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Livelihood Systems, Adaptive Strategies and Sustainability Indicators in the Western Indian Himalaya

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Abstract

The paper is based on an interdisciplinary team project in Kullu District, Himachal Pradesh, in the Western Indian Himalaya, and concentrates on three themes: land use and property-rights systems through which the local people interact with their environment; adaptive strategies used for sustainable livelihood security in the face of ecological, social and economic change, with focus on women's roles; and changes in the forest ecosystem and "signs and signals" of sustainability as perceived by the people of the area. Local villagers are recognized as actors who define what is important and relevant, rather than merely the objects of study. Their perspectives provide two important findings: (1) adaptive strategies used by households and villages are diverse and contribute to the resilience of the social system and the natural system, and (2) villagers recognize a complex array of signs and signals, that are biophysical, social and economic in nature, and that may be seen as indices of sustainability. Village institutions are "fuzzy" and resilient, and are the basis of both the system of adaptive strategies and the system of signs and signals. These institutions seem well adapted to fit into a decentralized, integrated, participatory resource management framework.

1. Introduction

The linkages between social systems and ecological systems are part of everyday life in many rural communities around the world. From the point of view of these people, social systems and natural systems may be so closely intertwined that it may be difficult to delineate two distinct kinds of systems. In some cases, local perceptions of "sustainability" of the environment is one and the same as the perceptions of livelihood security In some cases, the indicators of sustainability may be as much about natural systems as they are about social systems. Understanding changes in the environment is the first step to adapting Thus, indicators of sustainability are those signs and signals that enable the recognition of key changes which, in turn, may give rise to new adaptive strategies or help fine-tune the old This chapter will explore these ideas, using a case study from a mountain environment in the Western Indian Himalaya.

The literature on the Himalaya indicates widespread concern with deforestation and sustainability, especially in the Central Himalayas (Singh et al 1984, Moench 1989; Rai et al 1994) In part, the problem is related to forces of industrialization and globalization with their negative impacts on biodiversity and cultural diversity (Shiva 1993) In part, it is related to population pressure; as Bhati (1983) states it, the issue in these hill areas is how to meet basic human needs without simultaneously destroying the forest environment In part, the problem is related to the historical development of forest policy. In India, as elsewhere, colonial powers nationalized forests to expedite the extraction of timber and to generate revenue (Gadgil and Guha 1992) "Sustained timber yield and conservation of these forest lands has been the principal objective of most of the different forest land categories since that time, that is, since the 1800s (ODA 1994: 5). Large-scale commercial cutting of the Himalayan forests began 1865 in the Garhwal Himalaya and resulted in the removal of much of the rich deodar forest of the area (Denniston 1993). This produced not only an biophysical sustainability problem but also a social sustainability problem. Local people were excluded from the decision-making process, making it difficult for them to meet their basic needs from the resources of the forest (Bandyopadhyay 1992)

After independence, in India as elsewhere, a centralized model of forest management continued (Durning 1994) Decades of state management of local resources touched off cycles of

social protest in the Indian hill country. In Uttar Pradesh, the Chipko ("hug the trees") movement, a grassroots resistance movement, succeeded in the mid-1970s to stop commercial felling (Guha 1989). In response, the Indian government halted large-scale commercial forestry throughout the Indian Himalaya at least until 1996 (Denniston 1993). However, there is resistance to recognizing forest-dependent villages as legitimate users of the products of forest ecosystems (Shiva 1991). Some successful initiatives to return forests to community-based management in Nepal and India have resulted in new policies favouring participatory management or co-management (Messerschmidt 1993; Durning 1994). As Gadgil and Guha (1995) have pointed out, there seems to be a growing consensus to replace the pattern of centralized, sectoral, bureaucratic management of natural resources with a decentralized, integrated, and participatory management system.

The issue revolves around **sustainable livelihood security**, an integrating concept in which **livelihood** is defined as adequate stocks and flows of food and income to meet basic needs; **security** refers to secure ownership of, and access to, resources and income-generating activities; and **sustainable** refers to the maintenance or enhancement of resource productivity on a long-term basis (Chambers 1988 9) Titi and Singh (1994) defined **sustainable livelihoods** as people's capacities to generate and maintain their means of living, enhance their well-being and that of future generations, and defined **poverty** as "a condition of lack of access to options and entitlements which are social, political, economic, cultural and environmental". The term **adaptive** is used to mean anything that increases the probability of survival **Adaptive strategies** are the ways in which local individuals, households and communities change their productive activities, and modify their community rules and institutions to secure livelihoods (Titi and Singh 1994). **Coping strategies** are defined as "the bundle of poor people's responses to declining food availability and entitlements in abnormal seasons or years" (Davies 1993)

A livelihood is sustainable to the extent that it can deal with and recover from stress and shocks, and provide opportunities for the next generation (Chambers and Conway 1992). These capacities depend on the availability and accessibility of options which are "predicated on equity, ownership of resources and participatory decision-making" (Titi and Singh 1994). Hence the concept of sustainable livelihoods is closely related to participatory development (Chopra and Kadekodi 1991), empowerment (Singh and Titi 1995), and property rights issues (Hanna and Munasinghe

1995). Women's work is of special interest because in many areas of the world, India included, the main impact of nonsustainable practices is most strongly felt by rural women (Shiva 1991). Indeed, Agarwal (1992) argues that it is women who most often respond first for the protection of the environment and of resources needed for the family's livelihood

In many rural areas of the Third World, those of India included, there often is a close relation between livelihood security and access to common-property resources (defined here as the class of resources for which exclusion is difficult and joint use involves subtractability). Jodha (1992) observed that a dominant long-term trend was the conversion of resources used in common into private property and state property, with the consequent disempowerment of those most dependent on the commons. In mountain environments, many natural resources have historically been used as commons (Messerschmidt 1993). Singh et al (1984) have argued that the viability of agriculture in the hills of Uttar Pradesh was related to that of common-property resources. The reason for this is that agriculture in these areas is dependent on inputs from the forest and grazing commons that surround agricultural land (Pandey and Singh 1984; Moench 1989). Although most Himalayan forests are under the control of the Forest Department, "they are regularly used by villagers and viewed as 'their' forests" (Moench 1989)

This chapter is based on work carried out in the Manali area of the Kullu Valley in Himachal Pradesh, India (Berkes et al 1995, Ham 1995, Duffield 1995), an area famous for its beauty. The landscape is predominantly green, and the population is relatively well off As such, the Manali area provides an opportunity to investigate conditions for environmental and social sustainability, at least relatively speaking, in the context of rural India and mountain environments in general However, it is an area of rapid economic and social change, conflicting interests, and mounting pressures on natural systems that put sustainability under jeopardy Following some background on the area and the people, the chapter first investigates land use and property-rights systems through which the local people interact with their environment. Second, the chapter deals with adaptive strategies used for sustainable livelihood security in the face of ecological, social and economic change, with focus on women's roles. Third, the chapter focuses on changes in the forest ecosystem, and on signs and signals of sustainablity, as perceived by the people of the area.

2. Study Area and the People

The study area, centred on the town of Manali in the Kullu Valley, lies within the Pir Panjal Range of the Western Himalaya (Fig. 1). It is defined by the Upper Beas watershed, an area of great cultural and historical importance as the refuge and inspiration of the Great Indian epics. The area has been the destination of pilgrimages for centuries. The Beas River is the central axis and focus of the Kullu Valley which extends some 70 km from Bajaura in the south to the Manali area in the north. The Valley supports intensive land use and the majority of the regional population; it is as much as 3 km wide in some reaches and narrower elsewhere

The area is a typical high mountain environment characterized by vertical zonation of eco-climatic zones, controlled by decreasing temperature with increasing elevation. Valley bottom elevation in the Manali area is about 2,000 m. The immediate valleyside slopes rise another 2,500 m to an elevation of 4,500 m. Set back from these slopes are the major summits of the region which rise to 6,500 m The major summits and their surrounding mountain groups support small to medium-sized glacier systems which act as important water sources for the Beas and its tributaries. The climate of the area is characterized by a cool, snowy winter, and a relatively warm, wet monsoonal summer, with a mean maximum temperature of 25° C. Mean annual precipitation is approximately 1,200 mm Fully 50 percent of the annual precipitation falls in just three months, during the summer monsoon in July, August and September

With gain in elevation in the Manali area, temperature decreases. At the highest elevations used by Manali area pastoralists, about 4,000 m, a well-developed snow cover persists from November to July Climatic treeline in the Upper Beas watershed is at about 3,500 m. Above this elevation are extensive areas of alpine tundra vegetation which serves as a traditional resource base for summer transhumance grazing and the collecting of medicinal plants. Below the treeline is a mixed deciduous/coniferous forest interspersed with open meadow areas, grading into extensive areas of Himalayan coniferous forest at lower elevations. Lower on the valley slopes, the forest grades into small pockets of temperate forests and large areas converted into agricultural uses, including fodder production, orchards, horticulture, grain and, at lower elevations, rice cultivation.

The Hindu culture of the study area is distinct from both plains Hindu culture and tribal

cultures The people and culture of the Western Himalayas, and the Kullu Valley specifically, are identified by the collective term, Pahari (literally, "of the mountains") (Berreman 1970). One of the most striking characteristics is a distinct caste system based on a major division between the dominant Rajput caste and Scheduled Castes ("untouchable"; *harijan*; Service Castes). Those belonging to the Rajput caste are the primary landowners in the Valley. However, almost all of the households in the two study villages owned some land. Previously landless people had been given *natour* allocations from land previously classified as Undemarcated Protected Forest (UPF), a practice discontinued by the government in 1990 (ODA 1994. 5, 7).

"The Himalaya is a vertical archipelago of ethnic and cultural diversity" (Denniston 1993), but cultures are changing rapidly. Cultural transformation in the Kullu Valley is being driven by economic changes related to the development of export-oriented agriculture (mainly apple orchards) and tourism. It is also changing with increased contact with the plains culture through television, radio and tourism. The contemporary Kullu Valley supports a mix of traditional Pahari and other Hindu cultures, tourists, tribal people, Tibetans, Nepali and Kashmiri

3. Resource Use Systems, Property Rights, Local Institutions

In the Kullu Valley, each village has a resource area which usually includes a series of zones agricultural land on the valley bottom, mixed-use land, including some orchards and grazing land, upslope from the village, protected forest on the upper slopes and on the mountains of the interior; and forest meadows and alpine grazing land at higher elevations. This land use pattern is seen also in the two villages near Manali which were chosen as study areas, Goshal and Chachoga (Fig 2).

Chachoga has 155.ha of forest use area, while Goshal shares access to 1388 ha: The forest use area available per household in each village can be calculated given the number of households Chachoga, with 80 households, has approximately 2 ha of forest per household. Goshal, with 130 households, has approximately 5 ha per household (since Goshal shares access to 1388 ha with two other villages). However, much of Goshal's forest is relativly unproductive alpine and subalpine forest and meadow. In contrast, over two-thirds of Chachoga's forest use area is highly productive deodar forest Chachoga has approximately 83 ha of agricultural land, or about 1 ha per household. Goshal

has approximately 107 ha of agricultural land, or about 0 8 ha per household These figures are similar to the overall average of 1 ha per household in Kullu Valley, as estimated by ODA (1994)

Figure 3 shows a conceptual model of the flows of biophysical products and services upon which people of the two villages rely for direct use or income. The model shows that the villages are supported by materials, services, and income from system components of forests, pastures, agriculture and horticulture, livestock, and tourists. The first three of these components are directly based on the inputs of solar energy and moisture, which are further shaped by factors of altitude, soil quality, gradient, aspect, and climate moderation linked to forests. Indeed, these latter five factors are profoundly important in mountain ecosystems because they create a high degree of micro-climatic diversity and thus biodiversity To justify the biophysical focus of the model, it is assumed that people rely directly or indirectly upon biophysical components and flows as the basis for their livelihoods The biophysical system thus forms a basic foundation for sustainability upon which social, cultural, and economic factors play their part

In terms of importance to village livelihoods, forest--livestock--horiculture/agriculture--pasture make up an integrated system. As natural capital, the forest component is paramount, as can be seen in Figure 3 from the large number of flows and services which originate from forests Visually, forests dominate the landscape, but the relatively narrow, flat valley floor is the most productive, particularly with respect to agriculture. Key management considerations for the maintenance of the system and its components include the timing and intensity of biophysical flow appropriation Management also impacts soil quality and erosion. As soil is an important factor in the productivity of the biophysical system shown in Figure 3, soil erosion is a key indicator, as identified by the local people themselves

The figure does not illustrate the direct flows of timber which historically went to government contractors, nor does it include illegal felling As well, Figure 3 does not illustrate human waste flows (which now end up in the Beas River), nor the environmental service of waste assimilation These factors may become increasingly important in the Kullu forest ecosystem, considering the increasing impacts of tourists and the building boom created by tourism. Although the conceptual model does not directly illustrate it, the village community, and the resources they use, are in a two-way mutual causal relationships Villages shape the forest and, in turn, the forest shapes the village

In summary, the overall land and resource use system is an integrated system because of the interdependence of forest, pasture and farmland. Soil fertility and agricultural productivity depend on manure and compost from the livestock population; the livestock in turn depend on grazing land and forest for the provision of fodder, tree fodder and bedding. Since private agricultural holdings are small, on the order of one hectare per household, village economies strongly depend on access to common or state-owned forest and grazing land

Table 1 lists ten kinds of land use. The first three are privately owned agricultural land, in which users hold the full "bundle of property-rights", (1) the right of access, (2) the right to exclude others, (3) the right to manage, and (4) the right to alienate or sell the land (after Schlager and Ostrom 1993) The next four are types of pastoral land use. In all four cases, grazing rights have elements of common-property, that is, rights are neither fully private nor owned by the state but partly held by groups of resource users The last three land use types apply to forest areas. All three are state-property, but have elements of common-property, except that in the case of the Reserved Forest in which common rights are minimal Of the ten types of land use, seven show some elements of common-property, but also notable, many of these common rights are *de facto*, or unrecognized by law but effectively practiced by custom.

Agriculture. Chachoga and Goshal are located in the High Hill Wet Zone (1800 - 2200 m) of the Himalayas (Bhati et al. 1992). Here a mixed-farming system predominates, involving strong livestock--farming--forest linkages, and the farmers are typically *smallholders* (Netting 1993). Slopes are extensively terraced, an adaptation to farm the on the steep gradient while minimizing soil erosion and directing water movement.

Figure 4 shows the seasonal round of activities in agriculture Much of this activity is done by women, except ploughing, winter firewood stocking and apple picking, which are considered men's work. The local production of rice is small relative to needs, and rice is the main agricultural import. For most other crops, the traditional pattern of self-reliance is still evident. A household may sell surplus in some years and buy as needed in others, but remains self-sufficient for a range of crops from grains and vegetables to oil seeds, but not for the full range of agricultural products needed Agricultural land, including land under orchard, also produces fodder for animals. This fodder comes from plants weeded from the fields, from cut grass, and from crop residue after harvest In the two

study villages, the main agricultural export is apple.

Agricultural land holdings are distributed in the form of discrete parcels through the village area (Figure 5). Some of the parcels are used for a single crop, some for two or more crops grown separately within a single parcel, and some for intercropping, mixed culturing produces a mosaic of crops (Table 2). There are no extensive stands of any one crop but mixes of such ecologically compatible plants as corn and bean, and orchard agroforestry, as in some other parts of India. Apple trees are intercropped with grasses and legumes, a practice known to improve growth rates of apple trees, reduce erosion losses, and increase total yields from the land (Tejwani 1994: 92). The origin of the pattern of discrete land parcels is no doubt complex, but its functional significance is probably related to the provision of a diversity of subsistence produce for each household.

Pastures and Grazing. Livestock is an important but declining part of the rural economy Most households keep cattle for milk, manure, drought power and threshing Sheep and goats are kept mainly for meat and wool. Animals require grazing land, fodder, tree leaf fodder and bedding material Bedding, usually ferns, mixed with dung is returned to the fields Animals which stay in the village area are either taken out to graze or have fodder brought to them. The latter pattern is becoming more common as the area has "improved" varieties of cattle. Commercial milk production from Jersey-crosses is developing in importance (ODA 1994), but some villagers are concerned about the reduction in available manure because of the "efficiency" of these animals.

The major constraint to livestock production is shortage of grazing area nearby and suitable fodder The allocation of *natour* lands to landless people has reduced the extent of the grazing commons, leading to increased pressure on remaining grazing and tree forage resources. The traditional practice is to disperse grazing pressure by sending animals outside the village area, in the 1990s only those households which have large numbers of sheep and goats continue this practice The transhumance cycle for the sheep involves moving to lowland winter grazing in the Mandi district to the south, and to alpine grazing areas in the summer in the highlands of Kullu, and over the Rohtang Pass to Lauhal and Spiti (I. Davidson-Hunt 1995). The grazing rights system is complex. In Goshal, for example, there are at least five kinds of lands used by grazing animals: village grazing commons and/or unprotected forest area; abandoned agricultural land and old terraces (*kuth*) which are treated as private land; haying areas which are regulated by seasonal access for hay cutting (*paht*),

forest meadows (*thache*), and alpine meadows (*theli*), as summarized in Table 1

Forest Resources. The forest resource use system is also complex, and various types of trees are used for a variety of purposes (Table 3) Forest lands in the study area were brought under state ownership through the Government Forest Act of 1865 which was replaced by the Indian Forest Act of 1878 (ODA 1994). These acts are the basis of the current legal classification which includes the categories of Reserved Forest (RF) which are areas of minimal use rights for the local population; Demarcated Protected Forest (DPF) which supports more local use rights in the less commercially valuable parts of the forest, and Undemarcated Protected Forest (UPF).

In general, use rights in DPF lands are more specific, whereas UPF lands support more general village rights. UPF land could be alienated for cultivation if shown to have no trees The rules about the use of UPF areas are not clear, and there is disagreement regarding their status even among government departments (ODA 1994 7) Village landholder rights for the use of forests and forest products were defined in several settlements in the late nineteenth century for Kullu, and form the basis of current user-rights in protected forest lands. These include grazing rights, timber for house construction; fodder and bedding collection; wood for fuel and tool-making, and non-timber forest products such as medicinal herbs Village grazing rights in the forest are so well established that villages can collect user fees for the use of their grazing areas by semi-nomadic tribal groups.

Institutions. A number of local institutions are involved in the governance of land and resource use in Goshal and Chachoga The *pradahn* (the village headman) is chosen through the electoral process, and a group of *pradahns* make up the *panchayat*, the council for a group of villages The *panchayat* council is the official village-level institution, but in fact it takes little part in the managemet of local resources in Goshal and Chachoga. Instead, one key institution seems to be village *mimbers*, responsible for carrying out village works and running the daily affairs of the village The central difference is that the *pradahn* acts as a broker between the village and external agencies, whereas the *mimbers* are responsible for the internal affairs of the village

A main role of *mimbers* is to settle disputes, for example, land use boundary disputes and disputes over damage to crops by livestock. They can set rules for the use of some grazing areas. *Mimbers* are also responsible for the negotiation of grazing rights and for the collection of fees, for example, from *Gujjars*, waterbuffalo herders who use some of the higher alpine meadows in Goshal's

area. The number of *mimbers* is variable, there were nine in Goshal but only five in Chachoga They were chosen by the high caste village men during a religious celebration (I Davidson-Hunt 1995). The second key local institution for resource management is the *mahila mandal* (women's organization). There are many *mahila mandals* in India, initially set up by the Government of India In the Kullu Valley, *mahila mandals* have become increasingly incolved in forest protection, especially in Chacoga. Concerned about the depletion of forest products, the village's *mahila mandal* polices the illegal felling of trees by villagers and outsiders, and develops rules for the use of forest products such as tree fodder.

4. Adaptive Strategies for Sustainable Livelihoods

In analysing the linkages between social systems and ecological systems, we are interested in how people solve their everyday problems of using resources to create their livelihoods Livelihood strategies in Western industrial countries are usually one-dimensional, involving employment or a single source income. Livelihoods of rural people in developing countries, however, are based on multiple activities and sources of food, income and security Mountain environments, like semi-arid lands and arctic environments, are marginal environments that pose special problems for the people who live there. Kullu Valley, as with other mountain environments, is prone to unpredictable climatic and other biophysical events Human-induced changes in the environment are often dwarfed by natural hazards (Gardner 1995, Singh and Pandey 1995)

A sustainable livelihood system might be seen as one which shows high resilience and is able to "evolve varied mechanisms and strategies to strengthen resistance to stress" (Titi and Singh 1994), or better still, ability to *absorb* stress Such livelihood systems exhibit a capacity for change and flexibility, they will be able to evolve and adapt with changing or growing stress. By contrast, vulnerable livelihood systems (in which vulnerability is defined as defenselessness, insecurity, and exposure to risk, shocks and stress), are characterized as having low resilience in dealing with contingencies, uncertainty and stress. To continue the ecological analogy further, vulnerable systems might be seen as more *brittle* than their sustainable counterparts.

Individuals, households and communities adopt various strategies, referred to as adaptive

strategies, to minimize vulnerability in their lives, and incorporate various adaptations to help secure their livelihoods (Titi and Singh 1994). Adaptive strategies are a mix of traditional livelihood systems, modifications by local and external innovation, and coping strategies which have become permanent.Coping strategies are differentiated from adaptive strategies on the basis of the time-scale of response, the level of vulnerability, and type of risk faced by households and communities Coping strategies tend to be short-term responses of livelihood systems in *abnormal* periods of stress, whereas adaptive strategies constitute a permanent change in the mix of productive activities required to meet livelihood needs (Davies 1993)

Strategies adopted by households are not homogeneous across the village; different individuals, households and village groups may adopt different strategies Resilience is the result of the availablity of many strategies together. The distribution of available strategies in a village may not be equitable Some strategies may be viable for the majority of the households within a village, but others may be restricted to families of the higher caste (K. Davidson-Hunt 1995) The material summarized below includes elements of both coping and adaptive strategies, both of which are important The household which is able to turn to a number of coping strategies in times of stress (e g , the number of alternative short-term agricultural opportunities, handicraft manufacturing, and tourist-guiding jobs theat young men took following the failure of the apple crop in Goshal in 1994) will weather contingencies more successfully than those which have only one option to pursue (e g., selling the only cow of the household) Further, the continued availability of a range of coping strategies may be necessary for adaptive strategies to remain adaptive in the long-term

Eight kinds of strategies, some of them interrelated, are identified in the villages of Goshal and Chachoga, on the basis of their central importance in meeting day-to-day household needs (Ham 1995) (1) diversifying activities and household inputs, (2) maintaining crop biodiversity and spatial diversity in the agricultural system; (3) increasing market integration, (4) increasing reliance on agricultural wage labour and urban employment; (5) building up and drawing down household inventories for food, fodder and fuelwood, (6) relying on common property resources; (7) developing social networks leading to reciprocal labour and commodity relations; and (8) forming community groups for empowerment. Each will be analysed in turn, largely from the point of view of the women of the rural households

Diverse Activities and Household Inputs

Diversification or the concurrent involvement in multiple activities (occupational pluralism) is a key dimension of livelihood security in many parts of the world (Chambers 1983; Agarwal 1990) All of the 32 households in the study in Chachoga and Goshal engage in multiple activities that help secure diverse sources of household inputs, and regularly bring food, income or other inputs into the household.

Although primarily agriculturalists, most households participate in three or more secondary activities that provide household income and other inputs. For example, one representative household has seven sources of non-market inputs entering the household· crops, apples, milk and wool from privately owned assets (agricultural land or animals), and fodder, fuel and minor forest produce from the village forest. Further, money enters the household through interactions with the market The same household sells apples, milk and some minor forest products in the Manali market, and the woman of the house rent out a room of her house to a divorced woman from Kashmir, adding to the cash income entering the household In five selected households in Chachoga, the study indicates a mean of 5.2 non-market inputs, 2 0 different sources of income from market sales, and 2.4 different sources of income from employment

Figure 4 illustrates that throughout different months of the year, there are often a number of concurrent activities undertaken The diversity of this system adds to, and perhaps creates, its resilience. The seasonal activities of a household with agricultural land, apple trees and animals is complex Woven throughout the seasons are daily subsistence activities including the collection of firewood, caring for animals (cows and bullocks, largely), caring for the family (cooking and cleaning); and season-specific agricultural activities of planting, weeding and harvesting. Through participation in these activities, women interact with others, developing and maintaining important social relations while using the resources of the area. It is through these interactions that women come to possess many livelihood skills and develop an intimate knowledge of the natural systems on which they and their households depend The responsibility for daily, subsistence collection of forest products, maintainence and tending of crops, as well as tending of livestock appears to fall largely within the woman's realm of duty.

Only two of the thirty-two women in the study represents households with no land and no

animal assets. Both were of the Scheduled Caste and from Chachoga. These two households exhibit a very different "portfolio" of diverse activities The adaptive strategies for these women shows a lesser degree of diversity; the predominant activity throughout the year is participation in agricultural wage labour whenever there is opportunity.

Crop Biodiversity and Landscape Biodiversity in the Agricultural System

The diversity embedded in the agricultural system signifies that households of the area are largely self-sufficient, producing their own food, fiber and oil. Diversity may also work to minimize risk and to increase livelihood security. The diversity in the farming system of the region is expressed in two ways: in the diversity of crops planted (both throughout the year and during one season in a single field), and the diverse locations of fields owned by a given household. Throughout the year, two cycles of planting, growth and harvesting occurs. *Rabi* crops (winter crops) are those seeded in the fall (October 1 to November 30) and harvested in the late spring. *Kharif* crops (summer crops) are those seeded in the spring (April 15 - June 15) and harvested in the fall (Figure 4). Crops common to the winter season include wheat, barley, mustard and pea Crops common to the summer season include corn, kidney bean, paddy and upland rice, potatoes, millets, lentils, soybean, amaranth and a variety of vegetables. Although the larger harvest is the fall harvest, the presence of the winter crops and subsequent spring harvest ensures some minimal source of nutrition and income year round

The benefits of growing a diverse number of crops together in one field has long been recognized by rural people The advantages of mixed cropping are many· different root systems exploit different levels in the soil profile for moisture and nutrients, one crop may provide a favourable micro-climate for another; nitrogen-fixing plants fertilize non-nitrogen fixing plants (e.g , corn and beans together) ; crops which are scattered among others are less vulnerable to pest attacks than are single stands; labour requirements are less, especially in weeding; peaks in labour requirements are spread out, and there may be better retention of soil moisture (Chambers 1983: 86) These advantages are recognized and optimized by farmers when deciding what to plant in each of a number of fields. Home gardening is also extensively practised in both Chachoga and Goshal Most houses have a small garden growing *subji* (vegetables) directly adjacent to the building

In both Chachoga and Goshal, the majority of households own a number of discrete parcels

of land which are scattered throughout the village area If extensive flooding or a landslide occured and the household's land was all in one area, all could be lost. Thus, by not consolidating all their land holdings in one spot, households effectively manage risk and reduce uncertainty.

Figure 5 illustrates one household's land parcel distribution within village lands The household represented is of the Rajput caste, a wealthy household owning a larger than average amount of land. Their holdings are parcelled into fifteen discrete fields, each planted with different crops. Table 2 depicts the mixed cropping strategy in each of the fifteen fields shown in Figure 5 While the first field (parcel no. 1) was washed away by the river in 1993, the remaining 14 are planted in both the Rabi and Kharif seasons, with the exception of a number of fields in fallow.

The diversity in the agricultural system also extends to the grazing lands and forests that surround the village (Figure 3) For example, the forest provides the agricultural system with fodder and bedding for livestock. Women's roles in this regard involve the daily collection of both fern and conifer needles for bedding, and grass for fodder, and the transport of these products to the household Looking after livestock needs simultaneously provides the agricultural system with the highly valued mixture of bedding and manure (*gobar*) which the women then place in their fields and around the base of apple trees This example elucidates the way in which female labour works to link the diverse components of the land system, the forest and grazing commons, and the privately owned agricultural fields and animal assets.

Market Integration

Villages of the Kullu Valley have always had some experience with external market forces, as they are on the ancient trade routes to Central Asia, and during the 1880s, the area was involved in the production of opium and tobacco for external markets. Apple orchards in the Manali area started with the English settlers of the last century However, the major expansion of orchards did not occur until 1985-90 (Singh and Mishra 1995), and apples have become the major cash income of village households only in the last few years. All land-owning households in our study in 1994 were planning to plant more apple trees, thereby furthering their integration with the market. Some were planning to grow only apples and purchase all their food from the market in the future, whereas others stated that they will always grow some field crops

With the planting of more trees comes the reduction in land set aside for traditional mixed agriculture. Because the livelihood system and the agricultural system of the villages are virtually indistinguishable, there is no question that the further market integration of households will have far-reaching effects, touching the social, economic, political, cultural spheres of their lives. One concern in this regard is the reduction of the diversity in the agricultural system, and hence in the livelihoods, of the households. Whether further market integration is sustainable as an adaptive strategy is a question that warrants further analysis

It is clear, however, that village people do not move towards market integration blindly. Instead, the decision for a household to move from mixed field crops to apple trees is made incrementally. Over a period of years, farmers actively weigh the risks of the transition while learning from the experiences of their neighbours and other villages. The amount of experimentation farmers carry out themselves is appreciated little by outsiders (Chambers 1983). A number of women are quite aware of the risks in relying solely on the market for food and have thought through the implications of this transition. They point out, for example, that crops can continue to co-exist with apple trees for ten to fifteen years after the planting of an orchard. Then the trees mature and insufficient sunlight penetrates down to the crops below, making the concurrent planting of field crops and orchards no longer viable If a number of bad years occur in a row, households would continue to adapt and change, as they had in the past. As it was pointed out, apple trees could always be cut down and field crops replanted

Market integration may also have negative implications for the balance of money and power within the household, since women are the primary decision-makers in the traditional agricultural sector while men are the primary decision-makers with regard to apples Indeed, the income from the sale of surplus corn, millet, beans, amaranth, red rice, vegetables and weaving is often controlled by the women, while market and cash negotiations involving orchard produce falls under the responsibility of the men in the household

Employment and Reliance on Wage Labour

Formal employment, casual labour and contract work are all ways in which a household can further diversify their sources of livelihood Formal employment involves having an employer, a job,

a workplace and a wage, while casual labour is negotiated and renegotiated on a short-term basis, for example, a day, a week or until a task is completed. Contract work may include doing small tasks for others on a short-term, informal basis. Many women spin wool for other people for money during the winter months (*Posh, Maag and Phagun*) and are paid for their work. A number of women also weave for other households. One woman's husband does odd jobs in Chachoga throughout the year, he builds stone walls and does simple carpentry jobs. Within a given household, each of these income-generating activities may be represented.

Households which have a lack of assets (thought of in terms of livestock and apple trees) are most likely the poorest households in the village and possibly the most vulnerable In Chachoga, the decision of women to participate in agricultural wage labour falls distinctly along caste lines, eight women of eighteen (44 percent of the total or 80 percent of those belonging to the Scheduled Caste) participat to varying degrees in wage labour throughout the year No women from the Rajput caste state that they work as agricultural labourers. Of the eight women who work in wage labour, the average was 20 days per year The largest demand for wage labour coincides with the harvests, a time of labour shortage but also a time when food stores are traditionally low in rural households Some women state they could earn 30-40 rupees per day, an amount which is well above the minimum daily wage in Himachal Pradesh of 26 rupees.

The eight households of the women who participate in agricultural wage labour own a smaller number of apple trees, cows, bullocks, goats and sheep than the households of the women who do no wage labour For example, the average number of large apples trees owned by the eight households of the wage-labourers is about 6o trees, as compared to 156 trees owned by households in which women do no wage labour

Chachoga and Goshal are in close proximity to the larger center of Manali, a town which has been undergoing unprecedented tourism growth and urban expansion in the last decade This growth is leading to employment opportunities in town; jobs are readily available and outmigration from the region (which is common for example in the Central Himalayas) for work is not necessary. Many households have taken advantage of these opportunities, and it is likely that someone from a given household will be involved in some sort of activity in the Manali market or in tourism Of the thirty-two households in the study, twenty-one (66 percent) have members (one or more) who are

employed in either the market, the tourim industry, the government or elsewhere. Those involved in external employment are all men, except for one woman who works in a hotel.

Building Up and Drawing Down Inventories

In normal years, households store surplus commodities during the seasons of plenty, summer and fall, and draw down these inventories during the lean season, winter, when there is significant snow cover in the forest (approximately mid-December to mid-March) This is done to ensure the year-round availability of various essential goods. Firewood and conifer needles for bedding are collected from the forest on a daily basis from mid-October (*Shoj* and *Kati*) until snowfall Men are largely involved in these activities -- activities which involve the building up of stores, rather then the gathering of wood for daily use. These household stores are often the products of common property resources· grass and leaves for fodder, ferns and conifer needles for animal bedding, branches and twigs for fuel, plant fiber for making rope, and some minor forest products for food. Agricultural products are also stored, these include grains, dried pulses and other vegetables, herbs and oils Some families store more than 100 kg of rice for the winter.

Adequate stores are a characteristic of a sustainable livelihood systems (Chambers 1983) The presence of stores is a good indicator of household resilience; if stores are ample enough, unpredicted contingencies in the biophysical system (such as floods, avalanches, landslides or unusually heavy snowfalls), and those in the social system (such as a death, illness or pregnancy) can be absorbed until adjustments are made In Goshal, it was obvious that the poorer families do not have the stores that the richer ones have Many Rajput families have stores of bedding, grass and fuelwood that could last up to one year Women from poorer households, instead of building up their own inventories, might be cutting grass for a richer families' stores to earn money. This leaves the poorer families in the village more vulnerable to any contingency and stress

Drawing Upon Common Property Resources

Common property resources belong to the members of the village as a collective. Products of the forest and grazing lands can truly be seen as "common pool" resources from which members of the collective can withdraw units of use as needed -- but according to commonly agreed rules of

use (Ostrom 1990). A well functioning commons ensures equitable sharing (Berkes 1989), and thus provides resilience in the household livelihood security system. Commons is an important form of resource endowment for subsistence, "often a major source of livelihood for the rural poor and a safety-net fallback source of food and income in bad times" (Chambers 1994: 18).

In Goshal and Chachoga, women from households that have both land and animals are dependent on the commons for agricultural inputs, fuelwood, and products to fulfill animal needs. The poorest households, without land or animal assets, rely on the commons only for cooking fuel needs Although much of the commons literature based in India contends that it is the poorest villagers, and especially women, who are the most dependent on the commons (Jodha 1986, 1992, Chen 1988), this is not observed in Goshal and Chachoga Instead, it is the villagers with medium-sized land holdings that interacted the most with the commons and had the greatest stake in the conservation of the commons

The poorest households interact relatively less with the commons, having fewer household needs to fulfil The richest households also interact relatively less with the commons, as they can afford to pay for the inputs, rather than having to obtain these products themselves from the village commons The composition of the local *mahila mandal* reflects these differences in the intensity of interaction of households with the commons, the leadership is provided by the women with medium-sized land holdings, and not those who are among the poorest or the richest (K. Davidson-Hunt 1995). Further evidence for this conclusion comes from a comparison of the number of days each women spends gathering in the forest, against the number of days she spends in participation in agricultural wage labour, which is an index of poverty We find that those women who participate less in agricultural wage work go to the forest more The four respondents that use the forest commons the least, participate in the greatest number of wage work days (Ham 1995)

Despite these differences, the major finding is that all households participate in the use of common resources, and the overall agricultural and animal production system depends on inputs from the commons. Thus, secure access and user-rights to common property resources are an integral part of a secure livelihood system in Chachoga and Goshal. Functional common property institutions, the *mahila mandal* and the *mimbers* provide access and use-rights, and help conserve the commons to maintain a safely factor to increase the resilience of the village livelihood system.

Drawing Upon Social Relations

A very important inter-household strategy for livelihood security is that involving reciprocal labour relations and reciprocal commodity relations (Netting 1993). Both are interwoven throughout the work that women do every day to meet their household needs Reciprocal labour relations are practised in Chachoga and Goshal in two common forms, locally called *playdee* and *suari*. A task is said to be done in *playdee* if a certain group of women takes turns working in each other's fields over a certain period of time, often within a week or a few days. An example is the weeding of crops in the busy agricultural month of *Shard* (mid-June to mid-July). Five women might get together, all friends or neighbours and usually of the same caste, and work on one woman's fields until they are done, and then move to the next woman's field, and so on until all the fields are done.

In the case of *suari*, the reciprocal exchange does not need to happen within a set period of time For example, if a person is building a house, he or she might call a *suari* to help fetch clay from the river bank. This person is then obliged to attend and help at any *suari* called by the people who had previously worked for her/his benefit. *Playdee* and *suari* are important for the strengthening of social relations within the community, as well as making work more enjoyable In communities characterized by vulnerability, labour reciprocity is a very important function which establishes and strengthens fallback positions in times of stress, making households more resilient All households in the study regularly participate in *playdee* or *suari*

Reciprocal commodity relations also play an important role in securing household needs Households with differing endowments and assets can, by sharing these items or trading them at particular times during the year, attain the benefits of the item without investing in it themselves An example that a woman described in Chachoga involved her mother-in-law caring for her (the daughter-in-law's) cow. The older woman fed and cared for the cow, and in return, used its products (milk, butter and curd) The *gobar* was given to the daughter-in-law to apply to her crops and fertilize her parcel of land The daughter-in-law benefited from the *gobar*, yet was not responsible for looking after the cow. The mother-in-law benefited from the cow's milk, while providing what is seen as one of the most vital inputs to crop production, fertilizer

Another commodity which is extensively traded is the use of a bullock during planting seasons for ploughing Less than one-third of the households own a bullock; only one household owns two --

the number needed for the plough Therefore, the vast majority of households trade some service or commodity for the use of a bullock -- possibly their labour, food or some other form of payment. Reciprocal commodity relations such as these work in a way similar to reciprocal labour relations They are the basic strands of the social fabric and security within the villages; they create a web of interdependencies and make communities resilient to perturbations.

Community Groups as a Source of Livelihood Security

The formation of community groups that address village problems, provide a forum for discussion and community decision-making, is another example of risk-minimizing and empowering strategies which have positive effects for both household and community security. In both Goshal and Chachoga there is a women's group, the *mahila mandal.* These groups were initially encouraged and formed by the government in 1952 under the Community Development Program, and they have undergone a recent revitalization. In Chachoga, a dynamic group of women form the core of the *mahila mandal*, their largest activities being forest protection and operating the *balwari* (day care)

Although empowering for some, the *mahila mandal* in Chachoga is the subject of debate among many village women. The women who are most involved in the *mahila mandal*, and with the highest interests and incentives in forest protection, are of the Rajput caste Many women from the Scheduled Caste, however, do not feel that the group represents their interests. Worse, these women are effectively prevented from attending many group meetings due to social rules regarding caste interactions. Some Scheduled Caste women express the concern that the *mahila mandal* cares little for the poor In fact, in 1994-95, there was a petition demanding the disbandment of the local *mahila mandal* in Chachoga

Despite these problems, the women's conservation movement through the *mahila mandal* is definitely empowering for a certain group of women, as was the *Chipko* movement in the Central Himalayas Further, the actions of Chachoga's *mahila mandal* do benefit the entire village, especially with regards to forest resources and day care In both villages, the *mahila mandal* has effectively passed regulations regarding forest use and has enforced these regulations. Further, with the help of the Manali office of the Forest Departmenti, the group participates actively in reforestation

With the formation and development of strong village institutions such as the *mahila mandal,*

problems that were once solved only by seeking help from outside the village, or problems that were not solved at all, can now be dealt with within the village. This places decision-making processes and power back into the hands of the community, and increases local control over resources The social, economic and biophysical environment of these villages and their surroundings are constantly changing. Institutions that stimulate and provide a forum for the discussion of these changes help fine-tune adaptive strategies, assuming that the people also have the ability to recognize and monitor environmental change and sustainability.

5. Forest Change and Sustainability

The forests of the Western Indian Himalaya are anthropogenic landscapes, that is, people of the mountain villages have affected the composition and appearance of these forests for centuries The tools employed in shaping the forests include harvesting and replanting, cutting branches for fodder and fuel, grazing animals, gathering forest floor litter, burning grazing areas, and the harvest of various foods, medicines, and minor forest products. Given the central importance of forests for village livelihoods, it is important to understand how the villagers themselves perceive and monitor changes in the composition and abundance of various tree and shrub species important for their livelihoods

Table 3 provides a list of the most important tree species used locally for fuel, animal fodder, construction and other needs To capture some of the complexity of the people's perception of the dynamics of their forest environment, we compiled their views on both short and long-term trends regarding these species Table 4 summarizes villager perceptions of long-term (30-year) and short-term (2-3 year) trends in availability and area cover of these species in the forest use areas of Goshal and Chachoga. Where both the 30-year and 2-3 year trends show decline, the species is being used unsustainably. Where the 30-year trend shows decline, yet the 2-3 year trend shows an increase, this may indicate a reversal of previously unsustainable use. Downward trends in the past 2-3 years are the most critical, as they suggest currently unsustainable levels of use; relatively few species show that trend The four species which show sharp decline over 30 years (spruce, alder, deodar and pine) are also species which are preferred for a variety of uses (Table 3) In some cases, catastrophic events

such as fires and floods have also contributed to the declines A general decrease in fuelwood species over 30 years has halted in recent years in all but two species (wild chestnut and spruce) The possible explanation for this in Chachoga is that the *mahila mandal* has been making and enforcing rules against the selling of fuelwood outside the village

Another reason behind the halt in fuelwood species decline may be the fact that women have been ranging further to collect fuelwood. The total stock of fuelwood within a half day's return distance is greater than the stock within a quarter day's return distance. Thus, longer travel distances may help conserve the resource near the village by spreading out the harvesting effort over a larger area However, this self-regulating process faces the limit of distances that can be travelled in a day Singh and Pandey (1995) have surveyed the villages in the Kullu Valley and report that the travel distances and travel times to collect fuelwood and fodder from the forest have increased in recent years In 1994, both Goshal and Chachoga villagers travelled 4 km, and the regional average for 12 villages was 6 5 km Twenty years previously, the same task required 2 km of travel in Chachoga, 3 km in Goshal, and an average of 4 km travel in the 12 villages.

There is a sustainability problem also with winter fodder resources (Table 4). The most critical time for fodder availability is during the winter months If stored fodder and grass run low, villagers turn to two species of winter fodder tree which keep their leaves all year It is these two species which have declined over the last 30 years The species used as general fodder have not shown the long-term decline as seen with fuel and winter fodder species The reason is that livestock feed mostly upon grasses, and general tree fodder makes up only a small proportion of the diet Further, livestock populations have declined over the last 30 years

The tree most preferred for timber is the highly valuable Himalayan cedar, deodar (Table 3) Deodar, together with several other timber species, provide opportunity for the direct commercial use of the forest. The trends in timber species, which also includes spruce and silver fir, indicate sharp declines over 30 years (Table 4) Over-harvesting by villagers, both legally and unsanctioned, and in Goshal's case, direct over-harvest by government clear-cutting in the 1960s, and fires in 1970 and 1972, have contributed to the long-term decline. The 30-year decline in pine and silver fir has halted in recent years, while the downward trends in deodar and spruce continue A major reason for the continuing decline in these species is the recent tourism boom and the building of a large number

of hotels in the Manali area

Trends in high altitude species (silver fir, korsh oak, and birch) tend to be more stable. Trends in rare species (sweet chestnut, black mulberry, elm, ash, and wild walnut) show stability in the cases in which the trees are considered sacred by villagers (ash and walnut) but show decline in other cases (black mulberry and elm). "Other utilized species" (Table 4) are not favoured for any particular use, and this fact alone probably explains why these species have suffered the least depletion over 30 years, and show the most positive trends in recent years.

Villagers' perceptions of the trends in tree species were compared in our study to that of the local forest range officer On long-term trends, the level of agreement was very high (80 percent), on short-term trends, it was still good but lower (55 percent) Regarding short-term trends, the forester was more optimistic than villagers in 25 percent of the cases but more pessimistic in 13 percent.There was only one single instance in which the villagers' perspective directly opposed that of the forester the short-term trend of Chachoga's deodar Villagers perceived deodar as continuing to decline on the basis of declining numbers of mature trees, whereas the forester suggested deodar was increasing in recent years on the basis of recent plantings (Duffield 1995)

Villagers and the forester also have differing views on the preferred use for various tree species For example, the forester considers spruce, silver fir, deodar and pine, to be the best timber species However, villagers use spruce and silver fir branches more for fuelwood. Although villagers do prefer deodar and pine for timber, these two species are nearly as often used for lopping of branches for fuelwood and bedding

In sum, the villager perspective emphasizes meeting daily needs for fuelwood and bedding from the forest, whereas the forester's perspective, for the most part, tends to focus on timber production The regional analysis of forest composition, looking at the Kullu Forest district as a whole, suggests overall forest sustainability (J.S. Walia, Forestry Dept., pers comm) But species and age-classes are not distributed throughout the area evenly (Duffield 1995). From the village perspective, what is in fact available to the village from its own forest-use area is the critical issue Thus, there is a problem of scale in evaluating sustainability, and in making decisions regarding cutting rights and afforestation. When managing for sustainable livelihoods, it is the local perspective that is most relevant, but there other, competing perspectives in the management of a forest.

6. Monitoring Sustainability: Locally Identified "Signs and Signals"

There is a large and growing literature on sustainability indicators, biophysical, economic and social Yet very few studies have used local knowledge and local perspectives, exceptions include some work done by ICIMOD (Dev 1994). In Goshal and Chachoga, we investigated the locally identified "signs and signals which should be monitored in order to predict a good future", as a way to monitor sustainability as it is perceived by the people of the area. The results can be considered at several levels: (a) these signs and signals may be considered as a proxy for sustainability indicators, (b) they suggest an underlying body of local knowledge that likely helped shape the adaptive strategies used by the villagers, and (c) these indicators may be used (and perhaps are being used) to monitor the sustainability of livelihood systems and as a basis for new adaptive strategies Figure 6 provides a compilation of these locally recognized signs and signals as nine clusters of items

Forest Indicators. The first grouping of indicators relates directly to the quantity and quality of forest amount of cover, tree species diversity, forest density, and the availability of forest products Forest cover is the single most frequently identified indicator by the villagers of Goshal and Chachoga, followed by diversity and density These indicators suggest that villagers understand the idea that a **stock** of forest is required a provide a **flow** of resources for livelihood needs Their understanding corresponds to the idea of natural capital (stock) in ecological economics as the basis for flows of benefits and products ("interest" from the stock)

Forest-Linked Indicators. The second cluster of indicators identified by the villagers captures ecosystem services provided by the natural capital of forests. The number of snow avalanches and landslides, and consistent waterflow (hydrology of streams, springs and rivers) are the two most frequent responses in this grouping, followed by clean water, scenic beauty of the area, control of erosion, and consistency of climate -- all of which relate to forest cover. The amount of shade (an indirect measure of crown closure), and the presence of bees (as pollinators for apple orchards and crops) are also identified as signs or signals related to forest quantity and quality.

Forest Management Indicators. One cluster of responses pertains to various aspects of forest management The presence of reforestation efforts and natural forest regeneration is thought to constitute a highly important sign of a good future forest. The effectiveness of enforcement of the

annual timber harvest allowed per household is also important according to villagers, and so is the control of felling of green trees, which are sold on an illegal market for one-quarter the legal price A third indicator, suggested by a few people, is increased village control of timber distribution, and increased village-level enforcement of rules.

Orchards and Economic Indicators. Two of the clusters of responses may be considered a measure of the relative importance of the economic dimensions of sustainability. Increased area under apple orchard and increased area of any other cash crop are both considered signs of a good future "Cash crop" likely refers to apples and other orchard species, although crops such as peas and red rice can also be sold for income. Market access, in particular, the existence of good roads down to the plains, is considered very important for apple export and for tourism

Other Indicators. Several people mention that areas of quality grazing and areas suitable for haying are important signs, together with the proximity of good grazing areas and availability of manure Some of the social and cultural indicators include education and literacy for children and women's rights, both particularly important for future generations. Some respondents suggest that forest conservation interest by young men would be a good sign, considering that young men currently favour the profitability of wage work in Manali Increased milk production per cow and the availability of pesticide subsidies and mechanization are also considered good signs by some A few mention that the quality of air and water, a problem around Manali, is important As well, a number of respondents identify the availability of family planning as a sign for a good future

For cross-verification, we asked the question regarding "signs and signals which should be monitored in order to predict a good future" to nine resource management professionals working in the Manali area. In both groups, forest and forest-related indicators were the largest clusters of responses, two-thirds of all responses in the case of the villagers and one-half in the case of resource management professionals. The villagers put relatively more emphasis on forest cover and mix, and avalanche and landslide frequency; the professionals emphasize the importance of management, especially reforestation. Among other indicators, the villagers give relatively more weight to apples and cash crops, the professionals to crop diversification (especially vegetable cash crops) and agroforestry (including more diverse fruit trees) The villagers emphasize market access and tourism, the professionals, village cooperatives and credit availability. None of the professionals mention

education, literacy or women's rights, but they weigh family planning and air and water pollution more heavily than do the villagers.

7. Conclusions

The Western Himalaya case study is significant in showing that natural systems and social systems are already linked in the minds and resource use practices of the people of the area. Both resilience and sustainability have local meanings in livelihood systems and adaptive strategies. In interpreting the lessons from the case study, we focus on three themes: the adaptations of the local social system to the dynamics of the ecosystem of which it is a part, social mechanisms for the maintenance of resilience, and institutions and property-rights arrangements for resilience and sustainability We deal with each in turn.

In the villages and the mountain sides of the Kullu Valley, there are time-tested practices for securing a livelihood. Referred to as adaptive strategies, these practices are the major mechanisms by which the social system deals with the dynamics of the ecosystem in which it is located Adaptive strategies evolve and persist over time, locally recognized signs and signals of changes in the environment shape and re-shape adaptive strategies The eight adaptive strategies identified in the study area are not unique to the Kullu Valley or the Himalayas; many such adaptive strategies are commonly found in many parts of Asia, Afric and Latin America (Netting 1993)

The knowledge system that underlies these adaptations in the Kullu Valley has not been deciphered fully; no doubt it includes extensive local knowledge of species and varieties in agricultural fields, the forest and grazing lands Also important is a detailed knowledge of soil, water and climate, and the biophysical conditions that lead to environmental hazards unique to mountain ecosystems, such as avalanches In the Kullu Valley, environmental knowledge and resource use are both gendered. Women know more about agriculture and the nearby forest; men know more about the grazing areas and the distant forest. Women are intimately familiar, through their day-to-day work from the age of eight or ten, with the upslope area above their village. They know where to obtain wood, bedding and fodder, and through these livelihood activities, they get to monitor environmental changes over a lifetime. This detailed local knowledge is what makes the women especially qualified

to participate in forest management and to guard the forest environment through institutions such as the *mahila mandal*.

Also part of the knowledge system is the ability to identify and read signs and signals from the environment. The close correspondence between the villagers' knowledge and the forestry professionals' knowledge of changes of tree species mix in the forest over time provides cross-validation. Forest-related sustainability indicators are important from the village perspective, and it makes sense indeed to keep an eye on the forest, as many goods and services needed for the local livelihood system flow from the wooded slopes.

It is difficult to differentiate between mechanisms for the maintenance of resilience in ecological systems from those for the maintenance of resilience in social systems Clearly, crop biodiversity and landscape biodiversity are important for both ecosystem resilience and social system resilience As well, diversified uses of grazing lands and forests probably help maintain species diversity and the integrity and productivity of the natural system. For example, although deodar is one tree species favoured by both villagers and government, a monoculture deodar forest was definitely not desired by the users. To obtain fuel, animal fodder and bedding, construction wood and other products, people need a diversity of forest species. As another example, historical maps compiled by Duffield (1995) show that open areas in the forest (*thache*) seem to have been actively maintained over generations by animal grazing and possibly by controlled burning Such open areas create a forest mosaic and increase landscape diversity in the forest ecosystem These openings are a source of ongoing political battles between the Forest Department, which periodically tries to replant some of them, and the herders who have an arsenal of overt and covert techniques to try to keep them open (I Davidson-Hunt 1995)

Seven of the eight adaptive strategies are people's responses, as Chambers (1988) put it, to offset risk, ease shocks and meet contingencies They function to enhance the resilience of the social system Resilience refers here to the ability of the system to absorb perturbations, as opposed to the other ecological meaning of resilience, of bouncing back to a suppposed equilibrium. Villagers of the Kullu Valley know of no such equilibrium, instead they are experts in developing social safety nets, reciprocal exchanges, and occupational and income diversity -- a range of adaptive and coping strategies which allows their livelihood systems to absorb and carry on in the face of both predictable

and unpredictable perturbations To this end, resource use in the area is patterned in such a way as to enhance social relationships among the people For example, animal herding or firewood collecting in a group or calling a *suari* not only gets the work done, but it also creates and enhances social relationships

One of the threats to time-tested adaptive strategies of the area is the recent and rapid development in export-oriented apple orchards and in the tourism industry. These developments are altering the traditional, largely subsistence-based economy of the region. But we have little evidence that commercialization is going so far as "destroying farmers' organic links with both the soil and the community", as Shiva (1993· 19) observed in the Punjab Rather, commercialization in the Kullu Valley seems to have both costs and benefits, but has (so far) been accommodated within the existing adaptive strategies. For example, cash from apples has become a part of income diversification, and short-term employment in the tourism industry has increased the range of coping strategies available to those in need The risks might greatly increase, however, if orchard monoculture completely replaced subsistence agriculture, severing the link between food production and the population

Norberg-Hodge (1994) observed in Ladakh (on the plateau just to the north of Kullu) how population explosion came with the new monetary economy. In the traditional subsistence economy, people "could clearly see the limits of the land and were conscious that they needed to adapt their numbers and their practices to that limited resource base" (Norberg-Hodge 1994). The arrival of money economy and the imports of food at subsidized prices eliminated the feedback between local food production and population size. "In this modern economy, the birth rate can appear to be irrelevant: more money will simply buy the extra food needed .and money can be multiplied infinetely" (Norberg-Hodge 1994).

Land use and property rights in the Kullu Valley are complicated and diverse, as compared to the simple division of land into private and state in Western industrialised countries Unlike many other forested areas of the world, the local people have held since the 1800s, legally defined use rights for certain forest resources from delineated areas This may have been an important factor in the existence of participatory resource management institutions, and the relative sustainability of the Kullu forest. "Contrary to indications from other areas of India, the process of settlement of rights in Kullu did not result in the termination of local people's rights, but rather their acceptance and

formalisation Only limited areas of forest were placed in the reserved category" (ODA 1994: 6)

Villages hold use-rights in two kinds of forest land (UPF and DPF), even though the forest is technically state property. In the case of grazing land, the land belongs to the government, but some types of land (*kuth*) are effectively claimed by kin-groups, whereas other types (*pahi*) are used by villagers under rules made and enforced by the villagers themselves Each of these types of land satisfies the definition of common-property as a resource to which exclusion is difficult and joint use involves subtractability (Berkes 1989). None of these lands are open-access or free-for-all; outsiders are excluded. Enforcement is either by law (*de jure*) or effectively by custom (*de facto*), as summarized in Table 1.

However, one type of land has certain characteristics of open-access because property-rights are under dispute, and use-rights are unclear This is the Undemarcated Protected Forest (UPF) land which effectively became village common land, and from which redistributed lands (*natour)* were carved out in the 1970s and the 1980s As the traditional common lands shrank over the years, and the population and their needs grew, the UPF and the adjacent DPF lands have come under increasing pressure, creating a sustainability problem. Resources essential for the village economy but which come from the commons, principally firewood, animal fodder and bedding material, have to be obtained further upslope on DPF lands This in turn increases the travel time of those villagers, mostly women, who harvest these resources While the forest cover in the Upper Beas watershed is generally healthy, localized pressures contribute to the depletion of nearby forests, and increase risk from natural hazards such as landslides The key to maintaining the environmental health of the area will probably involve the clearer definition of property-rights in the UPF and the nearby forest

If there is one important characteristic of the case study with regard to resilience and sustainability, it is the diversity of options in the natural system-social system linkage The villagers do not have one adaptive strategy, but instead have many, mutually reinforcing strategies. The villagers do not look for one "sustainability index", but instead monitor a diversity of signs and signals. The reality of Kullu Valley villages bears out Shiva's (1993: 7) concern that policies imposed from, or inspired by, the West "may be turning this culturally and biologically diverse world into a monoculture " For example, the market economy offers but one policy to solve the commons problem. privatize the commons. By contrast, the villagers of Goshal and Chachoga have a wealth

of options, and ten kinds of landuse in terms of property-rights relationships, seven of which show elements of common-property.

Thompson (1993) contrasts the "elegant" workings of uni-dimensional and overly tidy typical Northern (Western) institutions, with the workings of typical "clumsy" institutions of the local rural peoples of the South. He defines a clumsy institution as one in which "transactions are parcelled out to what seem to be the appropriate cultural modes and, if circumstances change, some of those transactions can be switched to a more appropriate mode " He adds that "it is this combination of plurality and flexibility that confers such a high level of resilience on the Himalayan village" (Thompson 1993: 4). The conclusion seems entirely appropriate, except that institutions in our study villages appear neither awkward nor inept (common synonyms of clumsy). We therefore propose that "fuzzy institutions" (as in "fuzzy logic") may be a better way to characterize these resilient institutions which appear to be well adapted to fit into a decentralized, inegrated and participatory resource management framework.

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Figure 1. Location of the study site in Kullu District of temperate Himachal Pradesh state in the Himalayan front ranges

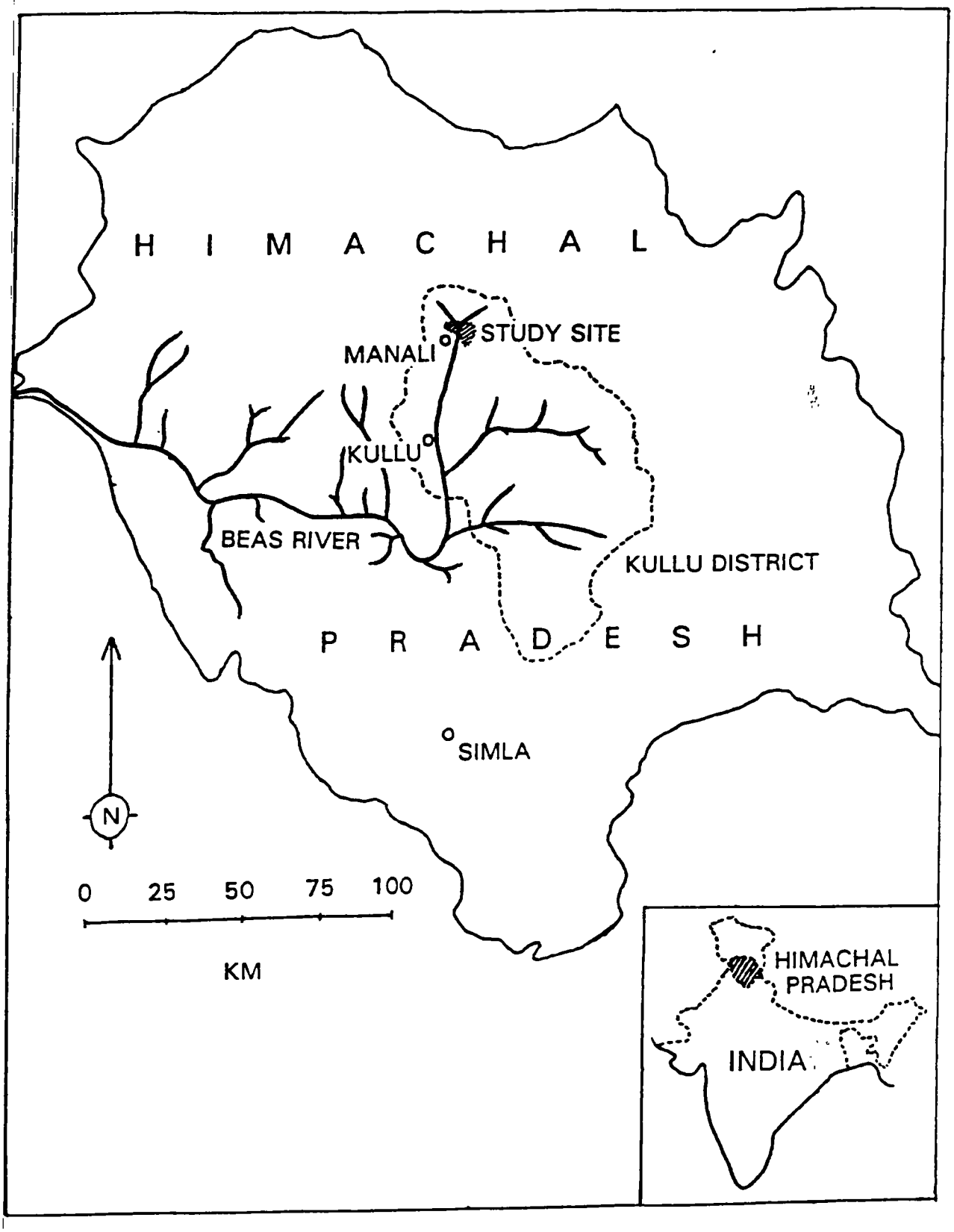
Figure 2. Village use areas of Goshal and Chachoga showing their respective demarcated forests (DPF), approximate undemarcated protected forests (UPF), and approximate agricultural areas (A). Goshal shares its small south western DPF area with Shanag, and its larger eastern DPF area with Kulang. Goshal also makes some *de facto* use of the dashed DPF area west of the village The (■■■) symbol denotes village sites Note, for simplicity, several more villages in the map area are not shown.

Figure 3. Village livelihood system: A conceptual illustration of the biophysical basis of sustainability and the importance of linkages involving forest--pasture--agricultural land and the village

Figure 4. Annual cycle of seasonal livelihood activities, focusing mainly on women's work, in Chachoga and Goshal, 1994

Figure 5. An example of the distribution of agricultural land parcels of one family in Goshal. The numbers show the approximate position of each parcel. The size of the parcel is not indicated (Data from I. Davidson-Hunt)

Figure 6 "Signs and signals that should be monitored in order to predict a good future", according to 20 Goshal and 16 Chachoga villagers. The answers provide a proxy for locally identified sustainability indicators. The figure shows the number of responses for each indicator. The responses were volunteered independently by the villagers, and not prompted by the use of a list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HIMACHAL PRADESH
INDIA

Figure 1.

Table 1. Types of land use and property rights regimes in Goshal Village according to law and custom. Source: I. Davidson-Hunt (1995).

Land Use[1]	Local Name	Village Rights to Resources[2]			
		Access[3]	Exclusion	Management	Alienation
Irrigated agricultural land	Ropa	√	√	√	√
Non-Irrigated agricultural land	Chait	√	√	√	√
Redistributed land	Natour	√	√	√	√
Linneage based grazing land	Kuth[4]	√	*De facto*	*De facto*	*De facto*
Linneage based haying areas[5]	Paht	√	*De facto*	*De facto*	–
Forest grazing	Thache	√	*De facto*	*De facto*	–
Alpine grazing	Theli	√	*De facto*	*De facto*	–
Undemarcated Protected Forest		√	*De facto*	*De facto*	–
Demarcated Protected Forest		√	*De facto*	*De facto*	–
Reserved Forest		√[6]	–	–	–

[1] Land which is considered private may be held by an individual, nuclear family, joint family or kin group.
[2] Classification of rights is taken from Schlager and Ostrom (1993). Holders of the full set of property rights are considered to be owners of private property. When the property rights are distributed between different parties such as the state and village it is often a type of common property. The first step in an analysis of village common property management requires a classification of the rights a village holds. The symbol (√) denotes that a village holds *de jure* (in law) rights for that land type. *De facto* rights, although unrecognized by law, are rights that have been acquired by the community and recognized by other resource users and are considered to be held in custom.
[3] Right of access to a resource also includes the right to withdraw the resource.
[4] Kuth is a local land type surrounded by either undemarcated or demarcated forest. Its classification as private is unclear on the part of both local villagers and the local forest department.
[5] Rights to cut grass are held by a kin group.
[6] Some limited gathering rights (eg. deadwood) apply to Reserved Forests.

Table 2. Examples of one family's land parcel use within village lands and the crops grown. See Figure 5 for the distribution of land parcels within village (data from I. Davidson-Hunt).

Parcel No.	Rabi ('93-'94)	Kharif ('94)	Rabi ('94-'95)[1]
1	----------Drowned by River----------		
2	Pea	Radish, Cabbage, Cucumber, Eggplant[2] ----------[3] Kidney Bean +[4] Corn	Mustard or Wheat
3	Pea	Kidney Bean + Corn	Barley
4	Barley	Kidney Bean + Corn	Wheat
5	Mustard	Millet + Cowpea	Barley
6	Mustard	Hemp	Barley
7	Fallow	Kidney Bean + Corn	Barley
8	Pea ---------- Wheat	Kidney Bean + Corn ---------- Kidney Bean	Fallow
9	Wheat	Kidney Bean	Fallow
10	Fallow	Kidney Bean + Corn	Mustard
11	Barley	Kidney Bean + Corn	Mustard
12	Mustard	Kidney Bean + Corn	Wheat
13	Mustard	Potato	Wheat
14	Fallow	Potato	Wheat
15	Fallow	Potato	Wheat

[1] Crops are those grown by the consultant or those she planned to grow in the coming rabi season.
[2] Vegetables grown for market and home consumption, other crops are grown primarily for home consumption.
[3] ——— indicates that crops are grown separately within the same parcel.
[4] + indicates crops which are planted together, intercropped within the same parcel.

Table 3. Preferred tree species for different uses, (●) denotes important species and (O) denotes less important species for a given use[1]. For Latin and local names see Table 4.

SPECIES	USE					
English Name[2]	Fuel[3]	Fodder	Timber	Bedding/ Fertilizer	Small wood[4]	Food/ Oil
FUEL:						
B.Kahti (shrub)[5,6]	●	O			O	
W.Kahti (shrub)[5,6]	●	O			O	
Sweet Chestnut[6]	●	O				O
Wild Chestnut[6]	●	O				O
Spruce	●		O	O		
Alder[7]	●			O		
Silver Fir[8]	O		O			
Shyen (shrub)	O					
FODDER:						
Oak (Morr)[6,9]	O	●				
Black Mulberry[9]		●				
Willow[10]		●				
Robinia[10,11,12]		●				
Oak (Bon)[6]	O	●				
Elm		●				
Hazelnut[6]	O	O				
Oak (Korsh)[6,8]	O	O				
Maple[13]		O			O	
CONSTRUCTION:						
Deodar[14]	●		●	O		
Pine[14]	O		O	O		
OTHER:						
Poplar[11]				O		
Ash[11,15]						
Black Walnut[15]					O	O
Wild Walnut[15]					O	
Wild Apricot						O
Beckeli (shrub)[12]						O
Shambel (shrub)						O
Jarainth (pear graft)						
Birch[8]						

[1] Based on open-ended, structured interviews with 20 Goshal and 16 Chachoga villagers. The symbol (●) preferred by six or more respondents, (O) preferred by less than six respondents. Each villager typically mentioned from 5 to 20 preferred species.
[2] The species list is clumped according to greatest preferrence, based on the number of responses. Each clump begins with the strongest preferrence, and decends to the weakest.
[3] Two respondents indicated all species are used as fuel.
[4] Small wood refers to wood for tools, handles, furniture, and carving.
[5] Used in prayer and marriage ceremonies.
[6] Best fuel species because of clean burning and good heat (particularly Kahti - which is also easy to carry).
[7] Preferred as fuel because of availability by river, especially in Goshal's past.
[8] High altitude species, above 2800 m.
[9] Particularly important as winter fodder.
[10] Used by cattle in summer.
[11] A multi-purpose tree according to foresters. Villagers preferred poplar for many uses, but poplar still rare.
[12] Thorny, thus not preferred for fuel, Beckeli in particular is recognized as good fuel excepting its thorns.
[13] Eaten by water buffalo.
[14] These species have sticky smoke, however they are desirable fuel because of availability.
[15] Some individual trees considered sacred.

Table 4. Tree species and trends in change over 30 years and 2-3 years[1]. Changes are denoted by (↑↑) large increase, (↑) increase, (↔) constant, (↓) decrease, (↓↓) large decrease, (N) introduced in the last 30 years, and (blank) species not found in area.

ENGLISH NAME[2]	LOCAL NAME	SCIENTIFIC NAME	30 YEAR	2-3 YEAR
FUEL[3]:				
B.Kahti (shrub)	Kahti (black)	*Indigofera spp.*	↓	↔
W.Kahti (shrub)	Kahti (white)	*Desmodium spp.*	↓	↔
Sweet Chestnut	Kenorr	*Castanea sativa*	↔	↔
Wild Chestnut	Jangli Kenorr	*Aesculus indica*	↓	↓
Spruce	Roi/Rai	*Picea smithiana*	↓↓	↓
Alder[4]	Kosh	*Alnus nitida*	↓↓	↔
Silver Fir[5]	Tos	*Abies pindrow*	↓	↔
Shyen (shrub)	Shyen	*Spirea spp.*	↓	↔
WINTER FODDER:				
Oak[6]	Morr/Mohru	*Quercus himalayana*	↓	↔
Black Mulberry	Chehwn/Tut	*Morus spp.*	↓	↔
GENERAL FODDER:				
Willow	Behli/Manjanu	*Salix spp.*	N	↑
Robinia	Kicker	*Robinia pseudoacacia*	N	↑
Oak[6]	Ban/Bon	*Quercus leucotricophora*	↓	↔
Elm	Mahan	*Ulmus wallenchia*	↓	↔
Hazelnut[6]	Himli/Himri	*Corylus spp.*	↔	↔
Oak[5]	Korsh/Kharsu	*Quercus semecarpifolia*	↔	↔
Maple	Maundre	*Acer spp.*	↓	↔
CONSTRUCTION:				
Deodar[7]	Deyar/Kaol	*Cedrus deodara*	↓↓	↓
Pine[7]	Kail	*Pinus wallenchia*	↓↓	↔
OTHER UTILIZED SPECIES:				
Poplar	Paoous	*Populus spp.*	↔	↑
Ash	Ongu	*Fraxinus excelsia*	↔	↔
Black Walnut	Awkrot/Korr	*Juglans nigra*	↑	↑
Wild Walnut	Jangli Awkrot/Korr	*Juglans regia*	↓	↔
Wild Apricot	Jangli Koobahni	*Prunus armeniaca*	↔	↔
Beckeli (shrub)	Beckeli/Becki	*Principia utilis*	↓	↑
Shambel (shrub)	Shambel	*Berberis spp.*	↓	↔
Jarainth[8]	Shegaal	*Pyrus spp.*	↓	↑
Birch[5]	Bhojh pater	*Betula alnoides*	↔	↔

[1] Based on open-ended, structured interviews with 20 Goshal and 16 Chachoga villagers. The war between India and China (1962) was used as a "memory marker" to help villagers recall 30 year trends.
[2] The species are clumped under primary use, as indicated by number of responses (see "preferred tree species", Table 3).
[3] Preferred for clean burning and good heat.
[4] Preferred because of availability (beside river), especially in Goshal's past.
[5] High altitude (above 2800 M) species.
[6] Also a preferred fuel.
[7] These species have sticky smoke, however they are desirable fuel because of availability.
[8] Pears are grafted onto this species (also called bird cherry), recent increases because of use in grafting; has declined in the wild.

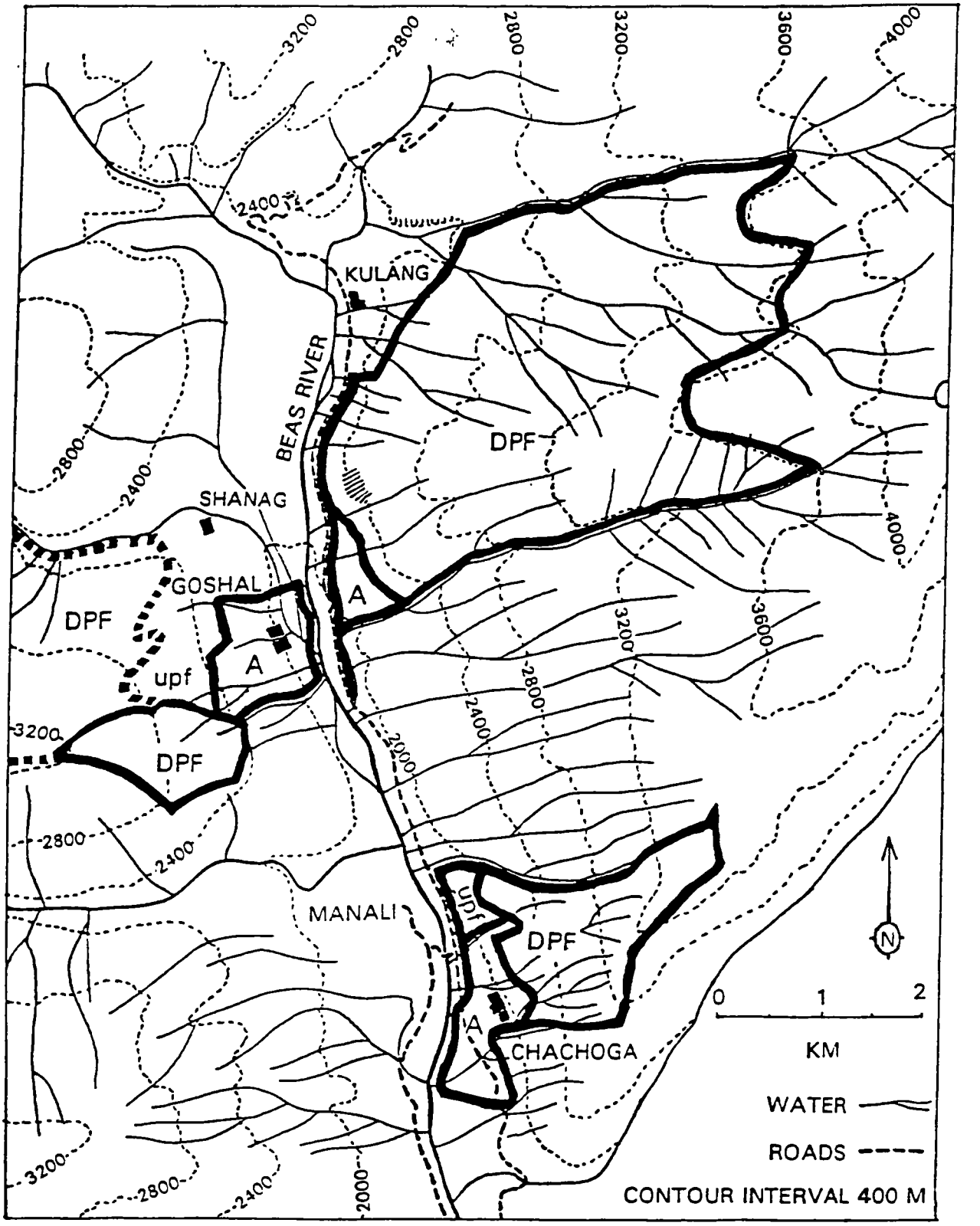
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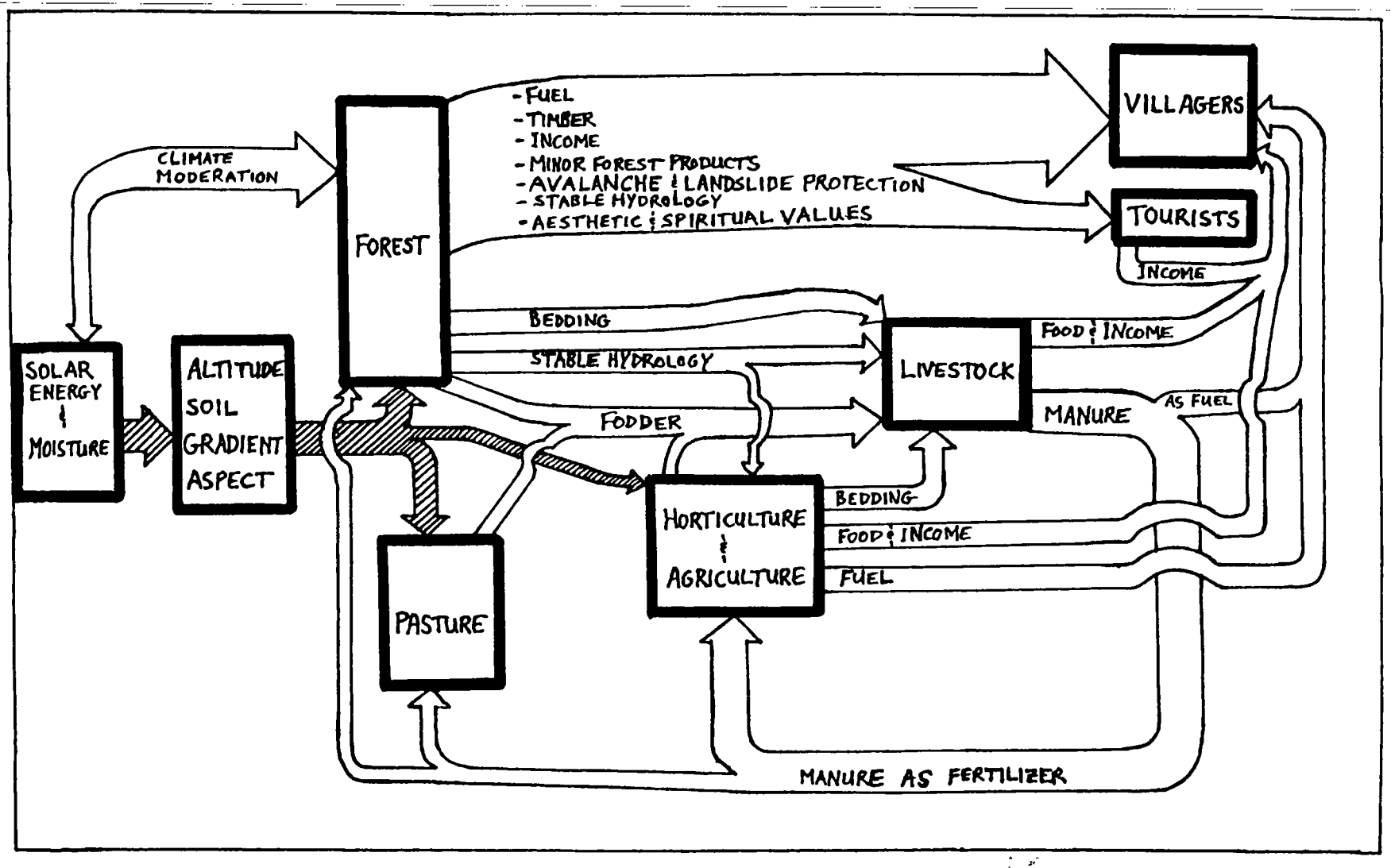
Figure 2.


SOLAR ENERGY & MOISTURE
ALTITUDE SOIL GRADIENT ASPECT
CLIMATE MODERATION
FOREST
- FUEL
- TIMBER
- INCOME
- MINOR FOREST PRODUCTS
- AVALANCHE & LANDSLIDE PROTECTION
- STABLE HYDROLOGY
- AESTHETIC & SPIRITUAL VALUES
VILLAGERS
TOURISTS
INCOME
BEDDING
STABLE HYDROLOGY
FODDER
LIVESTOCK
FOOD & INCOME
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BEDDING
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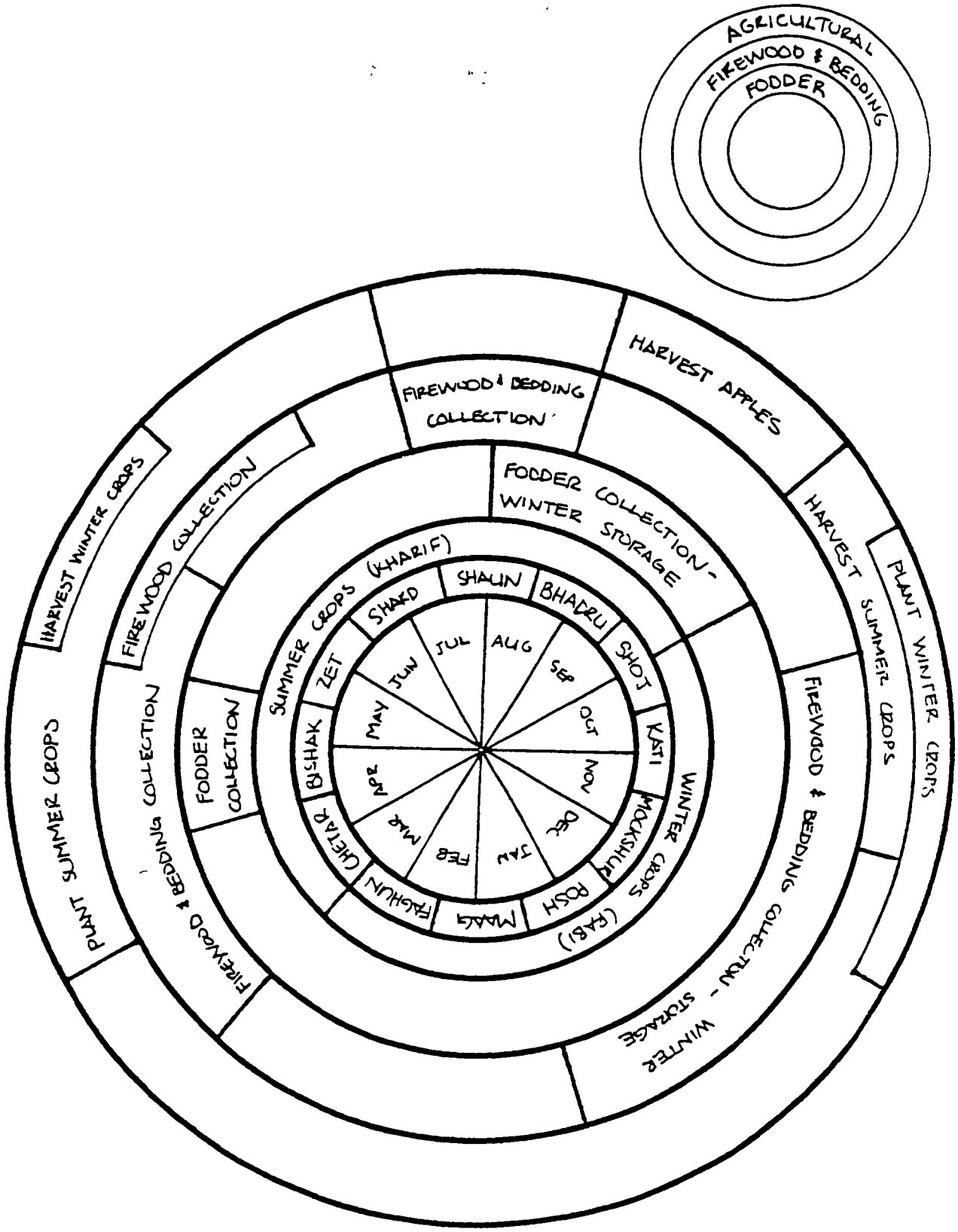
FUEL
PASTURE
MANURE AS FERTILIZER

Figure 3.


AGRICULTURAL
FIREWOOD & BEDDING
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WINTER
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PLANT SUMMER CROPS
HARVEST WINTER CROPS
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FIREWOOD & BEDDING COLLECTION
FODDER COLLECTION - WINTER STORAGE
SUMMER CROPS (KHARIF)
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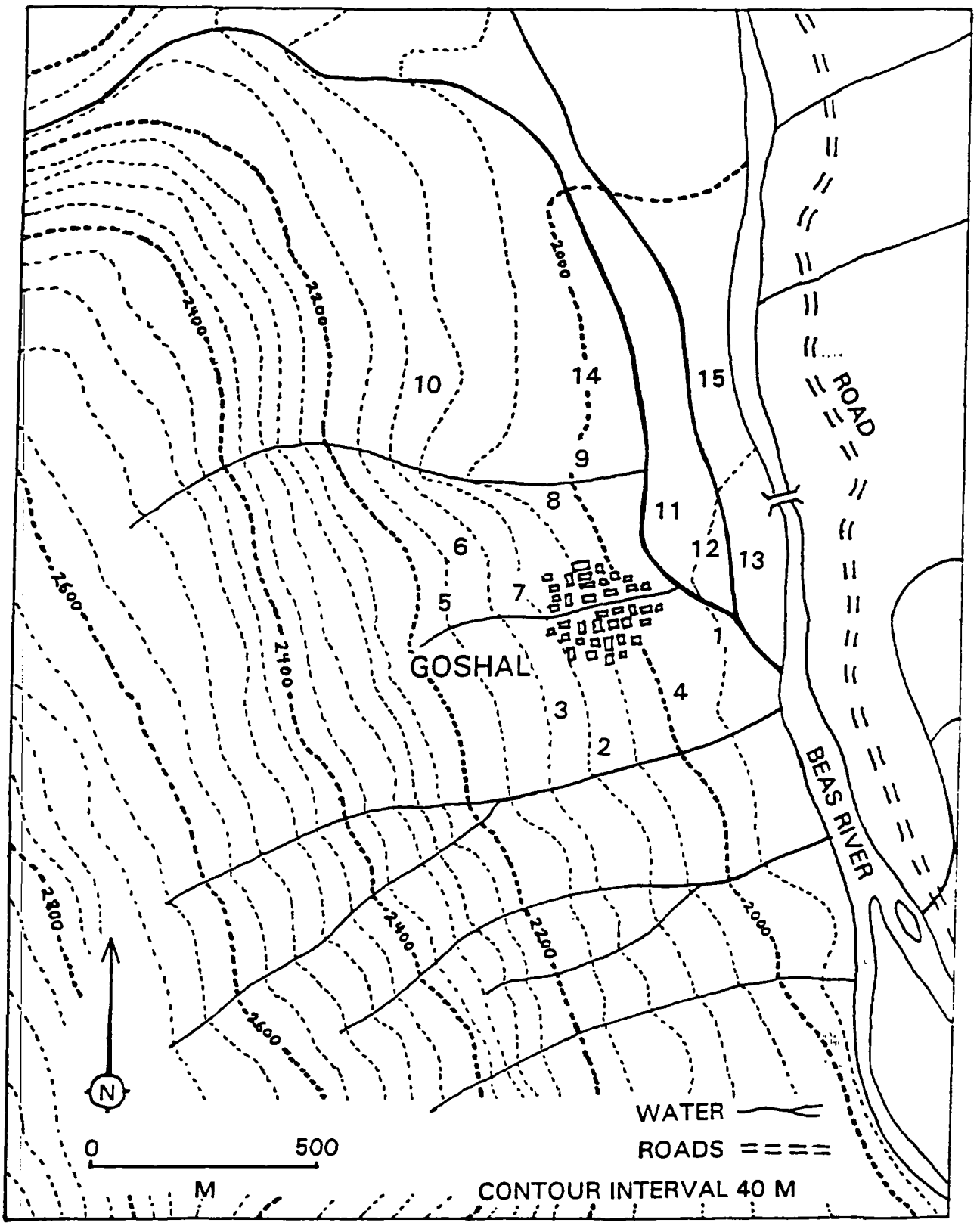
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CONTOUR INTERVAL 40 M

Figure 5.