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CHANGING TRADITIONAL LAND USE PATTERNS IN THE GREAT HIMALAYAS: A CASE STUDY OF LAHAUL VALLEY*

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ABSTRACT

Little is known about indigenous land use techniques and agricultural technologies hidden in the vale of Lahaul in Himachal state, in the northwestern Himalayas. The area is inaccessible by road for seven months most years due to heavy snowfall. Agricultural tasks are carried out in only one cropping season, the *rabi* season (summer cultivation). Until recent decades, agricultural practices were traditional, with high crop diversity. Recently cash crops such as potatoes, peas, and hops have gained favor. As a result, the diversity of staple food crops as well as "wild" cash crops has decreased rapidly. Yet one cannot ignore the improvement in socioeconomic status of many farmers (except marginal farmers) brought about by handsome cash crop yields. Government subsidies intending to promote cash crops have been reduced. The large numbers of marginal farmers have suffered the most from the cutbacks, since they can hardly afford expensive high-yield variety seeds, inorganic fertilizers, or pesticides. Cultivation has reached a *transition phase,* from a *solar-powered indigenous system* to a *solar-powered exogenous system.* On account of a shortage of suitable low-lying agricultural land in the area, people are now cultivating on > 45° slopes, which has caused heavy landslides. Since the whole area is cold and arid and falls within a rain

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shadow zone, it is crucial to upgrade existing earthen water irrigation channels. Tourism is considered to be a promising means of raising the income of the marginal farmers, as a supplement to traditional crops. We argue that the traditional systems need to be revived in a scientifically informed collaboration of administrators, planners, and local people, under a participatory, integrated management approach designed for long-term sustainability.

INTRODUCTION

Like many other hilly areas, the Himalayas are characterized by low availability of cultivable land, lack of diversity in economic activities, poor accessibility, inadequate infrastructure, lack of employment opportunities, out-migration, and distinctive sociocultural life styles. Very little is known about the indigenous practices of traditional agriculture and animal husbandry and of the sociocultural milieu of Lahaul Valley, which lies between the Pir Panjal in the south and Zanskar in the north, part of the Great Himalayan range in the Lahaul and Spiti district of the state of Himachal Pradesh, India. Lahaul and Spiti district occupies 24.85 percent of Himachal Pradesh but its population is only 0.61 percent of the state total. One hundred percent of the inhabitants live in rural areas [1]. There are large, long ranges of mountains with steep slopes, snow clad peaks, and long narrow valleys. These areas are commonly known as the cold deserts of the Great Himalayas. They have dry temperate and alpine climates with scanty vegetation. Administratively, they have been declared tribal areas, due to their remoteness and social and economic backwardness, for purposes of development policy.

As in other parts of the Himalayan region [2-4], agriculture is the prime economic activity of the northwestern Himalayan hill people, supplemented by animal husbandry and forest activities. In the nineteenth century, buckwheat was the predominant staple food crop of the Lahaul Valley [5]. Barley and wheat also were grown. Initially highly subsidized by government, potatoes and later peas and hops were introduced for commercial farming. The intensity and frequency of the use of traditional cultivars have decreased tremendously because of high expenditures on the modern inputs of cash crops. As a result, the traditional agricultural system has now reached a stage in between traditional subsistence and commercialized farming systems.

Much of our understanding of agriculture in the Himalayas is based on the analysis of traditional knowledge- and subsistence economy-based farming systems [2, 6-8]. The linkages between culture and development in Himalayan traditional society have not received significant recognition [9]. Therefore, this study principally centers on a micro-level analysis of traditional techniques and technologies prevailing in a traditional society governed by nature and culture. The present study aims to 1) bring to light indigenous knowledge embodied in traditional enterprises, 2) explore the factors responsible for changing the

traditional agriculture-based systems, and 3) seek ways to achieve a vitalized and sustainable use and management of local resources.

STUDY AREA

Geography

The Lahaul and Spiti districts in the Pir Panjol range of the Great Himalayas, extends from 31°44′34″N to 32°59′57″N and from 76°46′29″E to 78°41′34″E (Figure 1). This area of 13.835 km^2 accommodates 31.294 inhabitants—two persons/km^2 [1]. The Lahaul Valley consists of the Chandra and Bhaga river basins which have their confluence at Tandi. The valley runs from Khoksar in a southeast to northwest direction to a point near the town of Udaipur. The strip of cultivable land in the valley varies from 0.5 km to 2.0 km in width. The river itself varies from 20 m to 75 m in width. This valley remains cut-off from other parts of the state due to heavy snow on Rohtang crest, the only approach route to the valley, from November to June. Figure 1 shows the Lahaul Valley and its environs. Three villages, namely Khoksar (3185 m) in the Chandra sub-valley, Jahalma (3026 m) and Hinsa (2700 m) in the Bhaga sub-valley, were selected for detailed critical evaluation as representative of the valley as a whole.

Landscape

The undulating terrain and high Himalayan peaks make for difficult conditions. Elevation varies between 2400 m and 6400 m. Most upper mountain slopes are surrounded by perpetual ice without vegetation cover except for some alpine pastures. Villages are situated in valley areas around terraces and/or on spur tops. In general, sites for villages are selected to be free from shade, high winds, landslides and avalanches, and to be close to water sources.

Geology and Soils

In the Lahaul area, stratigraphy consists mainly of a schistose group and a calcareous group. The schistose incorporates biotite-schists, schistose phyllites, phyllites, slates, paragneissic bands, quartzites, and quartz-mica-schists. The calcareous group consists of white and greyish black crystalline limestone, flaggy and slaty limestones, calcareous phyllites, calcareous gneiss, carbonaceous schists, dark grey phyllites interbedded with limestones [10]. Valley soils are of mainly two types, alluvial and moraine. Alluvial soils are found under agricultural areas which are well irrigated and managed with organic manure. Moraine soils are thin and fragile in nature, rocky in composition and highly prone to landslides, creeping and avalanches. Such soils support very poor and scanty vegetation cover.

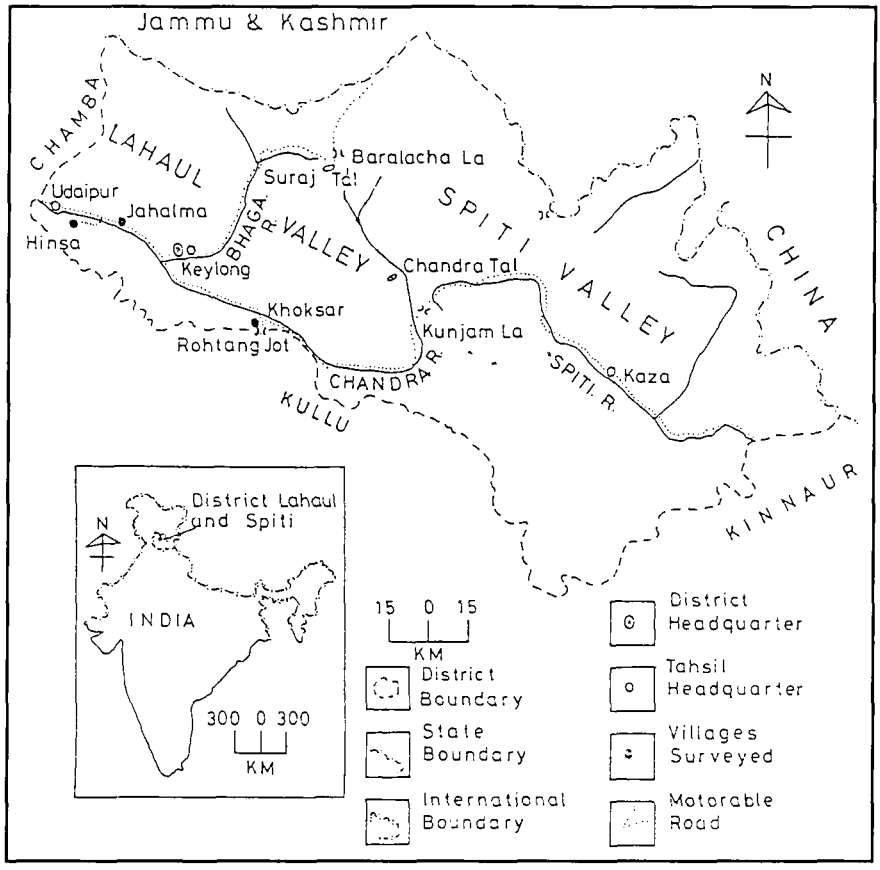

Figure 1. Geography of Lahaul Valley in Lahaul and Spiti district of Himachal Himalaya.

Climate

The land-locked valley experiences remarkable variations in climatic conditions due to its peculiar geographical setup, altitudinal variation, slope aspects, local relief, nearness of snow line, and relatively higher latitudinal extensions. Broadly, the valley has two seasons: short summers and prolonged severe winters. Snow may fall from September to April. Average temperature fluctuates from –12°C (minimum in January) to 23°C (maximum in August) at the district headquarter, Keylong. The area is characterized by high wind speeds averaging about 45 km hr^{-1}. The Lahaul Valley experiences scanty rainfall, almost none during summer. Winter is the only season in which moisture is received, as snow.

Vegetation

There are two vegetation zones in Lahaul Valley, temperate (2200 m to 3300 m) and alpine zone (above 3300 m) [10]. The temperate zone has the most woody species, used for timber, fuelwood, and fodder. The particularly harsh climatic conditions of the Chandra sub-valley give it a relatively poor vegetation cover: south-facing slopes are essentially devoid of vegetation up to Tailling. Beyond Tailling, few trees of *shur* (*Juniperus recurva* syn. *J. macropoda*) are visible. On the north-facing slopes on lower reaches, *chiat* (*Pinus wallichiana*) are found in a scanty form and on higher reaches, *bhiy* (*Betula utilis*) are found in a scattered form. North-facing slopes have much greater biodiversity and vegetation density than the south-facing slopes in general, and in between Tandi and Udaipur in particular, *Shur* is a major tree crop (southern slopes) at present; in the past, *chiat* was also found in patches within *shur* forests, according to local testimony. Excessive harvesting has eliminated *chiat* from the forests. North-facing slopes are covered with tree species *diyar or kley* (*Cedrus deodara*), *rie* (*Abies pindrow*), *tosh* (*Picea smithiana*), and *chiat* (*Pinus wallichiana*). The area receives very high snowfall where glaciers are common. Forests are found in longitudinal patches alternating with glaciers. *Chug* (*Hippophae rhamnoides* sp. *turkestanica*) is widespread in the valley, especially in landslide-prone zones and close to Bhaga Valley water sources.

In the alpine zone, scattered, stunted growths of *bhiy, chiat,* and *Rhododendron campanulatum* are found up to 3600 m. Several bushy species, e.g., *bithal* (*Juniperus communis, J. indica*), *shur, Rhododendron anthopogon* and *bhiy,* are found on rocks, ridges, and stony slopes. Several *bes or belly* (*Salix*) species, e.g., *S. flegilaris, S. lindleyana,* and *S. pycnostachya* are found either in pure patches or mixed and *bhiy* as shrubs. It is customary to plant species of Salix in and around agricultural fields of villages to help meet fuel and fodder requirements.

Villages and the People

The inhabitants of the area are of Indo-Aryan origin and are mainly Buddhists. An often-repeated perception among outsiders is that the people of Lahaul Valley are humorous, soft spoken, simple, and unsophisticated. Women are sturdy and self-reliant, typically performing agricultural activities and inherited domestic operations. The joint family system is common, although such traditions are now breaking down due to increased influences from outside. The Lahauli language is a mixture of Tibetan, Hindi, Ordu, and Persian [5].

Villages may be isolated hamlets or a cluster of settlements. Houses are stone, timber, and earth, with flat roofs. In two-story dwellings, the lower level is used as a cattle shed, the upper for family quarters.

METHODS OF STUDY

Following a preliminary reconnaissance, the three villages were selected for study, one each in eastern, central, and western Lahaul Valley. Forty percent of the households in each village were randomly sampled and surveyed in August 1995. Households were classified according to landholding group, as low (marginal), medium, or high. Information pertaining to crops, animal husbandry, domestic practices, and forest usages were recorded. Detailed information pertaining to indigenous techniques and technologies was collected, concerning traditional agriculture, cultivation and use of wild plants, and traditional cattle breeding changes in these practices induced by the introduction of high-yielding varieties (HYVs)—the cash crops—also were tracked in the questionnaires for each village, and by direct observation.

RESULTS AND DISCUSSION

Traditional Agricultural System

Land Use Patterns

Land use patterns are distinctive in comparison to those in other parts of Himachal Pradesh [11-13] and other parts of the central [3, 4] and eastern Himalaya [2]. Cropping intensity is virtually 100 percent during the single growing season. Four general landuse patterns (net area sown, grassland, barren land, and non-agricultural uses) were found on private land (Table 1). The net area sown is greater at lower elevations due to relatively gentle slopes and low-lying fertile valley soils. Grassland percentage is greater at higher than at lower elevations. Privately held barren lands are not found at higher elevations due to inaccessibility. Barren lands left at lower elevations reflect the effects of recent glacial movements. Every year a substantial area of crop fields are either damaged or partly washed away by the glaciers. The fourth land utilization pattern, non-agricultural uses, refers to compact, higher-elevation settlements that have insignificant agricultural land.

Table 1. Land Use Patterns in the Lahaul Valley

Land Use Type (%)	Moderate Altitude (< 2800m)	Higher Altitude (> 2800m)
Net area sown	49	46
Non-agricultural uses	2	3
Grassland	44	51
Barren land	5	—

Traditional Agricultural Practices

Here people are quite enterprising. There is an inequitable division of labor between women and men in farming activities. Women do most of the agricultural labor, in addition to household work. This unusual division of labor may partly be due to the influence of environment and partly to the influence of the immemorial male-dominated social structure. Hill agriculture requires very hard and intensive labor, especially in the initial stages of terracing the fields. Perhaps when agriculture was first begun in these hills, men took on more arduous tasks like that of clearing the fields and construction of the terrace walls. The traditional agricultural practices and operations as performed by the marginal farmers have evolved through extensive trial and error. All traditional staple food crops are local cultivars. With their accumulated experience, they have developed cultivation methods for many wild plants of high economic and medicinal values.

Crop Diversity and Cropping Patterns

Twenty-one crops are cultivated by the marginal farmers. As grouped in Table 2, seven are local varieties, three are HYVs, two are wild cultivated plants, and nine are vegetables. The HYV potato was introduced commercially in the 1960s, the HYV pea and hops in the 1980s. Government agencies initially supplied the seeds and related inputs at a heavy subsidy. The intensity and frequency of use of traditional cultivars have decreased tremendously in the face of market-oriented HYVs. Crop diversity in the study area is high compared to other reaches of the northeastern [14] and central Himalaya [4], and even to other mountainous regions [15, 16]. As noted, buckwheat was the only staple crop in the nineteenth century [5].

Monoculture is the primary farming practice through the short growing season. Lower and higher altitudes follow different cropping patterns. At lower elevations, two crops are harvested in one growing season, barley followed by buckwheat or mustard. Largely owing to the increasing economic value of cash crops, mustard cultivation is now negligible in the valley. Less drastic reductions have occurred for other local cultivars.

Commonly, wheat and pea crops are rotated in alternate years. Kuth and mano are cropped for up to three years (sometimes more); this is followed by potatoes. Generally, barley fields are not rotated, although in some fields barley is followed by wheat during the following year, which is regarded as a less preferred crop rotation. However, in the higher reaches of the valley, wheat is followed by wheat in the same fields. These crop rotations are distinctive ones not employed in other parts of Himachal Pradesh [11, 13].

Wild Crops

Among the major traditional wild crops are *kuth* and *mano*. Now in effect domesticated, these crops have been important for cash and in barter in the

Table 2. Crops in the Lahaul Valley

Crops	Sowing Time	Harvesting Time
Local varieties:		
Barley (*thaungjad*) *Hordeum himalayense*	April-May	July
Buckwheat (*kathu/braphoo*) *Fagopyrum esculentum*	July-August	September-October
Buckwheat (*gangri/phulado*) *F. tataricum*	July-August	September-October
Mustard (*yungar*) *Brassica compestris*	July-August	September-October
Pea (*nyarcha*) *Pisum sativum*	April-May	September-October
Potato (*adu*) *Solanum tubarosum*	April-May	September-October
Wheat (*chava*) *Triticum aestivum*	April-May	August-September
High yielding varieties:		
Hop (*hop*)* *Humulus lupulus*	October-November	July-August
Pea (*matar*) *Pisum sativum*	April-May	September-October
Potato (*aru*) *Solanum tubarosum*	April-May	September-October
Wild cultivated varieties:		
Kuth (*kuth*)* *Sausurea lappa*	November	September-October
Mano (*manuruchha*)* *Inula racemosa*	November	September-October
Vegetables:		
Beet root (*chukander*) *Beta vulgaris*	April-May	June-October
Cabbage (*patta gobhi*) *Brassica* sp.	April-May	August-September
Carrot (*gajar*) *Daucus carota*	April-May	August-September
Cauliflower (*gobhi*) *Brassica* sp.	April-May	June-October
Pumpkin (*kadu*) *Cucurbita* sp.	April-May	June-October
Radish (*mude*) *Rhaphanus sativus*	April-May	June-October
Spinach (*palak*) *Spinacia* sp.	April-May	June-October
Tamato (*tamatar*) *Lycopersicum esculentum*	April-May	June-October
Turnip (*salgam*) *Brassica* sp.	April-May	June-October

*Perennial crop

civilization of the residents of the valley. However, these crops are now grown rarely, owing to their long growth period, high manual labor inputs, high fluctuations in market rates, and the decline in know-how as older practitioners die. The interference of the Indian Department of Forest accelerated the disappearance of these wild crops. In the 1950s, *kuth* and *mano* began to be promoted as cash crops. This effort peaked in the 1970s; these crops now are grown only in a very few locales. The properties of these plants are of interest.

Kuth (Sausurea lappa—Asteraceae)

Kuth propagates by seeds which are sown in October and November. Germination occurs in April and May of the following year, when the snow melts. This oval-leaved plant ranges from 120 to 200 cm in height. Tap roots penetrate soil up to a length of 30 to 85 cm. Mature roots are harvested after two years in September and October. Roots are used for both domestic and commercial purposes. Roots are locally used as remedy for cough and asthma. Its root production ranges from 4000 to 5000 kg ha^{-1}, having a monetary value of Rs. 55 to 65 kg^{-1} as current rates. In the 1950s this value was in the range of about Rs. 5 to 10 kg^{-1}. Other parts of the plant are used in various forms, such as seeds for propagation, leaf for fodder, and hardy stem as for fuel.

Mano (Inula racemosa—Asteraceae)

Mano has elongated elliptic-lancelolate leaves, big yellow flowering heads, and branched surface roots (30 to 40 cm). Vegetative and seed propagation are its modes of regeneration. During harvesting, roots are left in soil profile, these sprout in the subsequent year. Plant height ranges from 80 to 150 cm. Leaves are used as fodder, stems for fuel, and aromatic roots for medicines to treat cough, cold and chronic bronchitis. Root yield varies from 2500 to 3500 kg ha^{-1}, at a recent market value of Rs. 30 to 35 kg^{-1} (Rs. 4 to 5 kg^{-1} in the 1950s). The flowers are used in religious ceremonies. Roots are also prized for their fragrance and are used in the preparation of incense sticks.

Other wild herbs extracted include *kalajera* (*Bunium persicum*—Apiaceae) and *singu*, or *ghanyorog* (*B. cylindricum*). Kalajera is a highly branched herb between 20 and 7 cm high, with 2 to 3 pinnatisect, petiolated leaves and white flowers. It grows wild near settlements, in low-moisture grassfields. Recently its monetary value rose from Rs. 10 to 15 kg^{-1} to Rs. 500 to 600 kg^{-1}. Its roots are used as vegetables. The fruits are used as condiments, curing abdominal pain and loss of appetite. *Singu* (*Bunium cylindricum*—Apiaceae) grows naturally close to grass fields in dry areas. It is traditionally used in frying vegetables and has medicinal uses. Villagers usually collect it for its monetary value, which has recently risen to Rs. 50 to 60 kg^{-1}. The plant also is used as a remedy for cough and cold. *Karu* (*Picorhiza kurrooa*) grows profusely in alpine zones. Its roots and rhizomes are important ingredients of many preparations of the indigenous system of medicines. Roots are used locally for liver trouble, anemia, and cold. The stem is used

as laxative. This plant is extensively exploited by locals to earn cash. It was once common in surrounding forest lands. Due to over-exploitation, people now have to travel to distant remote sites for collection. The large scale exploitation has depressed rates of its regeneration. As with other cultivable wild plants, *karu* can be grown in crop fields, with the addition of scientifically determined inputs.

Traditional Animal Husbandry

Traditional rearing of livestock is an integral part of the overall agricultural system and is a major source of livelihood for most residents. Cows, sheep, goats, and yaks are the important animals. The livestock provides wool, meat, milk, hide, organic manure, draught power, and local transportation. These animals are local breeds adapted to the severe cold climate. Traditional yak breeds are now being replaced by introduction of Jersey cows in many areas. A comparison of local breeds and high-milk-yielding Jersey cows is given in Table 3. The new cow breed is the prime cause of the reduced economic value and population of yaks in Lahaul Valley.

The yak (*Poephagus grunmens*), a native of Tibet, is domesticated in some parts of the valley. Its well-known ability to withstand low temperatures and snowy conditions and to survive on coarse fodder is unique. Farmers cross yaks with cows for agro-domestic uses (milk, meat, wool, draught power). Each village typically has one "original" male yak for breeding; it can live up to an age of forty years. In local belief it is worshipped as a god of animals in the area. The birth of yak offspring is celebrated by the sacrifice of a sheep that is then cooked and served to all villagers as a feast. It is believed that if one does not sacrifice a sheep then no offspring will be produced from the cow. Different offspring of yak

Table 3. Advantages and Disadvantages of Local and Introduced Cattle of the Lahaul Valley

Local Breeds	Introduced Breeds
Adapted for severe cold conditions	Not suitable in severe cold conditions
Well adapted for difficult geomorphological terrain	Less adapted for difficult geomorphological terrain
Required low nutritive values of feed and fodder	Required high nutritive values of feed and fodder
Cheaper to marginal farmers	Costly to marginal farmers
Have multiple use with low care	Have lesser use with high care

are given in Table 4. The original yak is segregated in the fifth generation after the crossing of cow and yak. There are also other traditional ways of breeding cows with local bulls (Table 4). Male (sterile) offspring are usually used for draught power and females are used for milk which is very rich in fats. The present cost of a three-year-old yak ranges from Rs. 10,000 to 12,000. In Lahaul Valley, yaks are now being imported from higher altitudes of Zanskar and Mayar valleys. An obvious reason for the decline in yaks and yak breeds in the Lahaul area is the change in cropping patterns and the application of modern inputs in the 1980s. Yaks and their offspring are open grazers that destroy crops in the fields, while Jerseys are stall-fed.

Peoples' Institutions

A number of societies and missionaries function in the area. Some of the societies were created after the introduction of new crops to the area. On the other hand, the Moravian mission, more than 100 years old, played a catalytic role in introducing the *tandoor* (a small iron oven used for cooking and room heating), the potato, and wool knitting.

The Lahaul Potato Society (LPS) was formed in 1966 with the objective of promoting potato cultivation and operating a marketing facility. Recently this society has branched into other services like supplying potato seeds, cylinders, diesel, petrol, kerosene, and packaging material (for example, gunny sacks). For the villagers' convenience, the LPS has very recently opened a few small stores offering basic supplies. The society needs further strengthening in collaboration with the scientists, planners, administrators, and growers. In 1971 as the Lahaul

Table 4. Different Offspring of Yak in the Lahaul Valley

Cross with		Offspring
A)		
Yak × Cow	=	Churu/churi[a] and Bong[b]
Yak × Churu	=	Gari[a] and Garu[b]
Yak × Gari	=	Lari[a] and Laru[a]
Yak × Lari	=	Bree[a] and Jee[b]
Yak × Bree	=	Bree[a] and Yak[c]
B)		
Churu × Bull	=	Tolmo[a] and Tolpho[b]
Tolmo × Yak	=	Churu[a] and Bong[b]

[a]Female offspring fetching milk
[b]Male offspring used for draught power
[c]Original Yak and used as breeder

Hop and Chicory Growers Cooperative Marketing cum Processing Society Ltd. (LPG) was formed to facilitate the collection, processing, and marketing of hops. This society owns three processing units in different hops-growing areas of the valley. The Hops' (*Humulus lupulus*) inflorescences are collected before maturation. Four kg green inflorescence produces 1 kg of processed product, used for flavoring beer and for medicinal purposes. The hops were sold to M/s Mohan Making Ltd., Solan and Gaziyabad. In 1994, demand was 80 MT but production went up to 130 MT, fostering an insecurity among the growers about market prospects. It is felt that there is an urgent need to raise the capacity of processing units in the valley to keep the pace with the hops harvest.

Traditional Knowledge

Indigenous people with a historical continuity of resource use practices often have distilled a broad practical knowledge of the behavior of complex ecological systems in their own localities [17]. Indigenous ecological knowledge of the people in the Lahaul Valley pertaining to agriculture, animal, domestic, and forest subsystems differs from that in other parts of Himachal Pradesh. Their approaches to maximum sustained use of resources in one short growing season may have evolved through repeated trials and errors, the upshot of which has been transmitted from generation to generation.

Indigenous practices for efficient use of water resources in such a cold arid environment with steep slopes are distinctive. Earthen channels (*nullah* or *kuhl*) for tapping melting snow water are used for irrigation. Channel lengths run anywhere from a few meters to more than 5 km. Khoksar village, for example, uses this system for its potato fields, which lie on a mountain side with a slope exceeding 45°. Ridges and furrows transverse to the slope retard water flow and soil loss (Figure 2). Two HYV potatoes, *Kuphri Chandramukhi* and *Kuphri Jyoti*, are grown. The former variety is well suited to slopes because it requires less water; the latter is preferred for low-lying areas.

Craftsmanship

A variety of woolen items once were commonly woven in the valley by these skilled people, especially by the women. These skills need to be revived by providing adequate training. Changing socioeconomic conditions have discouraged preparation of the wool *patti* (hand woven cloth for use in coats and trousers). Similarly, traditional practices of spinning, weaving, and knitting of mats and baskets once were part and parcel of the rural economy. Today these old practices have largely melted away.

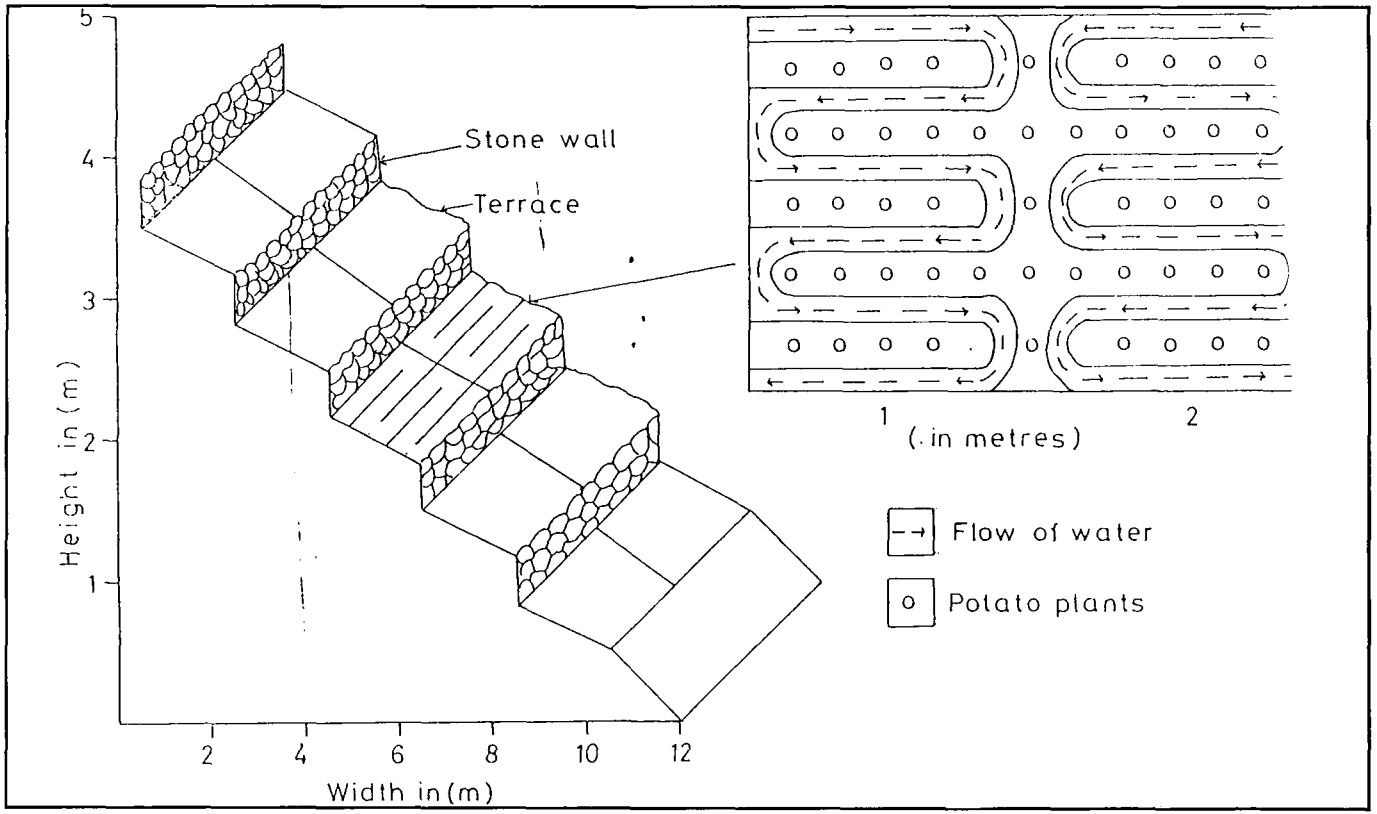

Figure 2. Typical hill farming on steep slopes.

Changes in Indigenous Systems

Traditional Agriculture and Animal Husbandry

Before the 1960s, agriculture operations depended on manure-based crops. With the introduction of cash crops, the demand for chemical fertilizers, pesticides, and insecticides has markedly increased. The change can be characterized as one from a *solar powered indigenous system* to a *solar powered exogenous system.* Crop diversity and cropping intensity have decreased significantly. In Jahalma, Udaipur, and other areas, people have incorporated horticultural crops into home gardens. But the extreme climate has frustrated attempts to commercialize these crops, which can barely be produced even at subsistence levels.

Socioeconomics

The area has been declared a tribal area, making it eligible for special priorities government subsidies. These as yet have had scant impact on marginal farmers. Since the area is unique in terms of geography and scenic beauty, tourism could be one way to raise the income of marginal farmers.

Cultural Values

Polyandry is an age-old practice in the Lahaul Valley. Though this practice of sharing a single wife by brothers of the same family exists even today, it is declining steadily, owing to the advent of education, migration of youths out of the valley in search of both education and jobs, establishment of social contacts with monogamous people who usually condemn this system, and rapid uplift in economic status of some of the sections of the society. Polyandry is a traditional mechanism for sharing inadequate land property, checking the fragmentation of land holdings, and reducing population growth in this demanding environment. Other advantages of polyandry include pooling of manpower resources for arduous agricultural activities, maintenance of a "joint family," and rationing fuel, fodder, and timber for sustainable use of limited resources in the domestic sector. Mann has reported less fuelwood consumption by polyandric Ladhaki families than by monogamous families [18]. At the same time, other social problems arising out of polyandry were noted. For example, a large number of the adult females remained unmarried in the family. Ultimately, they have to pass their lives as agricultural laborers in their family.

CONSTRAINTS ON DEVELOPMENT

Geographical Constraints

We have noted that the Lahaul Valley's highly rugged terrain, inaccessibility, dry soil, cold arid climate, and high altitude make it difficult for human habitation and agriculture. Barely a single crop is harvested in a year. Vast areas of arid land

lie unutilized in the wake of inadequate earthen-channel irrigation facilities and the permanently snow-clad slopes. Heavy landslides and avalanches can destroy each year's water channels, crop fields, houses, and vegetation at once. Human survival here is as precarious as it gets on our planet.

Small Landholdings

Small and medium farmers are still reluctant to convert their land to cash crops due to insecurity about having food for survival. Instead, they grow barley, wheat, buckwheat, and other subsistence crops that do not require high capital investment. Such farmers can ill afford the cash crop inputs of HYV seeds, inorganic fertilizers, weedicides, insecticides, and modern agricultural implements and irrigation facilities.

Lack of Infrastructure

There is no extension service or comparable institution in the valley equipped to transfer technical know-how regarding soil management, bio-engineering, and other useful practices. All-weather roads and continuous electricity service are not expected to be available anytime soon.

STRATEGIES AND APPROACHES OF DEVELOPMENT

Marginal farmers have no other means of development except through agricultural activities. Under the circumstances described thus far, the most effective measures appear to be the following: 1) reinforce earthen channels with stone and cement, to permit them to survive landslides, glaciers, and avalanches. This will help the channels realize their full irrigation potential. 2) Promote the use of indigenous crops and domesticated wild plants, so enhancing both ecosystem diversity and human food supply security. 3) Bring areas now cultivated as grass for fodder into an agro-silvi-pastoral regime by introducing selected tree species. The existing indigenous agroforestry system should be expanded beyond existing pockets. This will reduce dependence on dried cow dung for fuel, improve soil quality, and reduce pressures on the existing scanty vegetation. In particular, seabuckthorn (*Hippophae sp.*, locally called *chug* or *salalla*), a naturally occurring plant of many uses [19], should be encouraged. This bushy thorn is used as fuelwood by villagers. They need to learn about other uses of this plant. Further research also is needed about the plant. 4) Villages should be taught better techniques of animal husbandry that produce sustainable quantities of wool, manure, and cattle wealth. This includes better measures for storage of manure. Animal dung remains in a corner of the cowshed during winter, and is taken out in early summer and placed in a heap outside. Instead it should be kept in compost pits to preserve its quality. 5) Tourism could become an important source of

livelihood that could free Lahaul Valley inhabitants from some of the unremitting burdens of agricultural labor. Finally, 6) there is an overarching need to promote environmental awareness through improved soil conservation and forest and agriculture nutrient management.

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