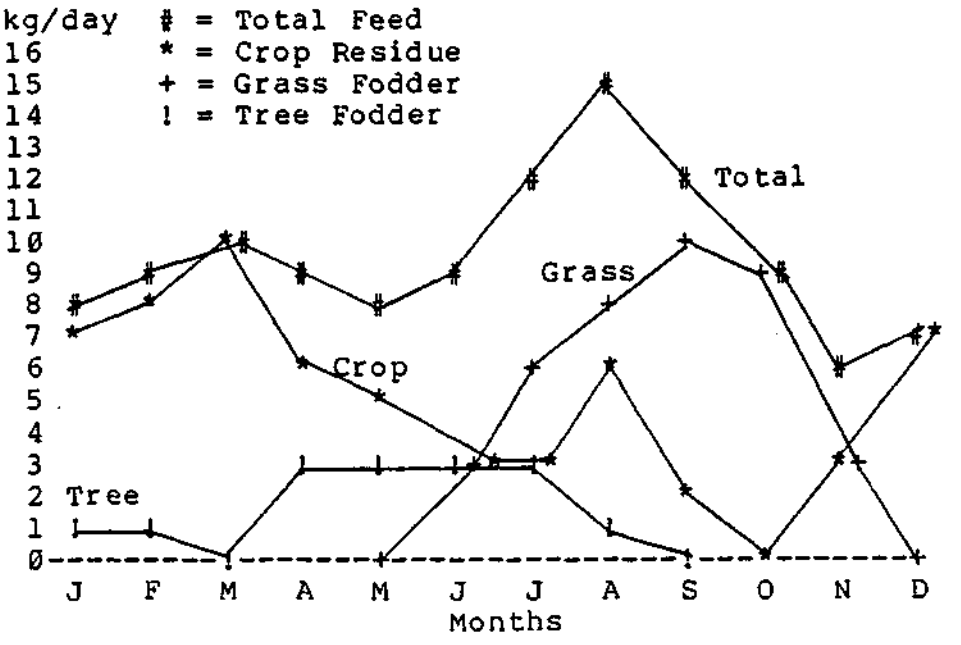


Fig. 4-9. Small Farmer's Buffalo Feed (kg/day) by month and type of feed

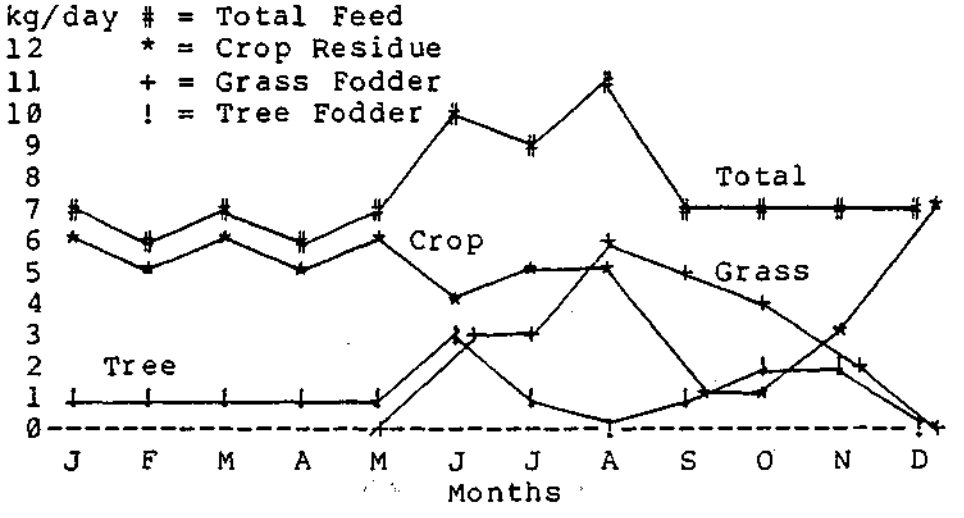


Fig. 4-10. Medium-Size Farmer's Buffalo Feed (kg/day) by month and type of feed

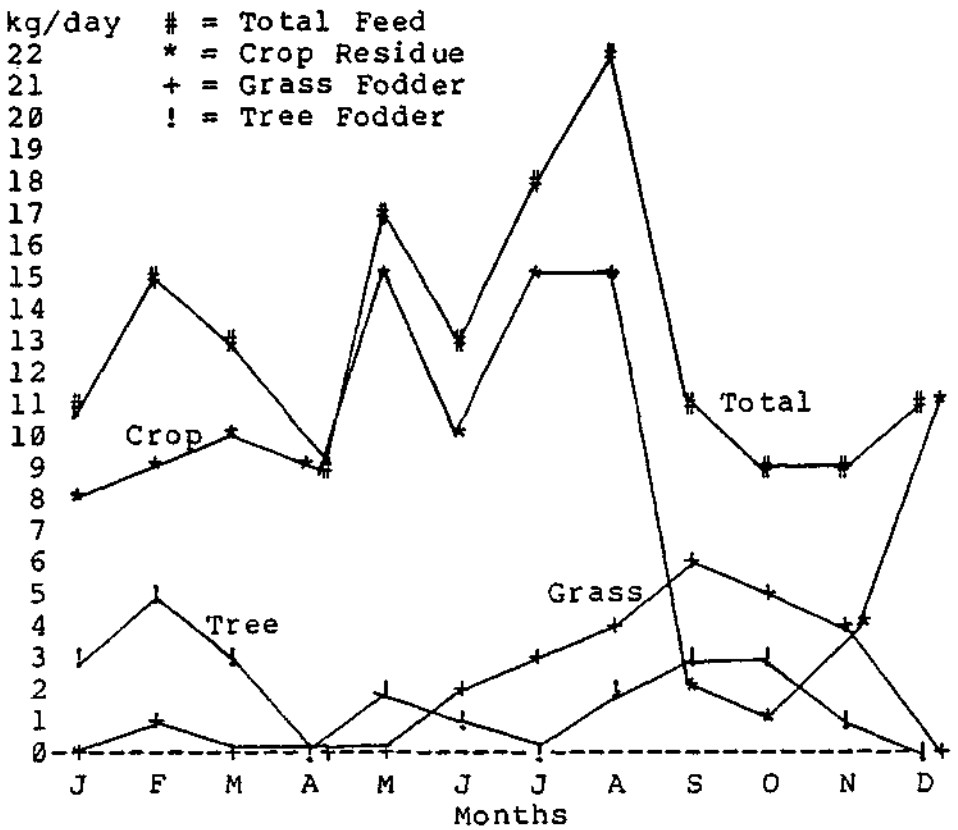


Fig. 4-11. Large Farmer's Buffalo Feed (kg/day) by month and type of feed

Table 4-7 shows the total kilograms of tree fodder collected in a year from public and private lands by different farm size groups. The amount of tree fodder cut by the village is about 120,000 kilograms per year. Public lands provide 28%, or 33,000 kilograms, of this supply. Of the tree fodder cut on public lands, small farmers collect 45%, and medium-size farmers 50%; this is 43% and 29%

of the total tree fodder supplies of small and medium-size farmers, respectively.

Table 4-7. Total Kilograms of Tree Fodder Collected per Year by Farm Size and Source

Farm Size Group	Private (kg/year)	(%)	Public (kg/year)	(%)	Total (kg/year)
Small	19,809	(23)	14,943	(45)	34,752
% of supply	(57)		(43)		
Medium	40,970	(48)	16,734	(50)	57,704
% of supply	(71)		(29)		
Large	24,595	(29)	1,851	(5)	26,446
% of supply	(93)		(7)		
Total	85,374		33,528		118,902

The amount of tree fodder collected on public lands is relatively small: only 33,528 kilograms, as opposed to 98,500 kilograms of firewood. Still, this fodder provides essential feed for the livestock of small and medium-size farmers during the dry season.

E. Grazing Patterns

The importance of public lands to grazing cannot be discussed in the same way as for firewood and fodder, since it was not possible to weigh the amounts of grass consumed. Instead, the number of hours livestock were grazed per day throughout the year was recorded. This is not as good an indicator of the importance of public lands

to livestock feed, because we cannot assume that grazing is equally productive on public and private lands. An animal allowed to graze for 1 hour on public lands may not consume the same amount it would if grazed for 1 hour on private lands.

Whyte (1957), in a thorough report on the fodder and grassland resources of India, argues that India's public grazing lands are so overgrazed that their main purpose is to provide an exercise place for livestock during the day. Grazing lands are important not only as a source of livestock feed, but also as a place to put livestock, particularly during the agricultural season. Even though the value of public and private lands to livestock feed cannot be determined, it is valid and important to determine the role of these lands as places to put livestock during the day. Figs. 4-12, 4-13, and 4-14 show the number of hours cattle, goats, and buffalo are grazed per day on private and public lands throughout one year.

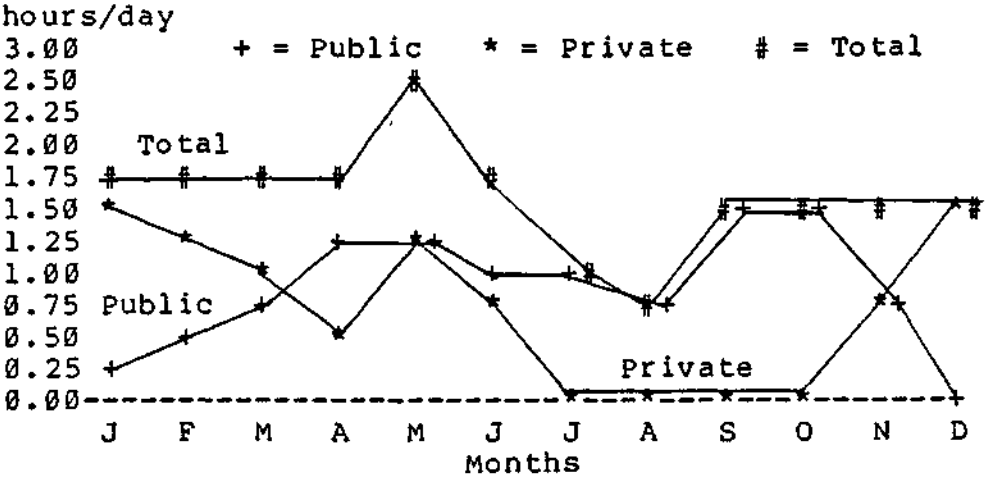


Fig. 4-12. Average Grazing Time per Cow or Ox (hours/day by Month)

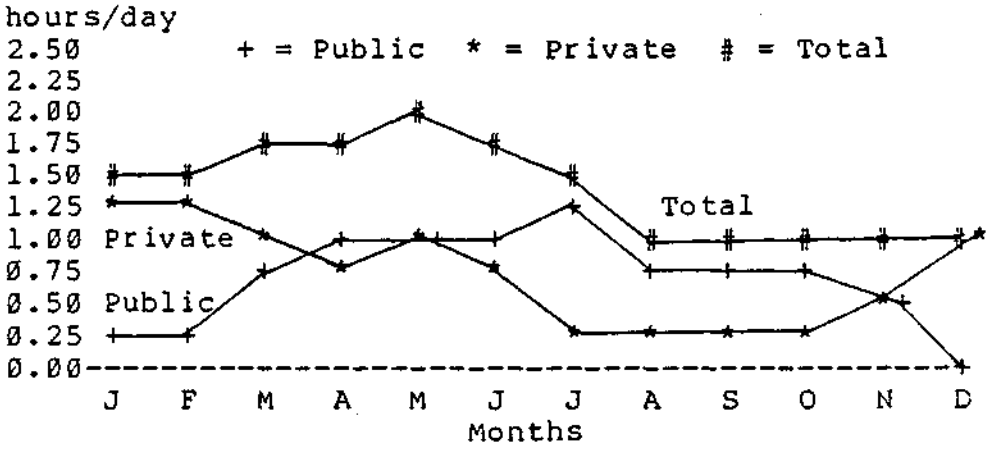


Fig. 4-13. Average Grazing Time per Goat (hours/day by Month)

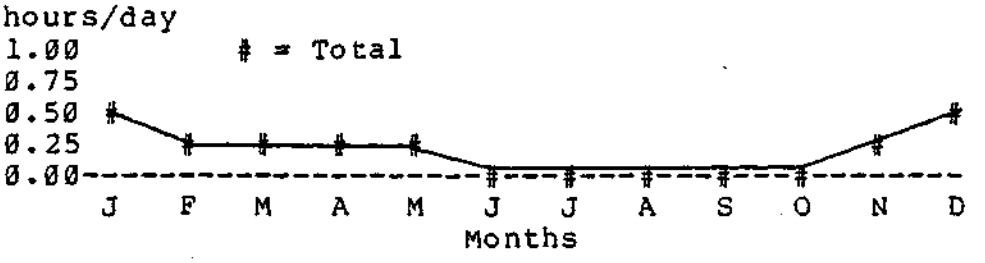


Fig. 4-14. Average Grazing Time per Buffalo (hours/day by Month)

The most intense grazing period is from April through June. It was observed in respect to stall feeding that this is a period when crop residues have been consumed but new grass fodder has not started to grow. During this period, grazing may provide only minimal feed, but livestock are desperate for whatever feed is available.

The least amount of grazing is done from mid-June through mid-August. This is the period when grass fodder grows abundantly on the bunds and risers of agricultural terraces. Since livestock cannot be grazed this close to crops, farmers spend long hours cutting grass to stall feed their livestock.

On private lands, grazing peaks after crops are harvested in December, and then steadily declines from January through March. In April, livestock feed supplies are scarce and animals are again grazed on private lands. As crops are planted, grazing decreases (May and June) until by July almost no grazing is done on private lands.

Grazing does not resume on these lands again until November.

On public lands, grazing reaches a peak in April and May, the period when crop residues and grass fodder are in short supply. Grazing declines slightly in June and then reaches another peak in August and September. After crops are harvested in December, almost no grazing is done on public lands until the following spring. Fifty-eight percent of all grazing is on public lands.

Small farmers graze livestock about 1.8 hours per day, 1 hour on public lands and 0.8 hours on private lands. For medium-size farmers these times are 2.5, 1.5, and 1.0; for large farmers they are 1.2, 0.75, and 0.47 hours. Livestock of small and medium-size farmers spend significantly more time ($Pr < .001$) grazing public lands than do those of large farmers.

The data are such that conclusions cannot be made about the significance of public lands to livestock feed. However, it can be concluded that public lands are grazed most during the dry season, and that small and medium-size farmers spend significantly more time grazing livestock on public lands than do large farmers.

F. Fodder Collecting and Grazing Labor Requirements

Changes in land use practices require changes in the allocation of household labor supplies. For example, management plans that emphasize fodder production and the elimination of free grazing on public lands require that labor invested in grazing be switched to fodder collecting. In order to design management plans sensitive to village realities, present fodder collecting and grazing labor patterns need to be known.

1. Fodder Collecting

Fig. 4-15 shows the number of minutes an average individual spends per day collecting fodder throughout one year. During some weeks in January and February, fodder is not collected at all. From June through October, an average person spends more than an hour per day collecting fodder .

Table 4-8 shows the number of minutes spent by individuals of different sex, age, and farm size groups in collecting fodder per day.

Adult women (>15 years) account for 50% of the total time spent collecting fodder in the village. All women combined (>5 years) account for 68% of that total time. An average woman spends 57 minutes per day collecting fodder, as opposed to 24 minutes per day for an average man ($Pr < .001$) .

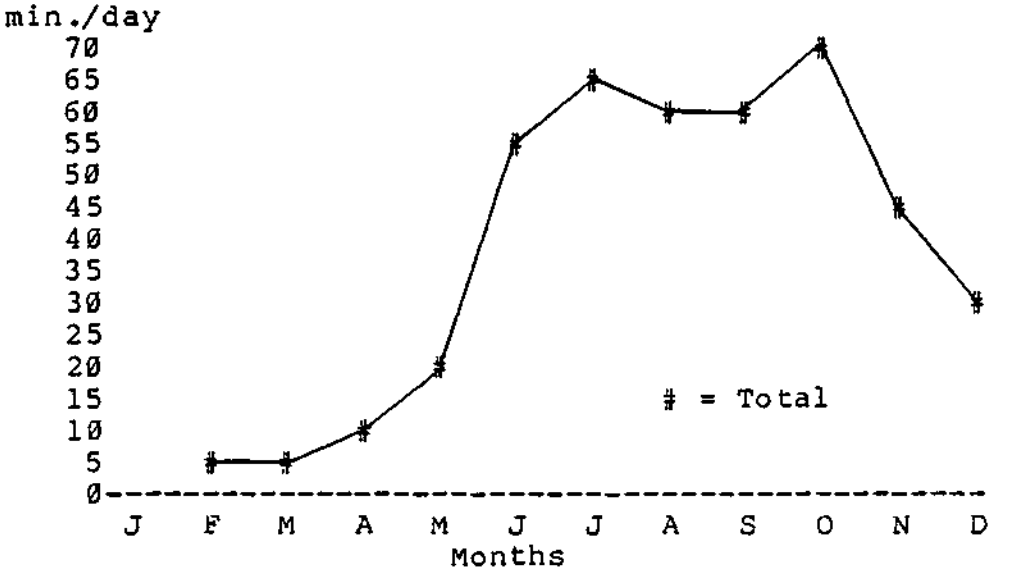


Fig. 4-15. Average Time (minutes) Spent per Individual per Day Collecting Fodder

Small, medium, and large farmers spend 3, 3.25, and 2 hours per day, respectively. The difference between small/medium and large farmers is due to the fact that large farmers hire help to collect fodder. An average household spends 3 hours per day collecting fodder.

Table 4-8. Fodder Collecting Labor Patterns (minutes/day/individual)

Group Sex, Age & Farm Size	Private Forest	Public Forest	Total
Boys (5-9)			
Small	9	3	12
Medium	14	1	15
Large	0	0	0
Girls (5-9)			
Small	0	6	6
Medium	12	4	16
Large	0	0	0
Boys (10-14)			
Small	60	10	70
Medium	36	0	36
Large	16	0	16
Girls (10-14)			
Small	79	7	86
Medium	98	9	107
Large	36	0	36
Men (>14)			
Small	26	4	30
Medium	14	1	15
Large	6	0	6
Women (>14)			
Small	53	9	62
Medium	50	5	55
Large	42	2	44
All Groups			
Small	40	7	47
Medium	36	3	39
Large	21	1	22
Total	35	4	39

Two important points should be noted about fodder collecting: 1) it is a time-consuming and highly seasonal job; and 2) it is done mainly by adult women.

2. Grazing

The amount of time spent per person per day grazing livestock varies throughout a year. The most time is spent grazing animals from April through mid-June. Grazing stops from mid-June through July for rice planting. From August, onward grazing is fairly constant, except for a few weeks in the fall when less grazing takes place because labor is needed for harvesting crops. Fig. 4-16 shows the average amount of time spent per person grazing livestock per day throughout a year.

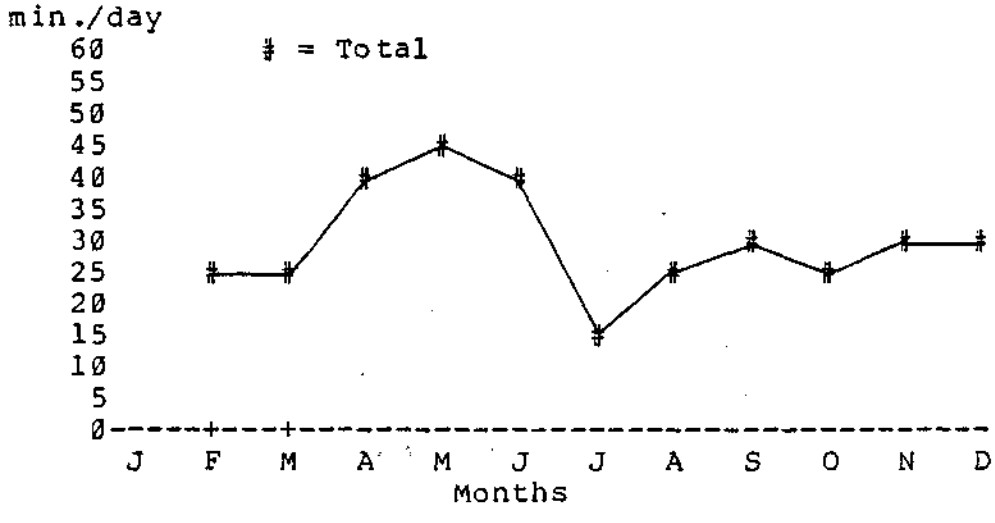


Fig. 4-16. Averge Time (minutes) Spent per Individual per Day Grazing Livestock.

Table 4-9 shows the average time spent per person per day grazing livestock by land type, farm size, sex, and age group.

Table 4-9. Grazing Labor Patterns (minutes/day/individual)

Group Sex, Age & Farm Size	Private Forest	Public Forest	Total
Boys (5-9)			
Small	4	31	35
Medium	8	31	39
Large	3	6	9
Girls (5-9)			
Small	12	12	24
Medium	2	20	22
Large	0	0	0
Boys (10-14)			
Small	7	19	26
Medium	19	31	50
Large	8	20	28
Girls (10-14)			
Small	31	64	95
Medium	23	90	113
Large	0	6	6
Men (>14)			
Small	7	21	28
Medium	8	14	22
Large	4	12	16
Women (>14)			
Small	11	6	17
Medium	7	14	21
Large	16	16	32
All Groups			
Small	10	20	30
Medium	9	24	33
Large	8	13	21
Total	9	20	29

Children (5-14 years) account for 48% of the tine spent grazing livestock, and the elderly (>51 years) account for 18% of this time. Children spend an average of 45 minutes per day; the elderly spend 39 minutes per day (those between 61 and 70 spend 66 minutes per day), and middle-age adults spend 18 minutes per day.

Small, medium, and large farmers spend 2, 2.75, and 2 hours per day, respectively, grazing livestock. Since hired help is seldom used to graze animals, members of large farms spend as much time grazing as do small farmers. Individuals on medium-size farms spend significantly more time grazing livestock than do small and large farmers. An average farmer spends 2.2 hours per day grazing livestock.

The main points to be made about grazing labor patterns are: 1) grazing is less time-consuming and more evenly distributed through a year than is fodder collecting; 2) grazing is done mainly by children and the elderly; and 3) the labor requirements of grazing and fodder collecting are not equivalent: while fodder collecting requires the labor of strong adults, grazing is less strenuous and is done by children and the elderly.

G. Fodder and Grassland Resources

In the previous sections, the amount of tree and grass fodder collected and the number of hours livestock are grazed on private and public lands have been determined. How much fodder can be collected and how many livestock can be grazed on public lands without damaging these resources? This is a difficult question to answer, because few studies have attempted to determine the productivity of unmanaged forest lands, and because (as mentioned in Chapter 3) environmental factors like climate, slope, and soil vary so widely across the middle-hills that productivity studies done elsewhere may not be applicable in Bhogteni.

1. Private Lands

Panday (1976) estimates that privately owned fodder trees in Nepal produce between 20 and 200 kilograms per year per tree (with a mean of 70 kilograms). Small, medium, and large farmers in Bhogteni own 13, 30 and 59 fodder trees, respectively, and cut about 365, 949, and 2044 kilograms of tree fodder from private trees per year. On a per tree basis, this is equal, to 28, 32, and 35 kilograms of tree fodder per year. In comparison with the fodder yields Panday reports, fodder trees in Bhogteni either are low producers or are not being cut of all their new growth. Assuming that fodder trees in Bhogteni are

similar to the ones studied by Panday, the amount of tree fodder collected on private lands is not more than the trees can sustain.

2. Public Lands

Wormald (1976) estimates that unmanaged forest lands in western Nepal produce between 1,500 and 2,500 kilograms of tree fodder per hectare per year. The sal forest is the only forest in the village with a tree density great enough to approach this level of fodder production. The 39 hectares of this forest should supply about 60,000 kilograms of tree fodder (1,500 kgs/ha.) per year. Table 4-7 indicates that 33,000 kilograms of tree fodder are collected in the village from public lands per year. In spite of the fact that the tree fodder production estimates used here may be too high for this forest, tree fodder collecting does not appear to be more than the forest can support.

In terms of grazing, Badoux (1959) estimates that a hectare of forest lands in Nepal can support .83 head of large cattle. Rajbhandry (1981), however, estimates that these lands can support only .31 livestock units per hectare. At these rates, Bhogteni's 112 hectares of public lands can support between 35 and 93 livestock units. Farmers in Bhogteni, however, own 489 livestock units. If all livestock in the village are grazed on public lands,

stocking rates are 5 to 14 times greater than recommended levels. If buffalo are omitted, since they are seldom grazed, the 520 cattle and goats in the village (282 L.S.U.) graze public lands at rates 3 to 8 times greater than recommended. Forest lands, however, are not grazed evenly. Lands close to the village and near trails are grazed more than are those at a distance from the village or far from the trail. Some of Bhogteni's public lands are so over-grazed that they are barely more than parking lots for livestock.

Per hectare stocking rates are not the whole story. Herbage growth is seasonal and needs rest periods. Abell (1979) points out that in Nepal the critical periods for grasses are: 1) the first flush period (this occurs as soon as there is enough moisture to break dormancy, i.e., the first showers in April and May); and 2) the pre-dormancy period (this occurs in September and October and is the period when grasses accumulate root reserves for growth after dormancy) . It has already been shown that grazing on public lands peaks in April-May and in September-October. Not only are there too many livestock in the village for the available grazing lands, but livestock grazing is most intense during the months when it is most harmful to grasslands.

H. Conclusions

This study's major findings regarding fodder collecting and grazing practices on public lands are summarized below.

I. Types and Number of Livestock

A. An average family owns 3.3 head of buffalo and cattle. This is considerably less than the national and watershed means, 4.4 and 5.3, respectively.

B. Small farmers own significantly fewer large livestock than do medium-size and large farmers. This is because small farmers lack both the financial and feed resources needed for buying and keeping large livestock.

II. Livestock feeding Patterns

A. Livestock are fed about 25% of the recommended feeding rate.

B. Tree and grass fodder are essential to livestock feed, especially during the months when crop residues are not available: June, September, and October.

III. Tree and Grass Fodder Collecting Patterns

A. Ninety-five percent of the grass fodder supply is cut on private lands.

B. Public lands are not important to grass fodder collecting either in terms of the amount produced or as a seasonal source of livestock feed.

C. Twenty-eight percent of the tree fodder supply is cut on public lands.

D. Tree fodder from public lands is essential to livestock feed in small and medium-size households in June.

IV. Grazing Patterns

A. Fifty-eight percent of all grazing is on public lands.

B. Grazing is most intense during April-May, and September-October.

C. Small and medium-size farmers spend significantly more time grazing livestock on public lands than do large farmers.

V. Labor Requirements of Fodder Collecting and Grazing

A. Fodder collecting is time consuming and highly seasonal. Women spend 68% of the total time spent collecting fodder.

B. Grazing is less time consuming and less seasonal than fodder collecting. Children (5-14 years) and the elderly (>51 years) spend significantly more time grazing livestock than do medium-age adults (15-51 years) .

C. The labor requirements of fodder collecting and grazing are not similar. Fodder collecting requires the strenuous labor of healthy adults, while grazing can make use of the marginal labor of children and the elderly.

VI. Fodder and Grassland Resources

A. Collecting of fodder and grazing on private lands is at acceptable levels.

B. Levels of tree fodder collecting on public lands appear to be acceptable.

C. Grazing on public lands is destroying these lands, because of too many animals and poor timing.

Both over-lopping trees for fodder and grazing are factors in the deforestation of Bhogteni's public lands. While the amount of tree fodder currently collected from public lands does not appear to be excessive, the number of grazing livestock is many times the number the land can support. Livestock management on public lands will play a major role in our discussion of watershed management plans in Chapter 7.

Chapter V

THE IMPORTANCE OF PUBLIC LANDS TO BHOGTENI'S ECONOMY

A. Introduction

Before management plans can be designed to control the use of public lands, information is needed on how these lands are currently used for meeting firewood and fodder needs, and on the role they play in the economy of farm households. In Chapters 3 and 4, firewood and fodder collection and utilization patterns were discussed. In this chapter, the role public lands play in household economies is examined.

Pradhan and Bennett (1981) describe the economy of Nepali hill villages as operating in 3 concentric spheres. Each sphere offers a set of strategies for increasing a family's subsistence level. Most rural households combine strategies from all 3 spheres in an attempt to maximize their welfare. Sphere I includes all production activities associated with the family farm. While Pradhan and Bennett include in this sphere all activities associated with farm production and "maintenance," i.e., food processing, cooking, etc., in this study maintenance activities, with the exception of firewood gathering, are not considered. Sphere II is the local market economy. This

sphere includes work in the village or nearby villages for wages in either cash or kind. Sphere III refers to short-term migration out of the village for employment in the wider market economy. In this study, Sphere I activities are referred to as "on-farm activities." Sphere II and Sphere III activities are referred to as "off-farm activities."

The objectives of this chapter are: 1) to describe on- and off-farm income producing activities in the village and the importance of each to farm income; 2) to describe the efficiency of labor inputs to each production activity (rupees per hour of labor); and 3) to discuss the value of public lands to household income.

B. On- and Off-Farm Income

Data concerning on- and off-farm income activities were collected in the Daily Recall Survey. Sample farmers were asked, weekly for a year, questions pertaining to animal husbandry, agricultural crops, firewood gathering activities, and off-farm income. Data concerning the amount of labor invested in different production activities were collected in the Time Allocation Survey.

1. On-Farm Income

a. Animal Husbandry

Livestock have value in terms of the amount of meat, milk, and manure they produce, the number of progeny they

bear, and the amount of labor (plowing) they provide. It is difficult to determine the economic value of two of the most important livestock products—manure and bullock labor .

In this study the value of manure is determined in the following manner. An average cow produces 30 kilograms per year of readily available nitrogen (as N) and about 4 kilograms of available phosphorous (as P) (Vollenweider, 1968). Assuming half this material is lost through inefficient collecting, incomplete composting, or runoff, it is reasonable to assume the each cow or buffalo contributes at least 15 kilograms of nitrogen and 2 kilograms of phosphorous to the farming system. According to the Nepal Rastryia Bank (1978) average prices for nitrogen (as N) and phosphorous (as $P_2,0_2$) are 6 and 18 rupees per kilogram, respectively. Each cow or buffalo in Bhogteni, therefore contributes approximately 126 rupees per year to household income by way of fertilizer production.

In Bhogteni, bullock labor is valued at about 10 rupees per day per pair of bullocks. This, however, underestimates the value of bullocks to the subsistence farming system. If bullock's were removed from the system it would require at least 5 days of manual labor (at 10 rupees per day per man) to replace a single day of bullock

labor. In order to give a fair but still conservative value to bullock labor, this study values bullock labor at 50 rupees per day.

Following Mathema and Van Der Veem (1980), gains from raising livestock are defined in this study as being equal to: (the value of livestock in mid-December, 1981) - (the value of livestock in mid-December, 1980) + (income from selling livestock) + (income from selling dead animals) + (the value of animals consumed) + (the value of livestock given away) - (the cost of any new livestock purchased during the year). Milk is valued at the current market value in Gorkha (2 rupees per liter).

When meat, milk and manure products, gains in value from raising, and bullock labor are monetized in this manner, the value of livestock raising to an average farmer is 1,748 rupees per year. On small, medium, and large farms, livestock contribute 994, 2,037, and 3,443 rupees per year to farm income, respectively. Milk provides 9% (small farmers) to 51% (large farmers), manure provides 15% (large farmers) to 33% (small farmers), and bullock labor provides 16% (medium-size farmers) to 47% (small farmers) of this income. Table 5-1 shows average annual income from livestock production...on small, medium and large farms.

Table 5-1. An Average Farmer's Annual Income from Livestock by Farm-Size Group and by Source.

Farm Size	Gain From Raising (rupees)	Milk (rupees)	Bullock Labor (rupees)	Manure (rupees)	Total (rupees)
Small	16	185	465	328	994
Medium	193	1,033	320	491	2,037
Large	189	1,822	1,000	542	3,553
Total	114	726	480	428	1,748

Cash income from livestock is shown in Table 5-2. An average farmer earns 230 rupees annually in cash income from livestock production. Almost all of this income is from selling livestock.

Table 5-2. An Average Farmer's Cash Income from Livestock by Farm-Size Group and by Source.

Farm Size	Milk (rupees)	Animals Sold (rupees)	Total (rupees)
Small	4	268	272
Medium	0	83	83
Large	0	505	505
Total	2	226	230

b. Agricultural Crops

The main crops grown in Bhogteni are rice, dryland rice, corn, millet, oil seeds (mustard and sesame), and various lentils. Corn and dryland rice are grown on bari lands (unirrigated) during the first cropping season, March through June. Millet, lentils and oil seeds are grown on these lands during the the second cropping season, July through November. Wetland rice is grown on khet lands (irrigated) from July through November.

Average small, medium, and large farmers own .48, .81, and 1.24 hectares of bari land and .08, .48, and 1.18 hectares of khet land, respectively. It was not possible to estimate the proportion of bari lands planted to corn,

as opposed to dryland rice, during the first cropping season, or the proportion planted to millet, lentils, or oil seed during the second cropping season. Consequently, corn and dryland rice are considered as one crop category. Millet, lentils, and oil seeds are considered as a second, and wetland rice makes up a third.

The average amount of land farmed, the total yield, the yield per hectare, and the amounts of farmyard manure (FYM), chemical fertilizers, and labor invested per hectare are shown in Table 5-3.

Small farmers produce approximately equal amounts of corn/dryland rice and millet/lentils/oil-seeds on bari lands during the two growing seasons, 328 and 333 kilograms, respectively. They produce only 175 kilograms of rice per year. Medium-size farmers produce 787 kilograms of corn/dryland rice, 798 kilograms of rice, and 530 kilograms of millet/lentils/oil-seeds. Large farmers produce an average of 2,617 kilograms of rice, 938 kilograms of corn/dryland rice, and 430 kilograms of millet/lentils/oil-seeds.

On a per hectare basis, small farmers have the highest yields for dryland crops, because they compensate for their lack of land by devoting more farmyard manure and labor to crop production. Large farmers, however, have the highest rice yields per hectare, probably because the

Table 5-3. An Average Farmer's Annual Crop Production by Farm-Size Group.

Crop & Farm Size	Land Area (ha)	Total Yield (kg)	Yield (kg/ha)	FYM (kg/ha)	Chem Fert (kg/ha)	Labor (hrs/ha)
Corn & Dryland Rice						
Small	.48	328	1,091	6,386	4.29	2,602
Medium	.81	787	1,072	4,109	1.43	1,244
Large	1.24	938	779	3,505	8.86	425
Total	.70	585	1,024	4,817	3.93	1,884
Millet, Lentils & Oil Seeds						
Small	.48	333	998	667	3.80	1,479
Medium	.81	530	816	409	15.80	591
Large	1.24	430	520	357	17.00	194
Total	.70	434	856	535	10.00	1,024
Rice						
Small	.08	175	2,306	1,923	7.50	5,381
Medium	.48	798	2,108	572	33.00	1,869
Large	1.18	2,617	2,678	340	29.00	1,704
Total	.37	750	2,256	963	24.00	2,853

location of their fields insures them better access to water supplies.

According to the prices shopkeepers in Gorkha pay for grains, the monetized value of crop production on small, medium, and large farms is 1,900, 4,500, and 8,200 rupees per year, respectively. Table 5-4 shows rupee value of agricultural crops by farm-size groups.

Table 5-4. Rupee Value of an Average Farmer's Annual Crop Production by Farm-Size Group.

Farm Size	Millet, lentils & oil seeds (rupees)	Corn & dryland rice (rupees)	Rice (rupees)	Total (rupees)
Small	686	677	543	1,906
Medium	1,062	1,675	1,770	4,507
Large	512	1,907	5,720	8,179
Total	809	1,222	1,960	3,991

The cash income received from agricultural crops is shown in Table 5-5. An average farmer receives only 36 rupees cash from crop production per year. Most of this income is from selling millet. Even though an average farmer receives 4 times as much total income from agricultural crops as from livestock, the cash income from livestock is six times greater than that from crop production. This indicates that farmers consume almost all of the agricultural products they produce, and that animal husbandry is the major on-farm cash producing activity.

Table 5-5. An Average Farmer's Cash Income from Agricultural Crops by Farm-Size Group.

Farm Size	Millet, lentils & oil seeds (rupees)	Corn & dryland rice (rupees)	Rice (rupees)	Total (rupees)
Small	11	1	7	19
Medium	30	0	0	30
Large	62	0	52	116
Total	25	1	10	36

c. Gathering Activities

In Bhogteni , gathering activities include collecting *Castanopsis* leaves for roofing and fencing; collecting ferns and tree litter for compost; collecting bark, roots, leaves, etc., for food and medicinal purposes; collecting fodder for livestock feed; and collecting firewood. Of these products, the only ones of sigificant economic value are fodder and firewood. The economic value of fodder is included in the animal husbandry section. This section is consequently limited to determining the economic value of firewood collecting activities.

Only small amounts of firewood are bought or sold in Bhogteni. Wood that is traded is priced on the basis of the labor required to collect it: a load of wood that takes 1 day to collect costs 1 day's wages. Prices are thus approximately 10 rupees per 25 kilograms, or .4

rupees per kilogram. This estimate, however, fails to consider the value of the wood itself. As wood becomes more scarce, its value is best estimated by the value of the next available substitute. In Bhogteni, this is dried cattle dung. In Table 5-6, the economic value of 1 kilogram of firewood is estimated by equating the value of manure to the increase in crop production caused by its application. Calculations in Table 5-6 assume that manure increases corn production by 15% (World Bank, 1980).

Table 5-6. Derivation of the Economic Price of Firewood (Based on World Bank Report, 1980)

Given:
1. 1 kg of dried firewood = 4,700 Kcal heat (1)
2. 1 kg of dried cow dung = 2,400 Kcal heat
3. 1 kg of dried cow dung = 4 kg raw dung (1)
4. Average corn yield in Bhogteni = 1,024 kg/ha
5. Average application of raw manure in Bhogteni = 5,300 kg/ha corn
6. 15% of corn yield is due to manure = 154 kg/ha
7. price of corn = 3.16 rupees/kg

Then: 1 kg dried firewood =

$$4{,}700 \text{ Kcal} \times \frac{1 \text{ kg dried cow dung}}{2{,}400 \text{ Kcal}} \times \frac{4 \text{ kg raw cow dung}}{1 \text{ kg dried cow dung}} \times \frac{154 \text{ kg corn}}{5300 \text{ kg raw cow dung}} \times \frac{3.16 \text{ rupees}}{1 \text{ kg corn}} = .72 \text{ rupees}$$

1. Government of India, 1968

In Chapter 3, it was determined that an average individual burns 1.75 kilograms of firewood per day. At .72 rupees per kilogram of wood, an average farm in Bhogteni burns approximately 2,667 rupees of firewood per year. The value of firewood to small, medium and large farms is 2,207, 2,989 and 3,541 rupees per year, respectively.

2. Off-Farm Income

Off-farm income is defined as all wages (either cash or trade) earned from labor off the family farm. Exchange labor agreements (parma) are not included. Field labor for other farmers for wages, occupational jobs such as blacksmiths, tailors, and cobblers, government jobs, military service, and pensions, etc., are included.

An average farmer in Bhogteni earns 3,922 rupees per year from off-farm employment. Small, medium, and large farmers earn 2,646, 3,728, and 4,688 rupees per year from off-farm employment. Table 5-7 shows average off-farm employment earnings by farm size groups.

Of the income earned from off-farm labor, 69% or 2,709 rupees is in cash. Off-farm employment provides the largest source of cash income for all farmers.

Table 5-7. An Average Farmer's Income from Off-Farm Employment by Farm-Size Group.

Farm Size Group	Kind (rps/year)	Cash (rps/year)	Total (rps/year)
Small	1,210	1,436	2,646
Medium	620	3,108	3,728
Large	616	4,072	4,688
Total	885	2,709	3,922

3. Total Household Income

When data from the previous 2 sections, on- and off-farm income, are summarized, the income of an average farmer in Bhogteni is 11,817 rupees per year. On-farm and off-farm activities contribute about 8,200 and 3,600 rupees per year to this income, respectively. Small, medium and large farmers have average incomes of 7,651, 13,010 and 19,675 rupees per year, respectively. Average farm incomes are summarized in Table 5-8.

The average household income in Bhogteni is slightly higher than that in Bakundol, the Brahmin-Chhetri village studied by Bennett (1981). In Bakundol, the average annual household income is 9,650 rupees. Most other studies in Nepal of household incomes have not included firewood gathering. If the 2,670 rupees earned through this activity are subtracted, the remaining income (9,150 rupees) compares well with average annual incomes reported

Table 5-8. An Average Farmer's Income by Farm-Size Group and by Source.

	[---On-Farm Activities----]			[Off-Farm]	
Farm Size	Live-stock	Agri-culture	Fire-wood	Wage	Total
Small	994	1,804	2,207	2,646	7,651
Medium	2,037	4,256	2,989	3,728	13,010
Large	3,553	7,893	3,541	4,688	19,675
Total	1,748	3,808	2,667	3,594	11,817

in other studies. Mathema and Van Der Veen (1981), for example, report household incomes of 7,461 and 9,120 in Pumdi Bhumdi and Khandbari,-the two villages they studied. Stone (1980) reports cash income only, and her figure of 2,653 rupees per year compares well with the 2,975 rupees reported in this study. Some studies, however, have reported much lower household incomes. Calkins (1976), for example reports only 1,800-2,000 rupees per household per year. Even though this estimate does not appear to include off-farm income, it is still low in comparison with results from this study, a disparity probably due to differences in methods of collecting data and pricing agricultural products as well as to differences in such variables as location, time, ethnic group studied, etc.

Table 5-9 shows the percent of household income derived from major production activities. Animal husbandry provides only 13% of a small farmer's household income and only 18% of that of a large farmer. Agricultural crops and firewood gathering contribute about 55% of household income for all farm-size groups. On-farm production contributes 65% to 76% of household income, and off-farm activities contribute the remaining 24% to 35%.

Table 5-9. Percent of Farm Income from Major Production Activities.

Farm Size	Live-stock	Agri-culture	Fire wood	Wages	Total On-Farm	Total Off-Farm
Small	13	23	29	35	65	35
Medium	15	33	23	29	71	29
Large	19	40	18	24	76	24
Total	15	32	23	30	70	30

Table 5-10 shows the percent of household cash income that comes from major production activities. On-farm activities contribute only 4% to 17% of the total. Of the cash income from on-farm activities, however, livestock contribute 75% to 95%.

For all farm-size groups, approximately 25% of farm income is in cash; the remaining 75% is in goods and serv-

Table 5-10. Percent of Farm Cash Income from Major Production Activities.

Farm Size	Live-stock	Agri-culture	Fire-wood	Wages	Total On-Farm	Total Off-Farm
Small	16	1	0	83	17	83
Medium	3	1	0	96	4	96
Large	11	2	0	87	13	87
Total	8	1	0	91	9	91

ices from either on-farm or off-farm production activities.

The most important income generating activities in Bhogteni are agriculture, firewood collecting and off-farm labor. These activities generate 85% of the income of farm households. In terms of cash income, off-farm labor is of overwhelming importance. However, among on-farm activities, animal husbandry is the major producer. This is particularly true among small farmers.

C. Efficiency of Labor Use

By determining the value of products from different income generating activities, it has been possible to compare the relative importance of these activities to household income. Another method of comparing production activities is to determine the amount of income produced

per unit of input. Since labor is the only input common to on-farm and off-farm production activities, the labor efficiency of these activities is examined.

Table 5-11 shows the labor efficiencies of animal husbandry, agriculture, firewood gathering and off-farm activities.

Table 5-11. Average Labor Efficiencies (rupees income/hour labor) by Farm-Size Group.

Farm Size	Live-stock	Agri-culture	Gath-ering	Off-Farm Labor
Small	.45	1.0	8.7	1.6
Medium	.73	2.1	14.1	2.1
Large	1.87	6.0	51.5	2.3
Total	.71	1.9	14.2	1.8

Labor invested in firewood collecting yields the highest returns. This result is artificial, since the price of firewood was determined from its most readily available substitute, manure. Still, this result indicates that farmers should be willing to expend considerably more labor collecting firewood before switching to burning manure. Agriculture and wage labor activities require about the same amount of labor per unit of output. Small farmers receive slightly higher returns on labor invested in off-farm wage activities than in agriculture.

Large farmers receive higher returns on labor invested in agriculture. Rates of return on labor invested in animal husbandry are very low, even when adjusted to include the value of manure and bullock labor.

D. Value of Public Lands

Chapters 3 and 4 showed that public lands provide about 28% of the village's annual firewood supply, and about 4% of its annual livestock feed (not including grazing). In June, public lands provide 35% of the livestock feed of small and medium-size farmers. This information can be used to determine upper and lower estimates of the value of public lands to the village economy.

For the upper limit, the maximum value of public lands to the village, it is assumed that without access to tree fodder on public lands in June, the livestock of small and medium-size farmers die, and that firewood supplies are reduced by the amount of wood collected on public lands in a year. For the lower limit, the minimum value of public lands to the village, it is assumed that livestock feed is reduced by the amount of fodder collected on public lands in a year, that all livestock survive, and that firewood supplies are reduced by the amount of wood collected on public lands in a year.

Table 5-12 shows the maximum value of public lands to farmers. In this table, the total value of animal

husbandry production on small and medium-size farms is accredited to public lands, because it is assumed that without tree fodder from public lands, the livestock of these farmers die. According to this table, public lands provide 28.6% of the income of small farmers (14.6% from firewood and 13% from livestock), 19.6% for medium-size farmers (4.6% from firewood and 15% from livestock), and only .7% for large farmers (100% from firewood) .

Table 5-12. Maximum Value of Public Lands to an Average Farmer. (1)

Farm Size	Livestock Feed	Fire-Wood	Total
Small	994 13%	1,015 14.6%	1,411 27.6%
Medium	1,541 15%	568 4.6%	2,109 19.6%
Large	0 0.0%	142 0.7%	142 0.7%

1. In each farm-size category the top line is the rupee value and the bottom line is the percent of farm income.

Table 5-13 shows the minimum value of public lands to farmers. In this table, the assumption is made that fodder supplies are reduced by the amount of fodder collected on public lands but that all livestock survive. According to this table, public lands provide 15% of the

income of small farmers (14.6% from firewood and .4% from livestock), 5% for middle-size farmers (4.6% from firewood and .4% from livestock), and only .7% for large farmers (100% from firewood).

Table 5-13. Minimum Value of Public Lands to an Average Farmer.

Farm Size	Livestock Feed	Fire-Wood	Total
Small	28 0.4%	1,015 14.6%	1,043 15%
Medium	46 0.4%	568 4.6%	614 5%
Large	0 0.0%	142 0.7%	142 0.7%

This estimate of the maximum value of public lands is obviously not very realistic. Even if all the village's public lands were managed and tree fodder collecting were strictly prohibited, some of the livestock of small and medium-size farmers would survive. In such an extreme scenario, however, the value of public lands to livestock feed could represent a significant portion of the income of small and medium-size farmers, 13% and 15% respectively.

When it is assumed that all livestock survive, even without access to public lands for feed, then the value of

public lands to village firewood supplies becomes of critical importance. At minimum, firewood from public lands provides 14.6% of the income of small farmers, 4.6% for medium-size farmers, and only .7% for large farmers.

Under the maximum assumption, medium-size farmers may be critical to the acceptance of controls on public lands, because they need to provide their livestock with feed during the dry season. Under both assumptions, small farmers are critical to the introduction of public land management because they are dependent on public lands for fodder and firewood supplies.

E. Conclusions

The major conclusions made in this chapter are as follows:

I. On-Farm Income

A. Animal husbandry provides average small, medium, and large farmers with 994, 2,037, and 3,553 rupees income per year, respectively. Of this, cash income is 272, 83, and 505 rupees per year .

B. Agricultural crops provide average small, medium, and large farmers with 1,906, 4,507, and 8,179 rupees income per year, respectively. Of this, cash income is only 19, 30, and 116 rupees per year.

C. Firewood gathering provides average small, medium, and large farmers with 2,207, 2,989, and 3,541 rupees income per year, respectively.

II. Off-Farm Income

A. Off-farm employment provides average small, medium, and large farmers with 2,646, 3,728, and 4,688 rupees per year, respectively. Of this, cash income is 1,436, 3,108, and 4,072 rupees per year.

III. Total Household Income

A. Total household income (including firewood) of small, medium, and large farmers is 7,651, 13,010 and 19,675 rupees per year, respectively.

IV. Labor Efficiency

A. Of all farm chores, firewood collecting produces the most income per hour of labor invested, 14.2 rupees per hour .

B. Agricultural and wage labor activities provide about the same amount of income per hour of labor invested, 1.9 and 1.8 rupees per hour, respectively.

C. Animal husbandry activities provide the lowest income per hour of labor invested, 0.71 rupees per hour of labor.

V. Value of Public Lands

A. If it is assumed that without feed from public lands the livestock of small and medium-size farmers die, public lands contribute 28% of the income of small farmers, 20% of that of medium-size farmers, and only .7% of that of large farmers.

B. If it is assumed that without feed from public lands the livestock of small and medium-size farmers do not die, public lands contribute 15% of the income of small farmers, 5% of

that of medium-size farmers, and only .7% of that of large farmers.

c. Public lands are important to the incomes of small farmers because they provide an essential supply of livestock feed and firewood. These lands may be important to the incomes of medium-size farmers because of the livestock feed they provide.

CHAPTER VI

PUBLIC LAND-USE IN BHOGTENI

A. Introduction

In Chapters 2 through 5, Bhogteni's public lands and land use practices were described. Supply and demand balances for wood, fodder, and grazing resources were estimated; the importance of forest products to household economies was discussed; and the different effects of farm-size and labor requirements on land use practices were documented. In this chapter, these results are used to answer the four questions posed in Chapter 1. These were:

1) What land uses compete for public lands, and what is the relationship between land use and land degradation?

2) How important are forest products from public lands to the subsistence farming system?

3) Do farm-size groups have different interests in how public lands are used?

4) What are the labor requirements of collecting different forest products?

Answers to these questions are used to determine the major causes of land degradation in Bhogteni and to suggest the potential of present needs, distribution of bene-

fits, and labor requirements to hinder or promote land management planning.

B. Public Land-Use and the Causes of Degradation

Deforestation is the consequence of at least 3 factors: clearing land for agriculture, felling trees for fuel and timber, and collecting livestock feed—fodder and grazing. To single out one demand as the major cause of deforestation is difficult and perhaps misleading, since all three demands are integral to the subsistence farming system. However, since land degradation can be controlled only when its causes are understood, an attempt will be made to determine the relative destructiveness of the different demands placed on Bhogteni's public lands.

An examination of tax records on khets (tiraj) showed that minimal land has been cleared for agriculture since 1938, the earliest available records. This finding was confirmed by asking farmers how much land they had cleared for agriculture since they had inherited their farms. The answers to this question suggest that a total of 2 or 3 hectares of forest/waste/pasture lands have been converted to agriculture by the present generation of farmers. This is primarily because remaining lands are too steep or shallow to be useful for agriculture. Some private forests (probably less than 1 ha) were cleared recently because farmers feared that the up-coming cadastral survey

would invalidate their claim to these lands. But generally, land clearing for agriculture is not currently a major cause of deforestation in Bhogteni.

Since on public lands, firewood supplies are scarce and the labor requirements of collecting it high, most firewood in Bhogteni is collected on private lands. Deforestation in Bhogteni, is consequently occurring on private lands. If the amount of wood cut which is in excess of incremental growth were to be cut on public lands instead, demand would be 1.7 times greater than supplies (Table 6-2).

The amount of tree fodder cut and its supply on public lands are about equal (Table 6-1). Livestock, however, are being fed only about 25%-30% of their recommended diet. If livestock were fed at recommended rates, and 25% of their diet came from tree fodder, the demand for tree fodder on public lands would be about 30 times greater than supplies (Table 6-2).

The number of grazing livestock in Bhogteni, is at least 3 times greater than the number that can be supported without damaging the land (Table 6-1).

Table 6-1. Amount Cut and Supply of Firewood, Fodder, and Grazing on Public Lands. (Kilograms or L.S.U.)

Forest Product	Amount Cut from Public Lands	Supply from Public Lands	Surplus or Deficit
Firewood	98,500 kg.	116,000 kg.	+17,500 kg.
Tree Fodder	33,500 kg.	30,000 kg.[1]	-3,000 kg.
Grazing	282 L.S.U.	94 L.S.U.[2]	-189 L.S.U.

1) Assume 20 ha. of sal forest producing 1,500 kg/ha.

2) Assume Bhogteni's 112 ha of public land can support .84 L.S.U. per ha.

Tables 6-1 and 6-2 show that fuel wood and fodder demand could cause deforestation but that farmers are limiting their collecting to sustainable yield levels. The number of livestock allowed to graze public lands freely, however, appears to be many times the acceptable level. The chief cause of land degradation on public lands in Bhogteni is overgrazing. This is not a new conclusion about land degradation in Nepal. R.C. Williams noted in 1967 that the "greatest single cause of soil erosion in Nepal is the excessive grazing of domestic livestock." After reviewing published data on the demand for, and the supply of, forest products, Wyaat-Smith (1982) concludes that 3 to 5 times as much public land is needed to feed

Table 6-2. Current Demand[1] and Supply of Firewood Fodder, and Grazing on Public Lands. (Kilograms or L.S.U.)

Forest Product	Demand from Public Lands	Supply from Public Lands	Surplus or Deficit
Firewood	217,000 kg.[2]	116,000 kg.	-103,500 kg.
Tree Fodder	867,000 kg.[3]	30,000 kg.	-837,000 kg.
Grazing	282 L.S.U.	94 L.S.U.	-189 L.S.U.

1) Demand is defined as the amount of firewood and and fodder farmers would like to collect on public lands if it were available.

2) Assume that small and medium-size farmers restrict firewood collecting on private lands to acceptable levels and meet other needs from public lands. Therefore (145,234 kg - 15,97.5 kg) + (153,535 kg - 65,806 kg) = 216,981 kg demand from public lands.

3) Assume that livestock are fed 25% of the recommended feeding level from tree fodder, and that private trees continue to produce at the same rate. Therefore (138 buffalos x 15,000 kg feed per year) + (223 cattle x 7,800 kg feed per year) x (25%) - (85,000 kg tree fodder on private lands) = 867,350 kg per year tree fodder demand from public lands.

the present livestock population as is needed to meet firewood requirements.

Livestock raising utilizes marginal lands and marginal labor. Consequently, despite very low productivity, farmers are willing to raise livestock in an attempt to produce as much cash, food and manure as possible on lim-

ited areas of land with a labor force too young or too old to be useful for other chores. The smaller the farm, the more labor farmers are willing to invest in livestock, even though the value of the product may be very small.

In Table 6-3, potential demands for forest products from public lands are estimated and compared with potential supplies of these products under land use management. This table shows that if the village's population continues to grow at 2% per year, public lands producing 5 m3/ha/year of incremental wood growth, a very conservative estimate of their potential, could meet firewood demands until 2000 A.D. If public lands produced 11 m3/ha/year, the World Bank's estimate of their potential, they could meet firewood demands until 2030 A.D.[1] This is based on the assumption that firewood production on private lands remains constant, and on the optimistic assumption that the wood yield from public lands can be spread out evenly over time.

---

[1]The World Bank (1978) estimates that in Panchayat Forests 5 m3/ha could be harvested in the 14th and 15th year and 160 m3/ha in the 16th year (end of rotation), and in Panchayat Protected Forests that 1.6 m3/ha could be harvested from now until *the* 17th year and 5 m3/ha from then on.

Tree fodder production, even assuming that all 112 hectares of the village's public lands produce at their optimal rate, is less than demand if livestock are fed at recommended levels. Since tree fodder production is unlikely to reach this rate, tree fodder supplies on public lands will never be able to support the present livestock population properly.

With good management, the number of grazing livestock these lands can support could be raised to 140, about half the present population.

The major land uses competing for public land resources are firewood collecting, fodder collecting, and grazing. Grazing is the land use currently causing the most severe land degradation problems. Land management plans need to emphasize afforestation projects to halt land degradation and to meet the growing fuel wood demand. The key to successful land management programs, however, is livestock management. The first priorities of land management in Bhogteni should be to control livestock and to increase fodder productivity on private and public lands.

Table 6-3. Potential Demand and Supply of Firewood Fodder, and Grazing on Public Lands. (Kilograms or L.S.U.)

Forest Product	Demand from Public Lands[1]	Supply from Public Lands	Surplus or Deficit
Firewood	407,714 kg.[2]	392,000 kg.[3]	-15,714 kg.
Tree Fodder	867,000 kg.	840,000 kg.[4]	-27,000 kg.
Grazing	282 L.S.U.	140 L.S.U.[5]	-142 L.S.U.

1) In the year 2000 A.D.

2) Assume fuel wood production on private lands remains constant, and the incremental demand caused by population growth is supplied from public lands.

3) Assume that 112 ha. of forest have an incremental growth rate of 5 m3/ha/year and that 1 m3 weights 700 kg.

4) Assume that 112 ha. of managed forests produce 7,500 kilograms of tree fodder per year.

5) Assume that with management the village's public lands could support 1.25 L.S.U. per hectare (Badoux, 1959).

C. Present Needs

When management plans are instituted on public lands, farmers will no longer have free access to these lands for collecting forest products. If the loss of one or more of these products causes farmers too much hardship, land man-

agement plans will probably not be successful. In order to design management plans sensitive to this problem, it is necessary to understand how important different forest products from public lands are to the farming system.

Public lands provide 28% of an average farmer's firewood supply, and 5% of his or her livestock feed. During the dry season, upwards of 35% of the stall feed of livestock comes from public lands. Fifty-eight percent of the grazing in the village is on public lands. It is doubtful, however, whether livestock derive much feed from this grazing. The analysis of household economies in Chapter 5 revealed that 6.6% of an average household's income comes from firewood and .4% from livestock feed gathered on public lands. These figures suggest that public lands are most valuable as a source of tree fodder during the dry season and as a source of firewood. These figures, however, do not make clear whether these needs are critical enough to cause farmers not to cooperate with controls on public land use.

When figures are broken down by farm-size groups, the story is different. Results from Chapters 3 through 5 show great discrepancies in the dependence of farm-size groups on public lands. Large farmers collected 4% of their firewood, 7% of their tree fodder, and 1% of their grass fodder on public lands. Medium-size farmers col-

lected 19% of their firewood, 29% of their tree fodder, and 2% of their grass fodder there, while small farmers collected 48% of their firewood, 43% of their tree fodder, and 6% of their grass fodder on these lands.

Tree fodder from public lands is essential to livestock feed during the dry season in medium-size and small farm households. The private firewood supplies of medium-size farmers are sufficient to meet their fuel demands for 10 to 15 years, a period long enough to establish an afforestation project. But small farmers will be almost completely dependent on public lands for fuel wood within a few years.

These figures suggest that because of their dependence on forest products from public lands, small farmers will not be able to cooperate with controls on public land use. Large and medium-size farmers, however, should be willing to cooperate with such controls. If alternative sources of forest products are made available to small farmers these farmers should also be able to cooperate with land management plans.

D. Distribution of Benefits

Data on public land use patterns indicate that a potential exists for conflict among farm-size groups over the use of public lands. Large and medium-size farmers do not currently derive much benefit from public lands, but would like to in the future. On the other hand, small farmers cannot afford to worry about future productivity, since they are dependent on these lands now. The concern of large and medium-size farmers for managing public lands conflicts with the current need of small farmers. Two examples can be cited to confirm this potential for conflict over the management of public lands.

For the last 15 years, the panchayat has managed a piece of communal land as panchayat property. This management has evidently been effective since tree density on this land is 325 trees per hectare, as opposed to less than 50 trees per hectare on unmanaged communal lands. The panchayat has been able to stop the cutting of trees by fining violators. To date, violators have all been small farmers.

The second example occurred during the course of this study. A small low-caste farmer attempted to extend his private agricultural fields by terracing adjacent communal scrub lands. Refusing to recognize this claim, concerned villagers decided to split this small piece of communal

land (<.5 ha) among all landowners with land adjoining the property. A majority of the villagers (led by a large farmer), however, also rejected this decision. A petition was then drawn up and signed to turn the land over to the Resource Conservation and Utilization Project nursery for management. The petition was never delivered because the threat of doing so was sufficient to stifle, at least for the moment, all private claims to this land.

Talks with farmers also supported the conclusion that a potential exists for conflict to occur among farm-size groups over public land use. Large and medium-size farmers seemed very eager for public lands to be managed in order to provide for the needs of their children. Small farmers seemed more concerned about present needs. Small Newari farmers wanted to know where they would collect firewood or graze livestock if land use plans were implemented. Untouchable farmers, already accused of stealing grass fodder and dead wood from other farmers, seemed resigned to fighting for survival no matter what happened. Small farmers also worried that if larger farmers started to use public lands in the future, they (the small farmers) would obtain less from these lands than at present.

As Wallace (1981) suggests might happen, common property ownership has given rise to a situation in which some

farmers are receiving a subsidy at the expense of the group. Small farmers are presently the recipients of that subsidy. Changing land use practices on public lands pit the interests of the group, including the village leaders and decision makers, against those of the small farmers. The resulting conflict could hinder the cooperation of some or all farmers with land management on public lands. If the present needs of small farmers for forest products can be met in some other way, the conflict between farm-size groups could be prevented.

E. Labor Requirements

Changing land use practices affect not only how and where forest products are collected, but also the labor required to collect these products. Land management plans that call for drastic changes in labor patterns or for more labor than is available to be invested in a chore are unlikely to be adopted. Land management plans sensitive to the farmer's situation are ideally based on an understanding of the labor requirements of all household activities, including agricultural production, livestock husbandry, firewood collecting, off-farm labor, and domestic chores. In this study, only firewood collecting, fodder collecting, and grazing labor patterns were examined. While limited, these patterns can suggest what

kinds of land management options are likely to be acceptable to farmers on the basis of labor requirements.

In Table 6.4, statistics on firewood and fodder collecting and grazing labor patterns are summarizied. Firewood collecting requires about .5 hours per day, fodder collecting 3 hours per day, and grazing 2.2 hours per day. Women provide 63% of the labor required to collect firewood and 50% of that required to collect fodder, while the young and the elderly provide 66% of the labor needed for grazing livestock. Firewood collecting on public lands takes 3 times more labor per unit of weight than on private lands, while fodder collecting takes about the same amount of time on both private and public lands. A majority of the time devoted to collecting firewood is spent during the dry season (February through April), while most fodder collecting takes place during the wet season (June through October) . Labor requirements for grazing livestock are fairly constant all year long. Small and medium-size farmers spend significantly more time collecting firewood and fodder than do large farmers. All three groups spend about the same amount of time grazing livestock. Finally, in terms of economic efficiency (rupees/hour of labor), firewood collecting is the most productive labor farmers perform, whereas animal

husbandry chores (including fodder collecting and grazing) are the least.

Table 6-4. A Summary of Firewood and Fodder Collecting, and Grazing Labor Statistics

Chore	Average Farm Time	Small Farm Time	Medium Farm Time	Large Farm Time	Season of most activity
	(-----hours/day/household-----)				
Firewood	.5	.6	.5	.2	Feb.-March
Fodder	3.0	3.0	3.3	2.0	June-Dec.
Grazing	2.2	2.0	2.8	2.0	April-June

Chore (Continued)	% Women	% Men	% Child	Labor Efficiency (1)	Economic Efficiency (2)
Firewood	63	23	14	3	14.2
Fodder	50	17	33	1	0.5 (3)
Grazing	27	25	48	--	0.7 (3)

(1) Ratio of time spent collecting on public lands to time spent collecting on private lands per unit weight of product.

(2) Rupees per hour of labor

(3) All livestock husbandry chores

It is difficult to assess the implications of these patterns for land management without having specific plans

in mind. Nevertheless, these results imply that some leeway exists for changing firewood labor patterns because of the minimal amount of time required for this chore. This change could be constrained, however, because firewood collecting is clearly a "women's" job; hence changes that call for men to spend more time collecting wood may be resisted. In Chapter 3, it was also suggested that special attention must be paid to the firewood labor requirements of small farmers, because these farmers consume as much wood per capita as do other farmers, yet have fewer private trees from which to collect it and less labor for collecting it on public lands.

These results also suggest that changing fodder collecting and grazing labor patterns may be difficult. This is because of the large amount of time farmers already invest in these activities and because of clear distinctions between the age and sex groups that engage in these two activities. In particular, substituting stall feeding for grazing might be more difficult than is generally believed. This is because fodder collecting requires the labor of healthy adult women, already the most overworked labor sector, whereas grazing makes use of the labor of children and the elderly.

F. Conclusion

This study has shown that while demands for food, fuel and livestock feed all compete for Bhogteni's public land resources, overgrazing is the major cause of degradation on these lands. The study has also shown that the present needs of small farmers for forest products from public lands and the conflict that can arise between these needs and the desire of larger farmers for increased productivity on public lands can hinder the adoption of land management plans on these lands. On the positive side, large and medium-size farmers are interested in managing public lands for increased productivity. Since village leaders are included in this group it is possible that a strong community land management program can be initiated in the village.

No project can maximize food, fuel wood, and fodder production on the same piece of ground at the same time. Since land resources are already scarce and overused, no project can fulfill all the village's land use demands. Meeting local needs will require trade-offs which will become increasingly difficult to make as the population increases. Although maximum amounts of food, fuel, and fodder cannot be grown on the same ground, a recognition of the significant demands, as well as of their conse-

quences on land degradation, may help planners design more workable and acceptable land management plans.

CHAPTER VII

IMPLICATIONS FOR PLANNING AND RESEARCH

A. Introduction

This study was designed to provide insights into one of Nepal's most pressing problems—how to stop public lands from deteriorating while meeting the basic needs of subsistence farmers for forest products from these lands. In this chapter, the conclusions reached in Chapter 6 regarding the causes of land degradation and villager participation in land use management planning are discussed in terms of their meaning for: 1) public land management in Bhogteni; 2) public land management in Nepal; and 3) future research on Nepal's land management problem.

It is not the intention of this work, however, to develop a standard "management plan" or model to be imposed upon any community, even Bhogteni. Rather, the intention of this work is to provide planners with information that will enable them to help communities find the development pattern most appropriate to their particular situation. This study does not provide a solution, but it does suggest ways in which workable and readily acceptable management plans may be designed for the middle-hills of Nepal .

B. Public Land Management in Bhogteni

There are several issues that need to be addressed in designing management plans for Bhogteni's public lands. These include: 1) What is the proper role of the panchayat and the government in managing public lands? 2) How can the community be organized to participate in land management planning? 3) What kinds of management plans make sense in light of the village's short-term needs for forest products and yet provide for the long-term stability of its public lands? and 4) How can land management plans be instituted?

1. Panchayat and Government Roles

The 1978 Community Forestry Law established a legal mechanism whereby the responsibility for, and rewards of, managing public lands can be given, to panchayats or individuals or can be maintained by the government. Given this choice, the type of management (panchayat, government, individual, or a mixture) that can most efficiently establish land use controls on public lands needs to be determined-

Local management of public lands was discussed in Chapter 1. Local participation is important because it promotes the development, protection, and management of village public lands; it assists in the equitable distribution of project costs and benefits; it aids in conflict

resolution; and it provides links to local and outside people and institutions (Odell, 1980). But local management of public lands in Bhogteni is necessary primarily because the other alternatives, private and government management, are not feasiable.

Private management can be ruled out for most of Bhogteni's public lands because it would reserve the products of these lands for the benefit of a few individuals, or would require that the village's 112 hectares of scrub and sal forest be divided equally among the 107 households in the village. The first alternative is probably not politically feasible. Neither large nor small farmers would allow an individual or a small group of farmers to claim an exclusive right to collect forest products from community lands. The second alternative is administratively infeasible. Dividing scrub lands and sal forest that differ vastly in their productivity equally among village households would be impossible. Dividing the village's public lands equally among groups of farmers would also be difficult for political and administrative reasons.

Complete government management of Bhogteni's public lands is not practical. There are only 2 Forest Department officials in Gorkha, who are responsible for enforcing forest department regulations in the entire Daraundi

watershed, approximately 600 square kilometers (APROSC, 1979). During the period of this study no forest official from Gorkha was known to have visited the village. Neither the Forest Office nor donor agencies have sufficient resources to plant and guard afforestation projects in such a large area without community support.

Panchayat or community management of Bhogteni's public lands is probably feasible as long as attention is given to the potential for conflict between large and small farmers over the use of public lands. This problem is explored more fully in the section on management plans.

The mechanism for soliciting a panchayat's cooperation and interest most often discussed in Nepal is the conservation committee. Such committees would organize community conservation activities, with technical and monetary assistance from the government.

2. Community Organization

Campbell (1978) suggests two ways in which community conservation committees could be organized. These are:

a. Organize committees at the panchayat level under the leadership of the Pradhan Panch, ward representatives, and interested farmers from each ward. Sub-committees would be formed at the ward level.

b. Organize committees at the ward level or at the level of a group of wards sharing a common natural resource with optional coordinating at the panchayat level.

The advantage of the first option is that it most closely conforms to the present administrative system and limits the number of committees with which the government has to make contact. From the government's perspective, this option is preferable. The disadvantage of this option is that it does not allow individual wards to form their own committees without the support of the whole panchayat. A greater disadvantage of this option is that it assumes that forest areas correspond to panchayat boundaries, when in fact they may be contained exclusively within a single ward or span two or more panchayats.

The advantage of the second option is that it allows individual wards to act whether or not they have panchayat support. However, this option has the disadvantage of increasing the number of committees with which government officials have to work.

The communal Schima-Castanopsis scrub lands in Bhogteni have been used almost exclusively by village residents. These lands, which qualify to become Panchayat Forests, would be best managed at the ward level, where villagers are interested in their use and preservation. On the other hand, the panchayat's sal forests along the Daraundi river qualify to become Panchayat Protected Forests. No single village claims these forests as its community property, nor uses them as its only source of

firewood and/or fodder. All residents of the panchayat have an interest in these lands as a source of timber for village schools, panchayat offices, etc., as well as for personal use. It would make most sense to manage these lands at the panchayat level.

In Bhogteni a two-tier system, managing Panchayat Forests at the ward level and Panchayat Protected Forests at the panchayat level, might be the best way to organize public land management in the village and the panchayat. Where forests span two or more wards or cover wards in different panchayats, the committees could be expanded to include the wards or panchayats needed to reflect forest boundaries.

In Chapter 6 it was concluded that equity is a major problem with regard to public land management in Bhogteni. Small farmers currently depend on these lands for firewood and tree fodder supplies, while large farmers do not use these lands but would like to see them managed for increased productivity. The conflict of interest that exists between large and small farmers and the fact that village leaders and people of power are all large or medium-size farmers means that the interests of small farmers may not be considered when public land management plans are designed. In order to insure that the interests of small farmers are fairly represented it may be necessary

to require that the number of small farmers on the panchayat and ward conservation committees at least be proportional to their numbers in the community. This is a solution that has been adopted in India under similar circumstances with regard to the distribtuion of irrigation water. In India small farmers near the tail-end of irrigation channels claimed that large farmers near the headworks took more than their share of water supplies. To resolve this problem, irrigation committees on which small farmers compose a majority of the members, were established to control water distribution.

Since in Bhogteni small farmers are the predominant users of public lands, management plans can be initiated only as rapidly as these farmers are willing and able to cooperate with these plans. A conservation committee composed of a majority of small farmers, or at least one on which small farmers are represented in proportion to their number in the community (approximately 50%) should design land management plans that incorporate present needs. Large farmers would benefit by the implementation of management plans on public lands, but the pace of implementation would be set by those most sensitive to land use changes on public lands—the small farmers.

Once established, these conservation committees need defined roles and powers. Campbell suggests the following

distribution of roles between local conservation committees and government officials or land management/afforestation projects.

Possible Roles of Local Committee	Corresponding Roles of Government Projects
Form committee and design conservation activities plan	Encourage, advise, and provide extension/training activities
Protect Panchayat Protected Forests through hiring watchmen and fining offenders	Demarcate Panchayat Protected Forests, contract with committees to contribute 50% of watchmens' cost
Promote conservation ethic	Provide training to committees
Establish areas for reforestation under Panchayat Forest scheme, hire watchmen and assistants for reforestation	Demarcate Panchayat Forest areas, provide seedlings, supervise and provide funds or food-for-work for laborers, provide financial assistance for watchmen
Propose and provide voluntary labor for approved projects such as irrigation, etc., establish local maintenance systems	After feasibility study and approval provide necessary commodities and technical support for construction of these projects

The power delegated to the conservation committees should include the authority to regulate the collection of dar-sukay daura, tree and grass fodder, and grazing rights.

3. Management Plans

Management plans should be sensitive to the the panchayat's present needs for forest products and to the longer-term needs of society for sound land management practices. There are several ways in which land management planners can help Bhogteni meet the present needs of its small farmers for firewood and tree fodder.

a. Short-Term Strategies

The present needs of small farmers for firewood and tree fodder were documented in Chapters 3 and 4. Traditional reforestation projects could take as long as 15 years to meet these needs. Small farmers cannot wait this long. If small farmers are going to be able to cooperate with land management plans, they need access to alternative sources of firewood during the period panchayat forests are being reforested.

Perhaps the most direct method of meeting the present needs of farmers for forest products is to integrate the management of Panchayat Forests with the management of Panchayat Protected Forests. The communal Schima-Castanopsis forests traditionally used in Bhogteni for firewood and fodder would become Panchayat Forests. The sal forests along the Daraundi river that have not been lumbered because of their distance from villages and because of the labor required to fell, split, and trans-

port this wood would become Panchayat Protected Forests. Land management plans designed to close degraded Panchayat Forests near the village to firewood and tree fodder cutting could allow limited amounts of these products to be collected under controlled conditions in the Panchayat Protected Forests. Integrating the use of Panchayat Forests and Panchayat Protected Forests would make it possible to meet some present firewood and tree fodder needs. This policy would also prevent firewood and fodder collecting patterns from simply being shifted, without management controls, to more distant forests when land management is introduced in Panchayat Forests. In addition, Panchayat Protected Forests produce more firewood per rupee of government money invested than does any other policy (Wallace, 1981). Integrating the management of Panchayat Forests and Panchayat Protected Forests would not only alleviate conflict but would also provide for the most efficient use of government resources.

Integrating the use of Panchayat and Panchayat Protected Forests would require that conservation committees be established at the panchayat level so that all residents of the panchayat would be represented in decisions on the use of Panchayat Protected Forests. The option of managing Panchayat Forests at the ward level, however, still remains.

This solution presents several problems. First, integrating the management of the two types of forests requires more than simply closing Panchayat Forests to users during afforestation. Before management plans can be designed which subsititute forest products from Panchayat Protected Forests for those lost from afforested Panchayat Forests, the planner has to have an idea of the amount of forest in the panchayat, its productivity, and the demands that need to be met. The expertise required to obtain this information may constrain an overextended forest service from working in many panchayats. One solution to this problem is to train local farmers in forest inventory and assessment techniques: This has the advantage of utilizing the skills of local personnel as well as insuring that the change 'agent' can communicate both culturally and linguistically with the people in the community.

A second problem that might arise is that imitating firewood and tree fodder cutting in Panchayat Protected Forests may unleash such a flood of illicit cutting on these lands that the project will not be able to control it. The most appropriate responses to this problem are to train local villagers to be forest guards, to educate villagers about the value of the forest, and to insure

that the needs of villagers for forest products are met in other ways.

Either of these problems, assessing forest productivity or controlling illicit cutting, could discourage planners from allowing controlled cutting of forest products in Panchayat Protected Forests. Yet this is the only direct method of meeting the present needs of small farmers for forest products.

A second way in which planners could help the village meet its present needs quickly is to design afforestation programs to produce as much biomass as possible, as quickly as possible. Both firewood and fodder demands can be met by small twigs and branches. By planting exotic tree and bush species at close spacings, it is possible to produce some firewood and fodder within a few years (Moss, 1981). Managing some degraded lands for quick results would meet some present needs, demonstrate the potential of the project to villagers, and solicit further cooperation with land management. The chief problem with this suggestion is that little research has been done in Nepal on planting fast growing species at close spacings. An approach to this problem is to establish research plots in forests near villages. This would meet the demands of researchers for data on forest productivity under field

conditions and provide a useful demonstration to villagers.

A major problem with both of these solutions, integrating Panchayat and Panchayat Protected Forests and planting fast growing species, is how to limit the distribution of forest products from managed forests to those farmers who need them the most. A degree of equity can be achieved by requiring farmers to work for the panchayat or ward conservation committees in order to earn the right to collect these products. For example, the labor required to earn a unit weight of firewood could be set as equal to or slightly greater than the average amount of time required to collect wood on degraded public lands. This would require large farmers to spend 3 times more labor than they presently expend collecting firewood on private lands, and would thus limit interest in collecting these products to those farmers currently using public lands—those with insufficient supplies on their private lands.

A third way to meet some present needs quickly is to encourage farmers to plant fast growing firewood and tree fodder species on private lands. The fact that an average farmer currently collects 75% of his or her firewood and tree fodder on private lands indicates the degree of interest farmers have in maintaining a private supply of

these products. Tree nurseries report that farmers are very interested in acquiring fodder seedlings to plant on their own land. By providing these seedlings, some grass seeds, and a little information about planting and maintaining them, a nursery can make it possible for farmers to increase their private firewood and fodder supplies quickly. This is probably the easiest method of increasing firewood and tree fodder production. From the government's perspective, this is also the most economically efficient of all afforestation projects (Wallace, 1981). The problem with this suggestion is that its fullest effects are limited to farmers with land to spare for growing trees. Small farmers would be only minimally affected by this program.

By providing for the present needs of small farmers for forest products, these 3 suggestions are ways in which government planners can assist Bhogteni and Nareswar Panchayat establish public land management programs.

b. Long-Term Strategies

The long-term objectives of public land management are to minimize land degradation on public lands and to increase the productivity of forest products, specifically firewood and livestock feed. Government planners can help the panchayat accomplish these goals by emphasizing livestock control and afforestation projects.

Since overgrazing is the main cause of land degradation, the first long term priority of land management plans should be livestock control. This includes reducing the number of livestock, eliminating free grazing, establishing rotational and deferred grazing, increasing the availability of tree and grass fodder, and increasing the amount of milk, meat, and manure produced from a limited amount of livestock feed. A ten year scheme for reconditioning village grasslands in India that have been denuded of vegetation by uncontrolled and excessive grazing was proposed by Kumar (see Whyte, 1957). This scheme is still worth considering today.

> One-tenth of the grazing area should be completely closed to all grazing for one year. The grass may be cut after maturity when the seeds have fallen to the ground. This grass hay or straw may be sold to the villagers for stall-feeding or probably stored for use during hot weather. In the following year, another tenth of the grazing area should be added to the first and treated in the same way. After the third year when three-tenths of the area has been reclaimed, the whole may be opened to controlled grazing. The main objective now is to prevent year-round grazing. The animals should be allowed to enter the pasture after the commencement of the rains, by which time the grasses will have made sufficient growth to withstand browsing and trampling. Grazing should end when the hot weather sets in.
>
> This procedure may be repeated until the entire grazing area of the village has been reconditioned. The number of cattle to be grazed in the reclaimed area should equal the carrying capacity of the area or at most should not exceed one-and-a-half times that capacity.' While grassland reclamation is in progress,

> every attempt should be made to reduce drastically the number of unserviceable cattle.

Closure of public lands to grazing livestock will make a significant contribution to ending the land degradation problem. The activities proposed by Kumar, however, will be unpopular with villagers. This is chiefly because of the traditional value Hindu culture places on livestock for reasons of religion and social status, the need of small farmers to utilize marginal lands and labor for every little bit of food or manure obtainable, and the fact that replacing grazing with stall feeding is not consistent with village labor patterns.

In the long run, however, restoration of village public lands and their preservation in a reasonable condition will be practical only when the measures suggested by Kumar have been adopted: closure to permit revegetation, controlled grazing during a limited season, closure during hot weather, and reduction of the number of non-utility animals. Land-use managers have to be inventive and flexible in exploring ways to promote these measures. Livestock management is undoubtedly the most pressing and difficult land use problem to be addressed in Bhogteni.

While livestock management will contribute significantly towards controlling the village's land degradation problem, meeting its growing demands for fuel and fodder

will require afforestation programs. The second long-term objective of land management should be to increase firewood and fodder production. One of the short-term strategies called for producing as much biomass as quickly as possible on some pieces of degraded land. In the longer run, forests can be reestablished that provide sufficient roundwood for fuel as well as for timber needs. Assuming managed lands produce the 11 m3/ha/year of incremental wood growth predicted by the World Bank, Bhogteni needs to manage 65 hectares of public lands to meet its firewood demand in 2000 A.D. (assuming 2% population growth). This is 30 hectares per ward, or 60% of the village's public lands.

Fuel wood can also be conserved by introducing more efficient wood burning stoves or alternative sources of energy such as bio-gas, solar or hydro power. Wallace's analysis of the economic efficiency of energy programs found that bio-gas is the least economically efficient. The efficiency of improved stoves was comparable to that of Panchayat Forests. The analysis, however, did not indicate which policy would be easier to implement. Wallace states:

> Each improved stove can save 2.75 m3/year of fuelwood; this is the amount of fuelwood which can be produced on one-quarter hectare of well managed Panchayat Forest. Is it easier for the government (or the community) to persuade one

> family to adopt an efficient stove then it is to maintain a quarter-hectare of forest? A large fuelwood plantation can be maintained by a few people, but families adopt stoves one by one. On the other hand, once a family is convinced of the advantages of an improved stove—and incurs the costs of building a stove and learning how to use it, the gains are realized far into the future; but a fuelwood plantation requires continual management. Improved stoves also provide immediate benefits, while forests take a long time to grow.

Since public lands can be managed to produce sufficient energy to meet village demands, it may be more efficient to stress afforestation over energy conservation programs. This is not to deny the importance of energy conservation, but to recognize that it probably will be easier to increase wood production than to change the type of fuel or stoves farmers use.

A third problem long-term management plans should address, at least peripherally, is that of food production. As long as food supplies are inadequate, farmers will attempt to grow agricultural crops on marginal lands. Government policy and budgetary allocations for increasing food production should be seen as part of the solution to the public land use problem.

As livestock management and afforestation projects are successfully introduced, other problems, such as eroded trails, poor irrigation ditches, digging red clay

for building houses and glazing walls, etc., can be addressed.

The long-term strategy of public land management in Bhogteni needs to emphasize livestock control and afforestation. The short-term strategy of meeting the minimal needs of farmers for firewood and tree fodder lays the groundwork for soliciting farmer cooperation with long-term programs.

4. Implementing Land Management Plans

Several signs indicate that controls on the use of public' lands might be implemented successfully in Bhogteni. First, during the course of this study large and medium-size farmers indicated a strong desire to manage communal waste lands for increased productivity. If the forest product needs of small farmers can be met from alternative sources, it should be possible to introduce controls on the use of public lands. Second, the village's ability to conduct communal projects, demonstated by the building of a high school and a drinking water system, also indicate that community participation in a land management program is feasible. Community participation, however, has many definitions (Stone, 1980). To some participation means that local people obey an order to contribute resources to a project (labor, money, etc.) . To others participation means that local people play a role

in the planning, implementing, and evaluating of a project. While to still others participation means that a development project originates with the local people and is completed by them with perhaps some technical assistance from outsiders. In Bhogteni villagers clearly define participation according to the first definition—obeying the panchayat's orders to provide labor or other resources to a project. As Stone states:

> That there are other ways and levels of "participation" in development will be a new idea to most villagers. The idea that farmers (wealthy or poor) can bring in development assistance through organizing themselves, initiating plans and activities and willingly assuming responsiblity (as opposed to putting pressure on personnel contacts) will not be taken seriously in the beginning.

This type of participation is sufficient for instituting a land management program if a strong leader or an acceptable outsider provides direction. The five successful community forestry projects reviewed by Campbell (1978) all had in common a strong leader. Four of these projects were initiated by village leaders and one was initiated by a District Forest Officier. The disadvantage of planning a land management program around local leaders in Bhogteni, however, is the difficulty of insuring that the present needs of small farmers for firewood and fodder are met. This problem may not be fatal if village leaders are encouraged to consider the needs of small farmers, if

small farmers are included in the decision making process, if small farmers are allowed to earn the right to collect forest products in Panchayat and Panchayat Protected Forests, and if small farmers are provided a chance to become guards, nurserymen, etc., and given training to do these jobs well.

If these conditions are met controls on public lands may be successfully implemented. The following is a general strategy for afforesting and managing the public lands of Nareswar Panchayat. Since in reality management is an ongoing process constantly being fine tuned to circumstances in the field, this out-line is not meant as the final solution, but as a starting place for management planning.

I. First Year

A. A panchayat conservation committee and an appropriate number of ward sub-committees are established. There could be 9 sub-committees (1 for each ward), or wards that share the same forest resources could form a single committee. In Bhogteni, the two wards that compose the village should from 1 committee. The panchayat committee should be composed of the Pradhan Panch, ward representatives and farmers from each ward. Small farmers (however defined) should be represented on the committee at least in proportion to their numbers in the panchayat. The ward committees should be composed of farmers from the ward. At least 50% of the members of this committee should be small farmers.

B. The panchayat conservation committee hires villagers to help set up a tree seedling and grass nursery. The government pays half of the labor expenses and all of the cost of the nursery. The government also provides technical assistance for establishing the nursery. Tree species are determined jointly by the project forester and the panchayat committee. The nursery should be able to provide enough seedlings for afforesting Panchayat Forests and for meeting farmer demands for seedlings for private plantings.

C. The public lands of the panchayat are surveyed by the government and the boundaries of these lands demarcated. The amount of land, forest type and condition, present land uses, and the amount of firewood and tree fodder being harvested from these lands annually are identified by Forest Department employees or by villagers trained by Forest Department extension officials.

D. The panchayat conservation committee petions the Divisonal Forest Office to have the panchayat's public lands designated as Panchayat or Panchayat Protected Forests.

E. The panchayat and ward conservation committees and forest officials draw up simple well defined management plans that designate the land to be devoted to Panchayat and/or Panchayat Protected Forests in each ward. A portion of this land is slated for quick-growing species at close spacing. Controlled grazing is introduced on the remaining Panchayat and Panchayat Protected Forests. The amount of firewood and tree fodder that can be collected in Panchayat Protected Forests for meeting present needs is determined.

II. Second Year

A. The ward conservation committees hire villagers to clean, plant, and guard Panchayat Forests, and guard grazing lands. Workers are paid in cash (with assistance from the government) or in forest products.

B. The panchayat conservation committee hires villagers, establishes management in Panchayat Protected Forests and allows controlled cutting to meet short-term needs.

C. The panchayat and ward conservation committees work with government extension services to promote better animal husbandry practices, private tree plantings, etc.

III. Third year onward

A. Repeat stage II, adding more Panchayat Forest and grazing lands each year to managed lands until all the panchayat's lands are managed.

B. Begin harvesting quick growing fodder and firewood.

C. In fifth year begin controlled grazing on lands that have been closed for 3 years.

D. In seventh year begin cutting fodder and firewood in Panchayat Forests that have been managed for 5 years.

C. Implications for Land Management in Nepal

Despite the large amount of environmental and cultural diversity found in the middle-hills, enough similarity exists in land use practices to permit a few general remarks about the implications of this study for land use planning. More specifically, the nature of land degradation and its relation to land management policy', and two steps necessary for reducing land degradation, are discussed.

1. The Land Degradation Problem and Farm Needs

Land use practices in Nepal were based on a land-man-cattle-forest relationship that was relatively stable through the centuries. As the human population grew, forests were cleared and converted to agricultural lands. As forests were cut, livestock feed became increasingly scarce. As long as forests were being cleared, however, wood for fuel and timber was plentiful. Once all cultivatable lands were cleared, conflicting demands were placed on forest remnants for meeting livestock feed and wood product demands. Because overgrazed forests cannot regenerate themselves, wood products soon became as scarce as livestock feed.

Different communities began this process from different resource bases and at different times; consequently, land use problems vary widely across the country. For

example, Bajracharya (1981) studied an eastern hill village (Pangma) where public lands can still be cleared and where food needs are still the motivating factor behind deforestation. In Bhogteni, the central hill village of this study, and in Thak, a western hill village (Macfarlane, 1976), few public lands remain that can be converted to agricultural purposes. In these villages food supplies may or may not be sufficient, but grazing livestock are the main cause of land degradation on public lands.

In addressing the public land degradation problem, government and foreign assistance programs should not assume that energy, livestock, food, or any other factor is the major cause of deforestation. The causes of deforestation in each area need to be identified and management plans designed accordingly.

2. Livestock Management

While the causes of land degradation vary enormously across the country, many experts have warned that a major cause of soil erosion/land degradation in the hills is the large number of livestock allowed to graze freely. Cultural biases against controlling the number of livestock are strong. Yet so are cultural biases against birth control. While large amounts of money and effort have been invested in the population problem, little has

been invested in controlling the number of livestock, A national campaign to reduce livestock numbers, to control grazing, and to increase fodder production on private and public lands is essential if the land degradation problem is to be solved. But at the same time the needs of villagers for manure and draft oxen cannot be forgotten.

3. Panchayat and Panchayat Protected Forests

One of the few methods available for addressing the present needs of farmers for forest products is to integrate the use of Panchayat and Panchayat Protected Forests. While the 1978 Forest Law established both categories, the Forestry Department has been very slow in releasing state owned lands for Panchayat Protected Forests. If land degradation problems are to be solved, land has to be managed to meet the needs of the people. The Forestry Department should encourage panchayats to manage Panchayat Protected Forests.

The necessity of establishing community conservation committees at both the panchayat and the ward levels follows as a corollary to integrating the use of Panchayat and Panchayat Protected Forests. Since Panchayat Forests are are often considered to be communal lands, the community that has traditionally used these lands should manage them. This means forming ward-level conservation committees. Since Panchayat Protected Forests are of economic

value to the whole panchayat, these forests should be managed at the panchayat level.

D. Implications for Future Research

Because of time and financial restraints, this study was not able to measure forest productivity rates and relied on literature values for this purpose. The mean annual increment of timber, the standard measure of forest productivity, is of little use in a society where the main forest products are fuelwood and fodder. The productivity of unmanaged public lands, as well as that of lands under different types of management, needs to be better documented. A careful study of the productivity of major sources of firewood, such as tree tops, small trees, and branches, is needed. In addition, a study of deadwood or forest litter generation rates is essential. While several studies have reported on the fodder productivity of privately owned trees, little work has been done on the fodder production of trees on public lands. Nor has any field research been published on the livestock carrying capacity of unmanaged forests and pastures. This type of research is important in order to determine the main causes of land degradation under different environmental and land use conditions. Only when the causes of land degradation are well known can useful land management plans be designed.

In terms of managed lands, more research is required on increasing forest productivity. Since tree fodder and firewood are the most important forest products, research is needed on planting quick growing species at close spacing for the fastest possible production of large quantities of biomass. Research is also needed to document the effects of controlled and rotational grazing programs on grass production and soil erosion rates. Methods of increasing the productivity of fodder and firewood supplies on private lands also need to be studied more.

In terms of livestock management, the effect of a starvation diet on an animal's milk and/or manure production needs to be better documented. If feeding a cow twice as much feed doubles milk and manure production, farmers could keep half as many livestock and still receive as much milk and manure. While this would not reduce a farmer's needs for tree and grass fodder supplies, it would reduce the number of grazing animals. Methods of storing compost could also be improved so as to allow farmers to more efficiently use the manure available to them.

In terms of land use practices, one of the major conclusions of this study was that a potential for conflict among farm-size groups exists over the use of public lands. Yet little is known about the village's decision

making process. Who will take part in decisions as to how public lands are to be managed? At what stage and on what variables will different farm-size groups have input into these decisions? Will an elite of large farmers control these decisions, or will the needs of small farmers also receive consideration? A careful study of decision making in the village and of how farmers participate in this process needs to be made.

In addition studies of indigenous resource management systems, patterns of community cooperation, and ideas and institutions relevant to resource utilization would be useful. Studies are also needed of the effect past development projects have had on the receptiveness of villagers to development projects, villagers' attitudes towards development inputs and extension agents, and their felt needs and interests in various proposed land management activities .

Finally more village-level studies such as the present one are essential for understanding the man-land relationship in Nepal. Managing public lands is not simply a technical problem of devising effective forestry systems, nor simply an economic problem of assessing patterns of supply and demand and developing an economic structure to meet the demand. Successful land management depends upon grafting environmentally sound land use practices on to an

already existing agricultural and land use system. This involves a large element of social and cultural compatibility, which may well be the crucial factor determining the success or failure of land management policies. It is unfortunate that this is too often the element which is most neglected. As Moss (1981) states: "Knowledge of the generalities, let along the subtleties, of the inherent rationalities of the activities of rural communities in the Third World, is in many area minimal or even non-existent." More intensive land use studies are needed across Nepal under different environmental and cultural conditions. Only when Nepal has a thorough knowledge of its lands and their uses can it hope to control their degradation.

BIBLIOGRAPHY

Abell, T.M., 1979. "KHARDEP Phase 2: Draft Forestry Sector Programme for First Year, 1979-80." Kosi Hill Area Rural Development Programme, Planning Document No. 5, Kathmandu.

Abell, T.M., 1981. "Fuelwood and Fodder Collection Within the Kosi Hills." Kosi Hill Area Rural Development Programme, Report No. 25, Kathmandu.

Acharya, M., Bennett, L., 1981. The Rural Women of Nepal: An Aggregate Analysis and Summary of 8 Village Studies. Vol II Part 9, Centre for Economic Development and Administration, Kathmandu: Tribuhuvan Universtiy.

Agricultural Statistics Divison, 1978. Handbook of Agricultural Statistics of Nepal. Department of Food and Agricultural Marketing Services, Kathmandu.

APROSC, 1977. "Prefeasibility Study for Integrated Rural Development Project: Rapti Zone." Kathmandu.

APROSC, 1979. Resource Conservation and Utilization Project. Kathmandu.

Arnold, J.E., 1979. "Wood Energy and Rural Communities." Natural Resources Forum, Vol 3.

Axinn, G., Axinn, N., 1979. "Materials Flow and Energy Tranformation on Small Farms of Nepal: A New Approach to Comparative Analysis of Rural Family Ecosystems." Michigan State University Staff Paper 79-23, Lansing.

Badoux, S.V., 1959. "Pasture and Fodder Development." FAO Report No. 1155 to Government of Nepal, Rome: Food and Agricultural Organization.

Bailey, D.R., 1976. "Interdisciplinary Research-and-Action in Uttar Pradesh Hills." IN Hill Lands: Proceedings of an International Symposium. Morgantown: West Virgina University Books.

Bajracharya, D., 1979. "Firewood Consumption in the Nepal Hills: A Comparison of the Annual Recall and the Weekly Recorded Data." A paper read at the Rapid Rural Appraisal Conference, University of Sussex, Brighton.

Bajracharya, D., 1980. "Fuelwood and Food Needs Versus Deforestation: An Energy Study of a Hill Village Panchayat in Eastern Nepal". Resource Systems Institute, Honolulu: East-West Center.

Banskota, M., 1979. The Nepalese Hill Agro Ecosystem: A Simulation Analysis of Alternative Policies for Food Production and Environmental Change. Unpublished Ph.D. dissertation, Cornell University, Ithaca.

Banskota, M., 1979. "Interaction of Food Production, Household Energy and Environment: A Simulation Approach." Himalayan Review 2:45-64, Kathmandu.

Basler, H., 1975. "The Role of Energy Resources Management and Alternative Energy Sources to the Hill Regions of Nepal." Integrated Hill Development Project, Sun Kosi, Nepal.

Bennett, L., 1981. The Parbatiya Women of Bakundol. The Status of Women in Nepal, Vol 2, Field Studies. Centre for Economic Development and Administration, Kathmandu: Tribhuvan University.

Bhatta, B., Man-Nakarmi, I., Sabnam, K., Speich, A., Watanabe, K., 1977. "Mountain Forest Management for Community Development." Food and Agricultural Organization, Kathmandu.

Bishop, B., 1978. "The Changing Geoecology of Karnali Zone, Western Nepal Himalaya: A Case of Stress." Artic and Alpine Research 10, No 2.

Blaikie, P., Cameron, J., Seddon, D., 1980. Nepal in Crisis: Growth and Stagnation at the Periphery. Oxford: Oxford University Press.

Bromley, D., 1981. "The Economics of Social Forestry: An Analysis of a Proposed Program in Madhya Pradesh, India." Center for Resource Policy Studies, University of Wisconsin, Madison.

Butterfield, S.H., Campbell, J.G., n.d. "The Meaning, Value and Implications of a Participatory Approach to Development." USAID, Kathmandu.

Campbell, J.G., 1978. "Community Involvement in Conservation: Social and Organizational Aspects of the Proposed Resource Conservation and Utilization Project in Nepal." Unpublished Report, USAID/Nepal, Kathmandu.

Campbell, M.W., Joshi, S., 1979. "Seed Collection Times for Afforestation Species in Nepal." Nepal-Australia Forestry Project, Technical Note 1/78, Kathmandu.

Calkins, P., 1976. Shiva's Trident: The Impact on Income, Employment and Nutrition of Developing Horticulture in the Trisuli Watershed, Nepal. Unpublished Ph.D. dissertation, Agricultural Economics, Cornell University, Ithaca.

Cecelski, E., Dunkerley, J., Ramsay, W., 1979. Household Energy and the Poor in the Third World. Research Paper R-15. Washington DC: Resources for the Future.

Center for Economic Development and Administration, 1975. "A Background Study in Regional Development and Recommendations for Rural Development Package Program." Tribhuvan University, Kathmandu.

Center for Science and Environment, 1982. The State of India's Environment. New Delhi: Ravi Chopra.

Cohen, J.M., Uphoff, N.T., 1976. Concepts for Measuring Participation for Project Design, Implementation and Evaluation. Washington, DC: USAID.

Conlin, S., Falk, A., 1979. A Study of the Socioeconomy of the Kosi Hill Area: Guidelines for Planning an Integrated Rural Development Project, Vol I and II. Kosi Hill Area Rural Development Programme, Kathmandu.

Cottam, G., Curtis, J.T., 1956. "The Use of Distance Measures in Phytosociologial Sampling." Ecology, 37.

Das, Gupta, 1967. "Problem of Grassland Improvement in the Hills of Western Himalayas", Indian Forester 93 (1).

Department of Irrigation, Hydrology and Meteorology, 1977. Climatological Records of Nepal 1971-1975. Kathmandu.

Donovan, D.G., 1981. "Fuelwood: How Much Do We Need?" Institute of Current World Affairs, Hanover, New Hampshire.

Dutt, P., Gurung, G.P., 1976. "Fodder, Pasture/Forestry Section Technical Report." Lumle Agricultural Center, Nepal.

Dutt, P., 1977. "Grazing Improvement and Fodder Development in the Middle and High Hills of the Annapurna Region." Lumle Agricultural Center, Nepal.

Dutt, P. 1979. "Preliminary Findings and General Conclusions on Livestock in the KHARDEP Area." KHARDEP Report No. 5, Kosi Hill Area Rural Development Programme, Kathmandu.

Earl, D.E., 1975. Forest Energy and Economic Development, Oxford: Clarendon Press.

Eckholm, E.P., 1976. Losing Ground: Environmental Stress and World Food Prospects. New York: W. W. Norton.

Energy Research and Development Group, 1976. Nepal: The Energy Sector. Institute of Science, Tribhuvan University, Kathmandu.

Fearnside, A., 1977. "Afforestation Word List: English-Nepali." Nepal Australia Forestry Project, Technical Note 2/77, Kathmandu.

Fleming, W.M., 1978. Phewa-Tal Watershed Management Proposals. Phewa Tal Project Report No. 5, Integrated Watershed Management Project, Kathmandu.

Field, D.J., Pandey, K.R., 1969. Pasture, Fodder and Livestock Development. Trisuli Watershed Project Report No. 15, Food and Agricultrual Organization, Kathmandu.

Food and Agricultrual Organization, 1973. Management Plan for the Integrated Development of Phewa Watershed. Phewa Tal Technical Report No. 12, Kathmandu.

Food and Agricultural Organization, 1974. "Working Paper on Livestock Production, Perspective Study of Agricultural Development for Nepal." Kathmandu.

Food and Agricultural Organization, 1978. Forestry for Local Community Development. Forestry Paper No. 7, Rome.

Forest Resources Survey Office, 1973. Forest Statistics for the Hill Region. Department of Forestry, Kathmandu.

Fox, J.M., n.d. "Firewood Consumption in a Nepali Village." forthcoming IN Environmental Management.

Goldsmith, P.F., 1981. The Land and Soil Resources of the KHARDEP Area. KHARDEP Report No. 16, Kosi Hill Area Rural Development Programme, Kathmandu.

Government of India, 1968. "Report of the Energy Survey of India Committee." New Delhi.

Greenland, D.J., 1975. Soil Conservation and Management in the Humid Tropics. New York: John Wiley and Sons.

Griffin, D.M., 1978. "Proposals for Nepal-Australian Forestry Project, Stage 2." Australia Development Assistance Bureau.

Hara, H., Chater, A., Williams, L., 1982. An Ennumeration of the Flowering Plants of Nepal, Vol. I-III. London: British Museum (Natural History).

Hardin, G., 1968. "The Tragedy of the Commons." Science 162, No. 3859.

Hitchcock, J.T., 1966. The Magars of Banyan Hill. New York: Holt, Rhinehart and Winston.

Hitchcock, J.T., 1973. "Ecologically Related Differences Between the Transhumant and a Sedimentary Himalayan Village." Paper presented at the Annual Meeting of the American Anthropological Association, New Orleans.

Hoffpauir, R., 1978. "Deforestation in the Nepal Himalaya: a village perspective." IN Yearbook of the Association of Pacific Cost Geographers, Vol. 40.

Hoffpauir, R., 1978. "Subsistence Strategy and its Ecological Consequences in the Nepal Himalaya." Anthropos 73:215-252.

Hoskins, M.W., 1982, "Social Forestry in West Africa: Myths and Realities." A Paper Presented at the annual meeting of American Association for the Advancement of Science, Washington, D.C.

Howarth, S., 1978. "Energy Resources and Requirements in the Hills of Eastern Nepal." Pakhribas Agricultural Center, Technical Paper No. 29, Dhankuta, Nepal

Hudson, N., 1971. Soil Conservation, Ithaca: Cornell University Press.

Kessler, C.D., 1977. "Notes on the Raising of Some Fodder Trees for the Hills of Nepal." Pakhribas Agricultural Center, Technical Paper No. 11, Dhankuta, Nepal.

Kawakita, J., ed., 1979. "A Study of the Development of Remote Areas in Conformity with Environmental Conservation." Association for Technological Cooperation to the Himalayan Areas, Tokyo.

Kraayenhagen, J., 1980. "Progress in Planning Integrated Watershed Development." Integrated Watershed Mangement Project, Kathmandu.

Kunkle, S.H., Thomas, J.L., 1977. Guidelines for Watershed Management. FAO Conservation Guide No: 1, Rome: Food and Agriculture Organization.

Laban, P., 1978. "Field Measurements on Erosion and Sedimentation in Nepal." Integrated Watershed Management Project, Kathmandu.

Laban, P., 1979. "Landslide Occurrence in Nepal." Phewa Tal Project Report No. WP/13, Integrated Watershed Management Project, Kathmandu.

Lal, R., Russell, E.W., 1981. Tropical Agricultural Hydrology. Chichester: John Wiley and Sons.

Leistritz, L., Murdock, S., 1981. The Socioeconomic Impact of Resource Development: Methods for Assessment. Boulder: Westview Press.

Levenson, B., 1979. Fuelwood Utilization: A Study of the Demand and Available Fuelwood Resources at Six Selected Villages. Phewa Tal Technical Report No. 9, Integrated Watershed Mangement Project, Kathmandu.

Lumle Agricultural Centre, 1975. "Feed Requirements and Manure Production by Buffaloes and Cows at LAC." Lumle Agricultural Center Report No. FOR/T/4/75, Lumle, Nepal.

Macfarlane, A., 1976. Resources and Population: A Study of the Gurungs of Nepal. Cambridge: Cambridge University Press.

Malla, 1977. "Fodder Tree Production Study." Pakhribas Agricultural Center Technical Paper No. 49, Dhankuta, Nepal.

Manandhar, P.K., 1981. "Introduction to Policy, Legislation and Programmes of Community Forestry Development in Nepal." Community Forestry Development Project, Field Document No. 1, Kathmandu.

Mathema, S.B., Van Der Veen, M.G., 1980. "The Role of Livestock in the Farming Systems in Two Cropping Systems Sites of Nepal." Cropping Systems Program Technical Report, Department of Agriculture, Kathmandu.

Mauch, S., 1974. "The Long Term Perspective of the Region's Forest Resources." Unpublished Paper, Integrated Hill Development Project, Swiss Association for Technical Assistance, Kathmandu.

Mauch, S., 1975. "The Role of Energy Resource Management and Alternative Energy Sources for the Hilly Regions of Nepal." Internal Integraged Hill Development Project Report Draft, Swiss Association for Technical Assistance, Kathmandu.

Mauch, S., 1976. "The Energy Situation in the Hills: Imperative for Development Strategies?" IN Mountain Development and Environment, Kathmandu: Tribhuvan Universtiy Press.

Messerschmidt, D.A., 1976. "Ecological Change and Adaptation Among Gurungs of the Nepal Himalaya." Human Ecology 2:167-183.

Milcke, H., Bucheli, J., Chitrakar, K., 1974. "Utilization of Timber Along the Proposed Lamosanghu-Jiri Road in the Kalinchauk Area." Swiss Association for Technical Assistance, Kathmandu.

Moss, R.P., Morgan, W.B., 1981. Fuelwood and Rural Energy Production and Supply in the Humid Tropics. Dublin: Tycooly International Publishing.

Mulder, R.P., 1978. A Soil Survey of Phewa Tal Catchment. Phewa Tal Technical Report No. 4, Integrated Watershed Management Project, Kathmandu.

Mulder, R.P., 1978. "Erosion Plot Measurements in Phewa Tal Catchment." Phewa Tal Technical Report No. 6, Integrated Watershed Management Project, Kathmandu.

National Academy of Science, 1980. Proceedings: International Workshop on Energy Survey Methodologies for Developing Countries. Washington DC: National Academy Press.

National Academy of Science, 1980. Firewood Crops: Shrub and Tree Species for Energy Production. Washington DC: National Academy Press.

Nelson, D., 1980. "A Reconnaissance Inventory of the Major Ecological Land Units and their Watershed Condition in Nepal." Integrated Watershed Management Project, Kathmandu.

Nepal Recorder, 1978. "Panchayat Forest Rules, 1978." Nepal Press Digest, Kathmandu.

Odell, M.J., 1981. "Local Institutions and Management of Communal Resources: Lessons from Asia and Africa." Paper Presented at the Annual Meeting of the Rural Sociological Association, Guelph, Ontario.

Panday, K.K., 1976. "The Livestock, Fodder Situation and the Potential of Additional Fodder Resources." IN Mountain Environment and Development, Kathmandu: Tribhuvan University Press.

Pereira, H.C., 1973. Land Use and Water Resources. Cambridge: Cambridge University Press.

Pradhan, B., Bennett, L., 1981. "The Role of Women in Hill Farming Systems." Seminar Proceedings: Appropriate Technology for Hill Farming Systems, 22-26 June, Kathmandu.

Rajbhandary, N.B., Shah, S.G., 1981, "Trends and Projection of Livestock Production in the Hills of Nepal." Paper presented at the Seminar on Nepal's Experience in Hill Agricultural Development, Kathmandu.

Ramaswami, S., 1932. "Calorific Values of Some Indian Woods." Forest Research Institute (Chemistry Series) Forestry Bulletin No. 79.

Reddy, A.K., 1981. "An Indian Village Agricultural Ecosystem--Case Study of Ungra Village." Biomass Vol 1: 61-88.

Regmi, M.C., 1976. Landownership in Nepal. Berkeley: University of California Press.

Regmi Research Ltd, 1978. "Forest Legislation: 1) Private Forests Nationalization Act, 1957; 2) Forest Protection Act, 1967." Nepal Miscellaneous Series, Vol 16/78, Kathmandu.

Regmi Research Ltd, 1978. "Forest Act, 1961." Nepal Miscellaneous Series, Vol 15/78, Kathmandu.

Robbe, E., 1954. "Report to the Government of Nepal on Forestry." ETAP Report No. 209. Rome: Food and Agriculture Organization.

Rockefeller Foundation, 1976. "A Study of Hill Agriculture in Nepal." Unpublished Paper.

Russell, T.D., 1977. "Soil Conservation at Pakhribas Agricultural Centre." Pakhribas Agricultural Centre Technical Paper No. 13, Dhankuta, Nepal.

Salem, B.B., van Nao, T., 1981. "Fuelwood Production in Traditional Farming Systems." UNASYLVA, Vol 33, No 131.

Sherpa, N.W., 1979. "A Report of Firewood Use in Sagarmatha National Park, Khumbu Region, Nepal." Unpublished paper, Sagarmatha National Park, Namche Bazar, Nepal.

Singh, R.V., 1978. "Solution of Energy Crisis in Rural Areas Lies in Farm Forestry." Indian Forester, July: 463.

Stainton, J.D.A., 1972. Forests of Nepal. New York: Hafner Pub. Co.

Steiger, J., 1981, "Economic Aspects of the Utilization of Renewable Energy Resources in Nepal." Paper presented at the Workshop-Seminar on Renewable Energy Resources in Nepal, Research Centre for Applied Sciences and Technology, Kathmandu.

Stone, L., 1980. Case Studies of 5 Villages. Vol 5 Summary, Tinau Watershed Project, Center for Nepal and Asian Studies, Tribhuvan University, Kathmandu.

Tinau Watershed Project, 1980. "Tinau Watershed Management Plan." Swiss Association for Technical Assistance, Kathmandu.

Tengnas, Bo., 1981. "Community Forestry Development in Tanahu District, Gorkha Forest Division 1980-1981." Community Forestry Development Project Miscellaneous Document No. 4, Kathmandu.

USAID, 1978. "Nepal--Rad/RCUP Design Project." Washington, D.C.

Van Gelder, A., 1978. "The Integrated Watershed Management Approach for Erosion Control Project Formulation." Integrated Watershed Mangement Project, Kathmandu.

Vollenweider, R.A., 1968. Nutrients and Eutrophication: A World Review. Paris: OECD.

Wallace, M.B., 1981. Solving Common Property Resource Problems: Deforestation in Nepal. Unpublished Ph.D. dissertation, Public Policy, Harvard University, Cambridge.

Whyte, R.O., 1957. The Grassland and Fodder Resources of India. New Delhi: The Indian Council of Agricultural Research.

Whyte, R.O., 1968. Land, Livestock and Human Nutrition. New York: Praeger.

Wiart, J., 1983. Ecosysteme Villageois Traditionnel En Himalaya Nepalais: la production forestiere suffit-elle aux besoins de la population? Ph.D. Dissertation, Ecologie Appliquee, Universite Scientifique et Medicale de Grenoble.

Williams, R.C., 1967. "Forestry in Nepal." Unpublished Report of the Chief Conservator of Forests, 1962-1966.

Wormald, T.J., 1976. "Village Forestry in The Hills of West Central Nepal." Lumle Agricultural Center, Lumle, Nepal.

Wormald, T.J., 1976. "A Report on Village Forestry." The Gurkha Reintegration Scheme, British Embassy, Kathmandu.

World Bank, 1973. "Economic Situation and Prospects of Nepal." Document of South Asia Project Department, Washington D.C.

World Bank, 1978a. Nepal Forestry Sector Review. South Asia Projects Department Report No. 1952-NEP, Washington, D.C.

World Bank, 1978b. "Draft Report of the Nepal Community Forestry Development Project Identification Mission." FAO/World Bank Cooperative Programme Report No. 58/78 Nep 11, Rome: Food and Agriculture Organization.

World Bank, 1979. "Nepal Community Forestry Project, Preparation Mission." FAO/World Bank Cooperative Programme Report No. 16/79 Nep 12, Rome: Food and Agriculture Organization.

World Bank, 1980. "Nepal Staff Project Report Appraisal of the Community Forestry Development and Training Project." South Asia Projects Department Report No. 2663a-NEP, Washington, D.C.

Wyatt-Smith, J., 1981, "The Agricultrual System in the Hills of Nepal: Ratio of Agricultrual to Forest Land and the Problem of Animal Fodder." Unpublished Paper, British Technical Cooperation in the Nepal/UK Silvicultural Research Project, Kathmandu.

GLOSSARY

bari	unirrigated agricultural land
bhat	boiled rice
bhyanjyang	mountain or hill pass
bij	an area of land described by the amount of seed required to plant it
Brahmin	Hindu caste whose male members wear sacred thread and may serve as priests
Chhetri	Hindu caste whose male members wear sacred thread but are below Brahmins in rank
Damai	Hindu caste whose members are untouchable and work as tailors and musicians
Dasain	major Hindu festival in Nepal
dar-sukay daura	dead branches and twigs used for firewood
daura	general term for firewood
gharbari	home garden
ghās	grass fodder
jaād	beer
jhikra	crop residues, old fences, etc. used for fuel
kācho daura	fresh cut (wet) firewood
Kami	Hindu caste whose members are untouchable and work as blacksmiths
khaja	snack
khet	irrigated agricultural land

kūdo	mash cooked for livestock
mana	volume measure, about 1 pint
mato muri	land area described by the amount of land required to produce 1 muri of unhusked rice
muri	volume measure equal to 20 manas
Newar	indigenous people of the Kathmandu Valley
Panchayat	local administrative unit
parma	system of exchange labor
raksi	distilled alcohol
ropani	land area, about 125 m2
rook ko ghās	tree fodder
Sarkai	Hindu caste whose members are untouchable and work as shoemakers
sarkari	government property
sarvajanik	communal property
tiraj	tax records
vyatigat	private property

APPENDIX 1

TREE SPECIES FOUND IN BHOGTENI

The following is a list of some of the trees found in Bhogteni. Most of these trees are cut for firewood and/or fodder.

Family	Genus	Species	Nepali Name
Betulaceae	Alnus	nepalensis	utis
Combretaceae	Terminalia	bellirica	bori, barro
		chebula	harro
Dipterocarpaceae	Shorea	robusta	sal
Euphorbiaceae	Bridelia	retusa	gaiyo
	Phyllanthus	emblica	amala
Fagaceae	Castanopsis	indica	katus
Lauraceae	Litsea	monopetala	katmera
Leguminosae	Albizia	mollis	rato siris
	Bauhinia	purpurea	Taki
		variegata	koirala
	Erythrina	arborescans	phalaydo
Loganiaceae	Buddleja	asiatica	dhurselee
Lythraceae	Lagerstroemia	parviflora	buddhairo
	Woodfordia	fruticosa	dhangeri
Moraceae	Autocarpus	integra	rukh katahar
		lakoocha	badahar

	Ficus	benghalensis	bar
		lacor	kabro
		religiosa	pipal
		sp.	dumri
		sp.	tidu, khalu
Myricaceae	Myrica	esculente	kaaphal
Myrtaceae	Psidium	guajava	belauti
	Syzygium	cumini	jamun
Oleaceae	Fraxinus	floribunda	laakuri
Proteaceae	Grevillea	robusta	kolyo
Rubiaceae	Wend1andia	sp.	rato kolyo
Sapotaceae	Madhuca	longifolia	mewa
Theaceae	Schima	wallichii	chilaune

APPENDIX 2

DAILY RECALL SURVEY[1]

A. Household Census

Name of household members	Identification Number	Sex	Age	Relation to Head of Household

	Marital Status	Education

B. Livestock Population

Name of Livestock	Identification Number	(--Lactating Cows/Buffalo--) Birth date	Date of first calving	Date of last calving

[1]This survey is borrowed, with alterations, from the questionnaire used by Stone (1980) in the Tinau Watershed Project. I am grateful to Dr. Stone for permission to use it.

C. Land Holdings

Name of unirrigated lands owned	Area (bij) *	Identification Number
Name of irrigated lands owned	Area (mato muri) *	Identification Number
Name of unirrigated lands rented in or out	Area	Identification Number
Name of irrigated lands rented in or out	Area	Identification Number

* Bij is a measure of land defined by the amount of seed required to plant it. Mato muri is a measure of land defined by the amount of land required to produce a muri of rice.

D. Daily Record of Livestock Milk Production
(asked with regard to the previous day only)

Date	Livestock (Id. No.)	Amount of milk	Remarks

E. Weekly Record of Agriculture Cropping Patterns: Inputs and Outputs *
(asked with regard to the previous week)

Date	Field Id. No.	Crop	Seed			Compost			Irrigation		Chemical Fertilizer				Paid Labor		Bullocks			Total Cost	Total Yield	Remarks
			Kind	Amount	Source	Kind	Amount	Source	Source	Cost	Kind	Amount	Cost	Source	Days	Cost	Own	Hired	Cost			

*Amounts of compost, and crop yields were recorded in local units of volume and later converted to kilograms

F. Weekly Record of Household Budget
(asked with regard to the previous week)

Date	Cash Expenses	Purpose	Cash Income	Source

	In-Kind Expend-diture	Purpose	In-Kind Income	Source

Remarks

G. Weekly Record of Gathering Patterns *
(asked with regard to the previous week)

	(---------Firewood Collecting----------			
Date	How Much	Kind (species)	Place (Id. No.)	Time (hours)

-----)	(----------Forest Litter----------)			
Who Id.No.	How Much	Place (Id. No.)	Time (hours)	Who Id.No.

Firewood Consumption
Amount burned yesterday

*Amounts of firewood and forest litter gathered and consumed were recorded in local units of volume and later converted to kilograms.

H. Daily Record of Grazing
(asked with regard to the previous day only)

Date	Livestock Grazed Id. No.	Who did Grazing Id. No.	Time (hours)	Place Id. No.

Travel Time (minutes)	Remarks

I. Daily Record of Fodder Collecting
(asked with regard to the previous day only)

Date	Kind (grass or tree)	How Much	Who Collected (Id. No.)	Time (hours)

Place (Id. No.)	Travel Time (minutes)	Remarks

APPENDIX 3

TIME ALLOCATION SURVEY[1]

Daily Activities

A. Animal Husbandry

1. Grazing on public land
2. Grazing on private land
3. Fodder collecting on public land
4. Fodder collecting on private land
5. Care and feeding of animals within compound
6. Castrating/breeding
7. Shearing
8. Milking
9. Butchering
10. Other

B. Agriculture

1. Land preparation
2. Terrace upkeep and repair
3. Collecting and preparing organic fertilizer
4. Carrying and spreading organic or chemical fertilizer
5. Seed bed preparation, sowing, transplanting
6. Weeding
7. Irrigating
8. Harvesting
9. Threshing and cleaning grain
10. Horticulture
11. Kitchen gardening
12. Seed selection and storage
13. Guarding/protecting crops
14. Other

[1]This survey is borrowed with minor changes from Acharya and Bennett (1981). I am grateful to Dr. Bennnett for permission to use it.

C. Hunting and Gathering

1. Hunting wild animals, birds, etc.
2. Fishing
3. Gathering of materials for craft production (hemp, bamboo, leaves, etc.)
4. Gathering of edible foods (mushrooms, fruits, tobacco, nettles, etc.)
5. Collecting medicinal herbs
6. Collecting or preparing firewood
7. Other

D. Manufacturing

1. Textile
2. Rope/basketry
3. Blacksmith work
4. Leather work
5. Sewing
5. Other

E. Food Processing

1. Husking/drying grains, post husking winnowing
2. Roasting, grinding, oil pressing
3. Liquor making
4. Food preservation (drying meat, vegetables pickling)
5. Preparing dairy products (ghee, curds, cheese)
6. Other

F. Participation in Local Economy

1. Government Service
2. Wage labor (agriculture, construction, animal husbandry, portering, fuel gathering)
3. Trade (sale of food grains, dairy products and other food stuffs, of livestock or manufactured goods) .
4. Hotel, tea-shop, beer house, store
5. Lending/borrowing
6. Medical and religious service (for wages)
7. Entertainment (for wages)
8. Other

G. Construction

1. Building and repairing house
2. Constructing and reparing compound or field walls, animals sheds, out-buildings
3. Well-digging
4. Constructing dhiki, mills, grinding stones
5. Other

H. Domestic Activities

1. Cooking/serving
2. Cleaning dishes and pots
3. Cleaning house/mud plastering
4. Washing clothes and bedding
5. Fetching water
6. Shopping
7. Other

J. Child Bearing and Child Care

1. Child birth/recovery period
2. Tending
3. Feeding
4. Bathing/cleaning
5. Oiling and massaging
6. Other

K. Education

1. Academic
2. Non-formal
3. Other

L. Other Activities

1. Grooming and personal hygiene
2. Sickness/treatment
3. Eating

M. Social Activities

1. Ritual (for self or neighbor without pay)
2. Voluntary labor
3. Political service (Panchayat, etc.)
4. Voluntary community service (school, committee, youth organization, women's organization, etc.)
5. Other

N. Leisure

1. Drinking alcohol
2. Gambling/card playing
3. In-village visiting
4. Inter-village visiting
5. Sleeping
6. Other

APPENDIX 4

CENSUS SURVEY

A. Household Composition—Same as Daily Recall Survey

B. Livestock Population—Same as Daily Recall Survey

C. Land Holdings—Same as Daily Recall Survey

D. Firewood Consumption

1. How many chulos (a closed stove) are in your home?

2. How many agenas (a tripod for cooking over an open fire) are in your home?

3. If you make jaad or raksi how often do you make it in a month?

4. Do you make jaad or raksi on a chulo or an agena?

5. How much firewood does it take each time you make jaad or raksi?

6. How many times a day do you make kudo?

7. Do you prepare it on an agena or a chulo?

8. How much firewood does it take per day to make kūdo?

9. How many times do you heat water for laundry in a year?

10. How much firewood does it take each time?

11. How many times to you prepare khaja (snack) per day?

12. How much firewood does it take each time?

13. Do you prepare khaja on a chulo or an agena?

14. How many times do you make charcoal in a month?

15. How much firewood does it take each time?

16. Do you ever sell firewood or charcoal?

17. If so, how many times per year and at what rate?

18. Do you ever buy firewood or charcoal?

19. If so, how many times per year and at what rate?

20. How much firewood do you burn on a day in the warm season?

21. How much firewood do you burn on a day in the cold season?

E. Among the following activities which do you consider to be the three most troublesome?

1. Firewood Collecting
2. Fodder Collecting
3. Grazing Place
4. Irrigating
5. Rebuilding the School
6. Other (list the problems you consider troublesome)

F. Buying/Selling Trees

1. Have you ever bought a grown tree for any purpose? If so:

Number of trees	Purpose	Year	Rate

2. Have you ever sold a grown tree for any purpose? If so:

Number of trees	Purpose	Year	Rate

G. What fodder trees do you own?

Tree Name	Did you Plant it	How Many

Which of these do you like the best?

1. _____
2. _____
3. _____

H. What firewood trees do you own?

Tree Name	Did you Plant it	How Many

Which of these do you like the best?

1. _____
2. _____
3. _____

I. Buying/Selling Straw and Fodder

Have you bought/sold any straw or fodder this year? If so:

Kind	Amount	Price per unit

Have you been paid or paid any straw or fodder for labor services? If so:

Kind	Amount	Days labor per unit

J. Forest Litter

In a week how much forest litter do you collect for livestock bedding or compost?

Is this primarily tree or grass fodder?

Do you collect this litter all year long or only during certain months? If during certain months, what months?

K. Land Clearing

Since you inherited your land how much khet or bari have you cleared?

Name of land	Year Cleared	What was there before	What is the yield of this land per year

L. Buying/Selling/Morgaging Land

Since you inherited your land have you sold any of it?

Name of land	Irrigated or unirrigated	Amount of land	Price	Year

Since you inherited your land have you bought any land?

Name of land	Irrigated or unirrigated	Amount of land	Price	Year

Since you inherited your land have you morgaged any of it?

Name of land	Irrigated or unirrigated	Amount of land	Value	Year

M. Sharecropping

Do you sharecrop for someone else or give any of your land to someone to sharecrop?

Name of Land	Amount of land	Crop Planted	Average Harvest
	Amount of Seed	Amount of Fertilizer	

Do you provide (receive) seed? How much?

Do you provide (receive) fertilizer? How much?

N. Fallow

Do you have any thatching grass land, fallow land, or private forest?

Name of Land	Type of Land	Amount of Land

If fallow, why?