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FORESTRY – FARMING LINKAGES IN THE MOUNTAINS

T.B.S. Mahat

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Kathmandu, Nepal
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FOREWORD

The consideration of forests as a free and abundant resource, in some cases waiting to be cleared in order to make the land "productive", is slowly changing into deeper understanding, not only of the intimate relationship between forests, livestock and agricultural productivity, but also of the many ways in which forest and tree products contribute directly to the food and income requirements of the mountain people.

The present joint study by the Food and Agriculture Organization of the United Nations (FAO) and the International Centre for Integrated Mountain Development (ICIMOD) documents and provides examples of these relationships. It also shows the high degree of flexibility and adaptation to new levels of resource scarcity shown by the mountain communities themselves. However, it points to the urgency of external support and new investments if widespread human suffering and ecological damage is to be avoided.

We wish to express our recognition of the value of this study by Dr. T.B.S. Mahat with the professional participation of Mr. J-P. Jeanrenaud and Mrs. R. L. J. Shrestha, and our gratitude to the many people who gave their time and contribution to the document.

It is hoped that the study will stimulate interest in the rehabilitation of upland areas through investment in forestry activities as an integral part of a diversified mountain economy.

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This paper has evolved out of the earlier ICIMOD working papers on the subject which, because of the unconventional nature of the subject matter chosen, has been a rather complex and difficult task. The author is indebted to Mr. J-P. Jeanrenaud and Mrs. R.L.J. Shrestha, his colleagues in this study, who provided valuable assistance through research and contribution on the earlier working papers. Mr. J-P. Jeanrenaud has not only provided material for this paper, particularly to the sections on Daphne Paper, Bamboo and Allo Cloth, but has also made a valuable contribution to the better understanding of Nepal's lesser known forest resources for rural income generation by way of his already published work on Daphne (Lokta) paper making in Nepal. Mrs. R.L.J. Shrestha provided the economic analysis and other material, in particular the case studies of the Nepal-Australia Forestry Project, Medicinal Plants Development and Mushroom Farming.

The author is grateful to Dr. Colin Rosser, Director, ICIMOD for his valuable advice and keen interest throughout the course of the study. Sincere thanks are due to Mr. T. Michaelsen, Mr. L. S. Botero and Dr. K. D. Singh of the FAO, Forestry Department (Rome); Dr. R. V. Singh and Mr. P. Keshwani of the Forest Research Institute & College (Dehra Dun); Dr. K. R. Shepherd of the Australian National University, Forestry Department (Canberra); and Dr. Kk. Panday and Dr. R. P. Yadav of ICIMOD for their intellectual contribution.

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The views expressed in this paper are those of the author and do not necessarily represent the views of ICIMOD or FAO.

ABBREVIATIONS

ADAB	Australian Development Assistance Bureau
ADB/HMG-N	Asian Development Bank/ His Majesty's Government of Nepal
APROSC	Agricultural Projects Services Centre
BLU	Big Livestock Unit
c.	ca., circa, about
CBS	Central Bureau of Statistics
FAO/UN	Food and Agriculture Organization of the United Nations
HK-H Region	Hindu Kush-Himalaya (Mountain) Region
HMG-N	His Majesty's Government of Nepal
ICIMOD	International Centre for Integrated Mountain Development
Kabhre	Kabhre Palanchok
KHARDEP	Koshi Hill Area Rural Development Project
NAFP-2	Nepal-Australia Forestry Project. Stage-2
PF	Panchayat Forest
PPF	Panchayat Protected Forest
SFDP	Small Farmers' Development Programme
TDN	Total Digestible Nutrient
TSU	Tree Seed Unit
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
mt	Metric Tonne

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INTRODUCTION

Important linkages exist between forestry and farming in the mountains. Forestry supports agriculture and livestock husbandry, making important contributions to the highland farming economies. It is important to understand these linkages in the context of forestry development and to gear future forestry activities to fulfil the needs of the local people. This study attempts, therefore, to demonstrate how forestry plays a role in the economic and social development of the people living in the hills and mountains and thus establish a place for forestry in rural development.

The major objectives of this pilot study are, therefore, to broaden the understanding of forestry-farming inter-relationships and discuss forestry's contribution to hill farming economies while highlighting the related problems. It also tries to show that increasing activities and investment in forestry could mean an increase and diversification in the income and employment opportunities of rural people.

The study concentrates on three main aspects:

- Contribution of forestry to the hill farming system
- The hill farmer's problems
- Diversified income through forestry activities

Important policy implications of this study are identified.

In so far as ICIMOD is currently focusing its attention on the Hindu Kush-Himalaya Mountains, examples from this Region are taken to illustrate the above points. Examining in some detail a few case studies of forestry and allied practices relevant to the Region, therefore, also forms an important part of the study. Due to paucity of data, however, it may not be possible to illustrate case studies from all parts of the Hindu Kush-Himalaya Region

Plate 1: Farmer managed forest and terraced cropland in Banskharka, Sindhupalchok

or from each country within the Region. Most of the illustrative case studies are thus reported from Nepal where data became relatively easily available.

The economy of the Hindu Kush-Himalaya Mountain Region of Asia is dominated by a rural sector based exclusively on farming. Crop production, livestock husbandry and forestry constitute the three main closely and inseparably integrated components of much of the Region's hill farming system. The farmers who cultivate the land also raise livestock and depend on the forest for the support of both components. The practice is very different from that followed in developed countries in modern times. There, farming may be exclusively devoted either to crop production or livestock raising, and forestry is mainly seen as an independent commercial enterprise isolated from the other two. In the Hindu Kush-Himalaya Region, however, a change in one of the components of the farming system significantly affects the others. Although the hill farmers have always understood these linkages and closely integrated the agriculture, livestock husbandry and forestry practices, the interrelationships have only recently begun to be understood and appreciated at the professional level (Mahat, 1985).

The forests in the Region represent an important land use, and make a substantial contribution to the upland farming economies. They sustain the hill farming system by supporting agriculture and livestock husbandry. Hill agriculture is heavily dependent on trees and forests, and could not be sustained without them as it requires a net transfer of fertility from the forest,through fodder and leaf-litter, to the stall-fed animals. The forests are, as a result, also subject to heavy human and livestock pressure. Due to increasing competition for these resources the Hindu Kush-Himalaya Region has become the object of growing environmental and socio-economic concern in recent decades. The hill farmer has to bear the brunt of the ever-increasing problem.

Forestry, through appropriate activities and investment, could contribute to the Region's hill farming economies in a number of important ways. People oriented forestry development activities have high potential for creating additional income and employment opportunities, particularly for the poorer sections of hill rural populations, while also reestablishing the resource base for supplying their basic needs and reducing environmental deterioration. Logging and other harvesting operations may still be relevant in some areas to create some off-farm income to the local people. Promotion and development of forest based and allied cottage industries, handicrafts and cash crops also have a high potential for creating employment and income opportunities outside the farming occupation for hill farmers.

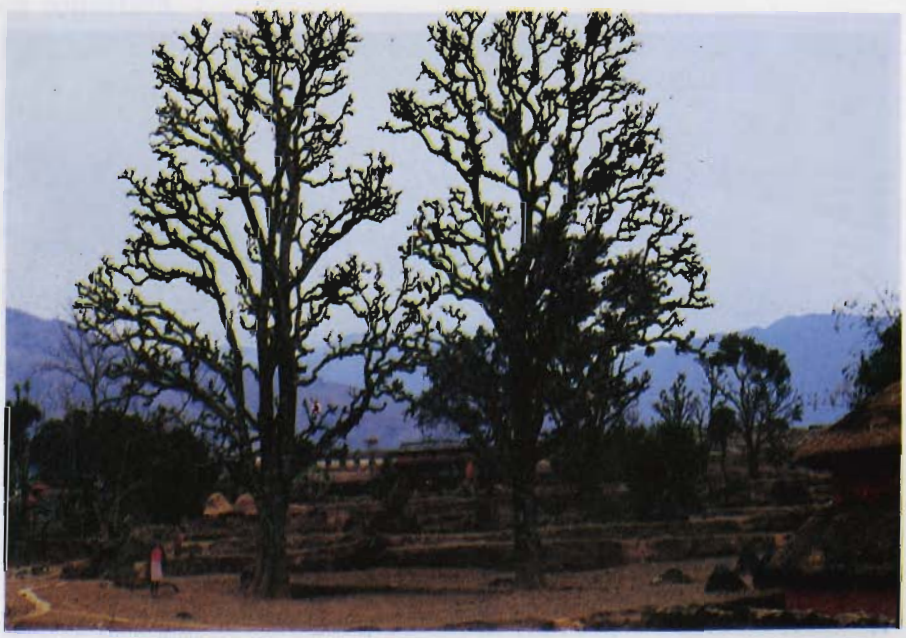


Plate 2: Trees on hill farmland maintained for livestock fodder & fuelwood: *Artocarpus lukoocha Roxb.* lopped for fodder by mid-Februrary

FORESTRY - HILL FARMING RELATIONSHIPS

In the past, throughout much of the Hindu Kush-Himalaya Region, government revenue derived mainly from sale of timber in saw log form was the principal consideration in forest management. A direct link exists, however, between the welfare of the local communities and the use of forested land. The forests supply the hill rural population with their essential basic needs: fuelwood, fodder, leaf-litter, poles, timber, etc. These represent the most important contribution of forestry to the generally subsistence types of hill farming economies of the Region. Local people also use forest products for direct domestic consumption and supplementary income generation. All these products of the forests are generally obtained by the local people as free goods.

It is important to understand the contribution forestry can make to the hill farming economies if future forestry and other related development activities are to be geared to fulfil the needs of the local people. This chapter tries to highlight the linkages between the hill farming system and forestry.

The hill farming system can be described in general as being comprised of a complex arrangement of soils, water, crops, livestock, forest and other resources within an environmental setting that the farm family manages in accordance with its preferences, capabilities and available technologies. The farm families are engaged in production of crops, livestock, and non-agricultural commodities such as handicrafts, and other income generating activities off the farm to supplement their income.

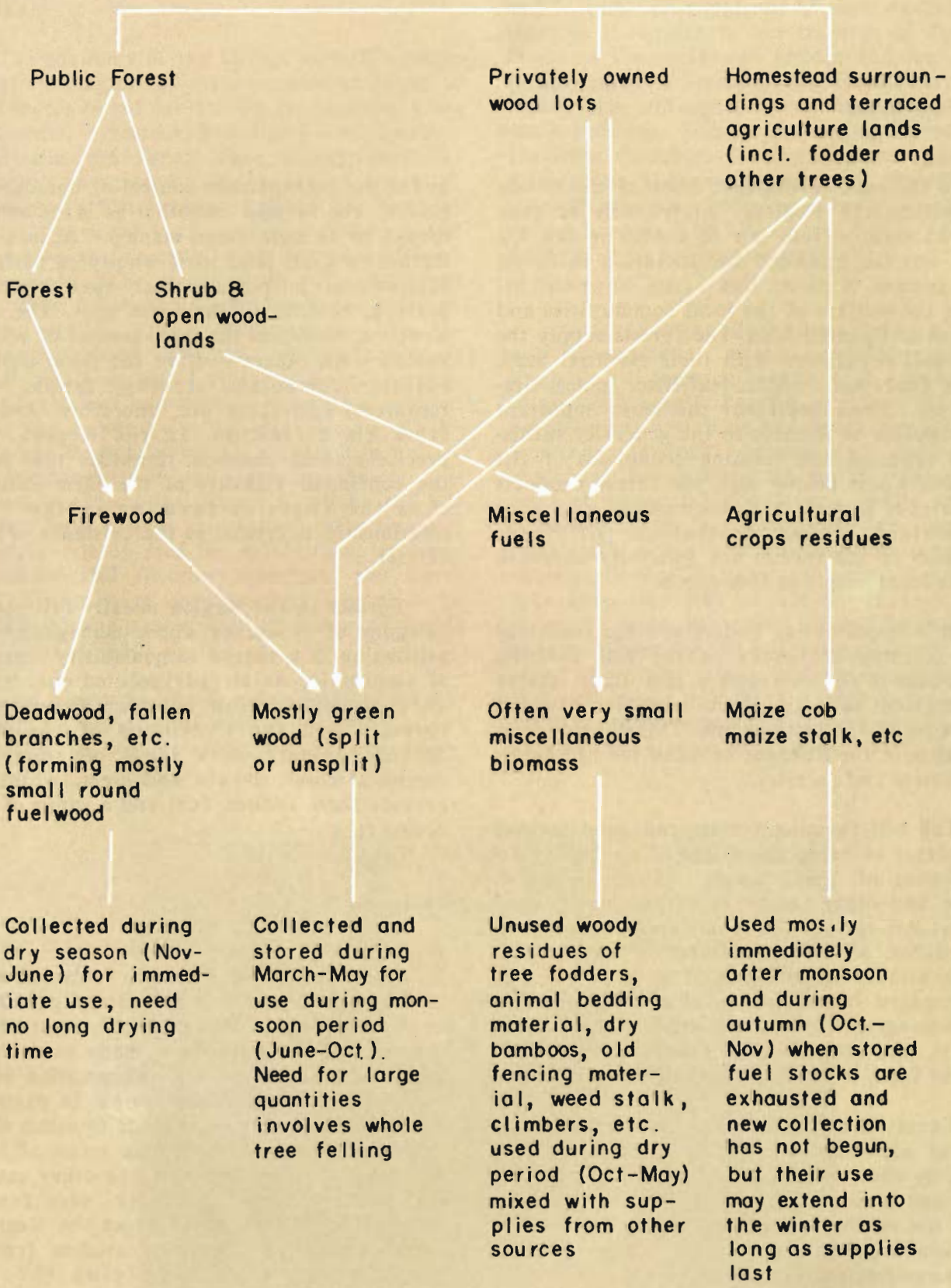
Farms are defined as systems because several activities are closely related to each other by the common use of the farm's labour, land and capital, by risk distribution and by joint use of the farmer's management capacity (Ruthenberg, 1980). Farms are considered both as ecosystems and independent economic units. Any system has a 'boundary' which separates it from the 'environment'. In the case of the farm unit, the system embraces all workers and resources (elements of the system) which are under the management control of one decision-maker - the farmer - whether he is the owner, a tenant, or an authorized manager. According to Ruthenberg, all land used wholly or partly for agricultural purposes, other than communal grazing, belongs to the farm unit. There are, however, resources the management of which is shared with others outside the farm unit (e.g. forests, communal grazing, lands, water resources) and these are, therefore, excluded from his definition. In the Region, it is precisely these common resources that permit the continued viability of the farm units and thus the forestry-farming system interrelationship is crucial to the existence of a hill farmer.

Forests in the Region usually fall into the category of resources where management and utilization is a shared responsibility regardless of ownership. As already pointed out, there is no clear distinction between farming and forestry and the livelihood of the people depends directly on a range of annual and perennial crops, shrubs and trees, which may provide food, fodder, fuel and a range of other products.

Fuelwood

The question of domestic fuelwood supply in developing countries has gained prominence in the past decade. However, only scattered and isolated efforts have been made to assess the quantities and patterns of consumption of fuel biomass by the rural population. In particular, efforts have hardly been made to assess the actual contribution in economic terms of forests and trees for fuel, biomass and other usage by the rural economy. Similarly, very few - if any - efforts are known from the Region of forest biomass productivity studies from the point of view of supplying the local population's fuelwood and other needs. The household energy question in developing countries is, however, very important and plant biomass has the most significant place in it.

Fig. 1: Biomass fuel sources



Source: Adapted from Mahat, 1985.

In the HK-H Region, by far the most important source of energy is the plant biomass, in one form or other, and hardly anything else is of any significance to most farmers. A serious source of confusion lies in the assumption that all fuel biomass is wood or tree product and all are subsumed as 'fuelwood'. Infact, not all fuel is tree or forest product. The fuel biomass supply is obtained from the forest, shrublands, agricultural and other private land (Fig. 1). In the central hill region of Nepal, the biomass from forest, including shrubland, supplies approximately two-thirds of the total annual fuel supplies of the rural population. This supply may come in the form of fuelwood, weeds and other miscellaneous biomass fuels. The rest (one-third or so) comes from private land in the form of agricultural crop residues, tree fodder residues, fuelwood from old or overmature trees and sometimes, purchased or bartered fuelwood. Similarly, the quantities and patterns of fuel consumption may also vary due to change in climate between higher and lower altitudes. Consumption at higher altitude may be almost twice as much as at the lower altitude areas. In the hills dependency on forest is, in general, higher in comparison to lowlands (Mahat, 1985).

Estimates of fuel biomass use show great variability. For Nepal, the estimates vary from 0.1 to 2.57 (or even 6.67) m^3/annum/person although the generally assumed figure for per capita fuelwood consumption is still at 1 m^3 (600 Kg.) per annum (Donovan, 1981; ADB/HMG-N, 1982). Such great uncertainties in data concerning consumption and fuelwood production in average forests and shrublands have led authors to differ in their conclusions regarding the adequacy of forests to meet either demand or actual consumption in the hill region of Nepal and elsewhere in the HK-H Region. It may also be noted that total sustainable fuelwood supply in many areas may exceed total consumption in those areas but the uneven distribution of the forest resource may cause areas of local fuelwood shortage (Bajracharya, 1983; Wiart, 1983).

For India, Singh & Berry (1985), estimate the energy need for cooking to be 1.56 gigacalories per capita which has to be met from fuelwood and agricultural residues. They assume that 1 m^3 of woodfuel produces 2.6 gigacalories and 1 Tonne of dried agricultural residues provides 4.0 gigacalories.

Fodder

Among the forest products derived mostly as free goods and forming the essential basic needs of the rural population in the HK-H Region, livestock fodder for stall feeding, grazing and browsing is perhaps the most important of all.

Farmers maintain large numbers of livestock, largely for manure production and draught power. They also provide milk and meat to supplement food even if crop production is high, as well as many other goods and services and are an additional source of income to hill farmers. It is, therefore, economic compulsion rather than merely religious beliefs that forces the hill farmers in the Region to keep large numbers of livestock. Forests supply the major share of the feed of these animals in the form of fodder. Fodder denotes plant material, fresh or dry, which is consumed by livestock as food and is taken to include material grazed, browsed and gathered. Forest fodder is particularly important for livestock maintenance during the dry season when it is characteristically in short supply. Stall-feeding of livestock is constrained by inadequate fodder supply. Declining availability of fodder from the forest and trees, natural pastures and crop residues is limiting stall-feeding of livestock to night time only for collection of manure, while the animals wander freely by day. Free range grazing and browsing, constituting the other part of the livestock management and production system, also takes place in the forest and shrub areas, grasslands and terraced agricultural land after harvest.

The shortage of fodder, especially in the dry season, greatly limits animal productivity. It is assumed that on an average throughout the year animals obtain only half the desirable ration of optimal productivity (Wyatt-Smith, 1983; Singh & Berry, 1985). Taking 1 ton of total digestible nutrient (TDN) per big livestock unit (BLU) annually, as the absolute minimum, Panday (1982) estimates that the fodder deficit may run over 20% of the present demand for maintenance and very low performance. Panday's estimates also show that over 50% of the total fodder supply comes from forest sources with the forest trees supplying 20%. Singh and Berry (1985) estimate that in the Dehradun region 57% of the annual fodder supply comes from forests, 19% from cultivated areas and the rest from the blank areas. Data collected in Thokarpa region of Nepal show

Plate 3: Fuelwood Collection

Plate 4: Tree leaves and branches for fodder and fuelwood

that one quarter of total gathered fodder is derived from forests (Mahat, 1985). Quantification is, however, not possible in the case of grazing and browsing, but casual observation suggests that the quantity of plant biomass involved in grazing and browsing is huge, and that the effects of uncontrolled browsing, particularly by goats, are serious. Excessive grazing leads to soil erosion besides the degeneration of grasslands and herb fields.

Regarding fodder availability and consumption Wyatt-Smith (1982) has suggested that 2.8 ha of accessible unmanaged forest are required for 1 ha of agricultural land to sustain the existing farming system. It is possible to calculate from Wyatt-Smith's (1982) data that each person requires c. 1.65 ha of accessible unmanaged forest to sustain the existing farming system. Similarly, for timber and fuelwood the requirements are 0.4 ha and 0.3 to 0.6 ha respectively (i.e. a total ratio of 1:3.5 or 3.8 between agricultural land and forest). Shepherd's (1985) estimates for the current mixed farming system in Nepal are in agreement with Wyatt-Smith, and show that 3 ha of forested land are required to support 1 ha of cultivated land. Applegate and Gilmour (1985) put the ratio as high as 1:6.

For most of the hill areas, however, this ratio between agricultural land and available forest land is much lower. In the Phewa Tal and Tinau watersheds in Nepal this ratio is in fact only 0.97, even when forest land is taken to include forest, shrubberies and grasslands. For Sindhu Palchok and Kabhre districts the values are only 1.69 and 0.52 respectively. Similarly, for the eight districts of U.P. Hills forming the entire Central Himalaya in India, this value is only 1.58, well below that required to sustain the hill farming system (Shah, 1982). On the above criteria of Wyatt-Smith and others, in terms of the adequacy of forest land to supply the animal fodder required by the hill farming system, most hill areas in the HK-H Region are grossly deficient in forest area including shrub land.

The problem of heavy pressure on land is compounded by the growing number of an already over-high livestock population that has far exceeded the carrying capacity of forest and other grazing lands. In Nepal, livestock population growth has kept pace with the high rate of growth of human population so that there is approximately 1 large livestock unit per capita in addition to small livestock units. The estimated carrying capacity of the open grassland and forest in the Middle Hills is only 0.54 and 0.31 livestock units per ha respectively whereas present stocking rate is 7 and 2.8 livestock units per ha, or 13 and 9 times greater respectively. (Rajbhandari and Shah, 1981). The situation is hardly any different in other parts of the Himalaya. In Himachal Pradesh in India, up to 80% of all fodder requirements are obtained from the forest (Singh and Swarup, 1980). Consequently, the intensity of grazing and browsing is very high at about 5 livestock units per ha of grazing land (Singh, 1984) that can support only 0.51 to 1.0 livestock unit at the present levels of production (Ashis, 1980; Singh, 1984 a; Singh, 1985a & b).

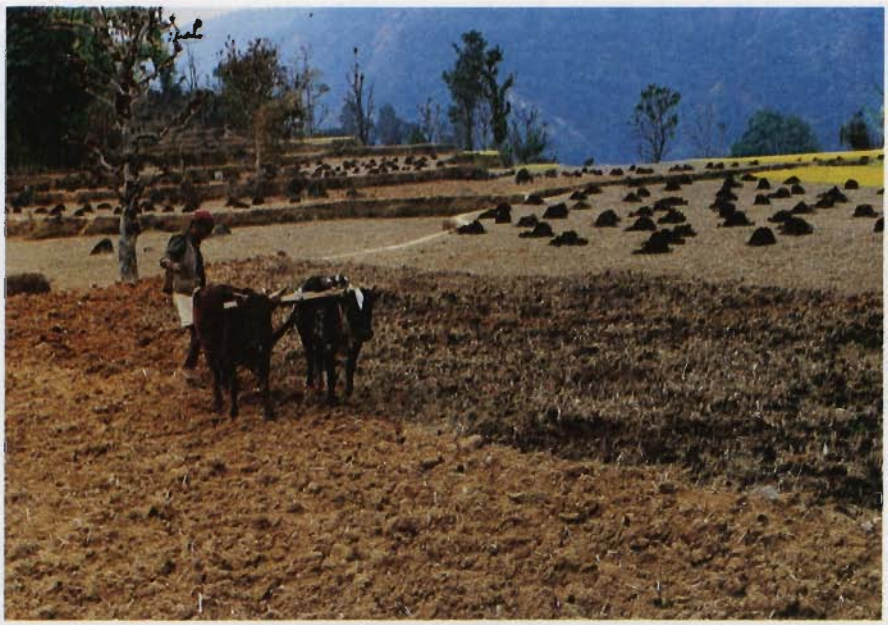


Plate 5: Forest biomass mixed with animal excreta yields organic manure, the principal source of soil nutrient for hill agricultural land

Thus, the increase in the total number of animals, along with the increase in human population, has aggravated the situation of over exploitation of forest for fodder in recent decades. The fodder resource base has contracted as a result and livestock productivity is declining. The hill farmer is forced to maintain more animal units to maintain his farm income, thus further aggravating the situation of over exploitation of forests.

Leaf-litter - organic compost manure

Another very important contribution of forestry to the hill farming system is the use of plant biomass as bedding for stall-fed animals. Forests are the principal source of fallen dry leaf-litter and lopped green foliage of trees and herbaceous species which are used for animal bedding and composting. Forest biomass, when mixed with animal excreta, yields organic compost manure which forms the principal source of soil nutrients for hill agricultural land. In fact, it provides almost the only manurial inputs to crop production in the hills. Hill farmers well know that agricultural yields decrease when fodder and leaf-litter are no longer available in sufficient quantities from the forests. However, this aspect of the forestry-farming system linkage is much less understood by professionals and the contribution of forestry to the hill farming economies is neglected so that there is a paucity of data on the subject. Adequate assessment of the effects of animal manure and litter is wanting but the significance of these to hill agriculture is obvious. Data collected from Sindhu Palchok & Kabhre in the Central Himalaya region of Nepal show some 2.3 metric tonnes of litter and manure are used per ha of cultivated land annually, whereas the use of chemical fertilizers is negligible, mainly because of shortage of cash in the rural economy and lack of irrigation facilities (Mahat, 1985). Khandka et al. (1984) have estimated that 50% of the litter production is removed annually from some forests in the Nepalese Middle hills. This seriously interrupts nutrient cycling within the forest. However, the overwhelming dependence of the crop lands on organic manuring derived from animal dung and forest biomass can not be over emphasized also. Organic manure yield is directly proportional not only to the number of livestock and stall-fed animals but also to the quantities of forest biomass used for the purpose.

Poles and timber for rural construction and farm implements

The forest, in addition, provides timber and poles for housing, livestock sheds, furniture, household and farm implements and tools for the rural population in these mountain areas. Timber, poles and bamboo are the principal construction materials. Thatch grass is the most commonly used roofing material. Conifer shingles at higher altitudes and tree leaves may also be used for roofing for temporary shelters and animal sheds. The forest also supplies the local population with wood for making various farm implements and tools which are renewed regularly to sustain the hill farming practices. All these products of the forest are generally available as free goods. As with other local uses of forest the data on consumption of timber, poles and other forest products for construction and maintenance of houses and for the manufacture of agricultural and household implements and tools is again in short supply. Available estimates vary greatly.

In India timber used for house construction alone is estimated to be only 0.018 m^3/person/annum (Bannerjee, 1978). For Nepalese Hills the estimates of timber for house construction and maintenance vary from 0.027 (Wiart 1983), and 0.05 m^3/person/annum (New Era, 1980) to 0.1 m^3/person/annum (Wyatt-Smith, 1982). Grunenfelder's (1977) estimates based on the experience of Integrated Hill Development Project in Nepal show that a medium sized house for a family of seven people uses, on average, 1.13 cubic metres finished wood or 2.26 m^3 round logs with a 50% conversion waste of timber using saws. Mahat's (1985) survey in the Thokarpa Region gives an annual per capita usage of saw log size round timber of 0.05 m^3 and 0.02 cubic metre of finished products where the axe is usually used in all timber conversion practices.

Besides the use of this timber, many pole sized components are used. Their volume has not been quantified, but the requirements per average household of 6 to 7 people with a medium sized holding for house construction and maintenance, exceeds 260 poles of medium and small size. Local houses in these hills may last 60 - 80 years but major maintenance would be required every 25 - 30 years. This shows high consumption of small poles and hence of the future potential tree crop (Mahat, 1985).

The local population uses the forest to obtain wood for making various farm implements such as plough-shares, poles, handles, levelling tools, hafts, shafts, stet, etc. The quantity of wood used for such implements and tools may vary greatly depending on percentage net utilization rates, design, duration and the site of use of the implements and other such factors. Plough life in India is taken to be 3 years with a timber content of 0.056 cubic metre (Banerjee, 1978). For Salme in Nepal it is 0.019 cubic metres with a life of 18 months (Wiart, 1983). For the Thokarpa region, the requirement (Nos.) of farm implements and tools per household per annum is shown to be much higher i.e. 3-4 plough-shares, 1-2 plough-poles, 2-3 plough-handles, 1-2 yokes of plough, 2-3 levelling tools, and an unquantifiable number of hafts, shafts, handles, etc. Two to three small sized trees may meet the needs of an average household. However, as the farmers use different species for various purposes many trees are involved for different tools and implements (Mahat, 1985).

Besides the use of timber for house construction and farm implements, timber is also used for various local and regional developmental activities such as building bridges, schools, etc., and form the contribution of forestry to the rural economy through economic and social development of the area. Singh and Berry (1985) in their case study of Dehradun, India, illustrate a very substantial contribution of forestry to the household economy of hill farmers. The Chakrata District in U.P. Hills of India has over 60% of its area under forest and 14% is cultivated land. Agriculture and animal husbandry, contributing 33% and 36% respectively of the household income, are of enormous importance to the household economy of the area. The Chakrata Forest Division covers an area of 362 km^2. In 1982 - 83, the Forest Department gave from the government forests 1512 m^3 of timber worth a value of about Indian Rupees 2.3 million to the local villagers free of cost. In the same year 67,058 animals (i.e. 434 buffalos, 22,439 cows, 44,185 sheep and goats) grazed free in these forest areas. In addition, 8,400 m^3 of timber worth the actual value of Indian Rupees 10.5 million and 6,813 quintals of fuelwood worth the actual value of Rs. 272,500.00 were purchased from these forest areas. Such forestry related economic activities generate additional cash income to the rural people in the form of wages often earned through seasonal employment outside the agricultural season and further illustrates the linkage of forestry to the socio-economic life of the hill people.

Forest products for direct domestic consumption

Besides the provision of basic needs as discussed above, the rural population also uses forest products for direct domestic consumption and income generation. Naturally occurring

Plate 6: Farm implements made from wood

foods, including wildlife, make a significant contribution to food supplies. Many wild forest plants provide naturally valuable supplements to diets based on a limited number of staple foods. The local population derives various forest products: plants, fungi, birds, fish, animals and insects, for direct domestic consumption, thus contributing to human nutrition. Tubers, roots and stolon, bamboo and other shoots, stems, whole or part, bark, leaves, flowers, fruits, nuts and berries, seeds, mushrooms, game, fish and honey are all such forest products for human consumption and nutrition. Data on quantification of these is lacking. The rural population in the Region however, is known to use various of these forest products to subsidise their food. These may be available when agricultural food produce is in short supply and thus contribute to the stability of food supplies throughout the year. Forest products play a particularly significant role in nutrient supply in areas of food scarcity and in periods of food shortages. For forest dwelling communities and those living in the vicinity of forests, forest products form a major source of nutritional supply. Some plants are also important sources of income, e.g. bamboo shoots and mushrooms. Honey is another significant source of food and income from the forest.

For both wild life and potential food plants, forests constitute the largest reserve of genetic diversity; the most certain way of conserving this vital pool of genetic material is the conservation of the forest habitats themselves.

Forest products for supplementary income generation

Local people use forest products for supplementary income generation also. Hill farmers augment their cash income and utilize their spare time by engaging in various home based small scale industries and trades dependent upon forest products. These often small forest based local industries and manufacturing processes provide a considerable and diversified source of income to the hill farming population of the Region. Some of these need forest products as raw material, others require fuelwood as the source of energy for primary and secondary processing, while some are forest dependent for both: raw material base and energy supply.

SUMMARY

The forests in the Hindu Kush-Himalaya Region represent one of the most important land uses. The foregoing discussion highlights the important contributions forestry is making to the upland farming economies. It is also clear, however, that forests in the Region do not stand apart as a separate sector but are closely interwoven with other land uses. The analysis of the inter-relationship of forestry with agriculture and livestock husbandry shows the need for an integrated management of resources in the mountain watersheds.

Plate 7: Disabled hill farmer earns a living by bamboo goods manufacturing

THE HILL FARMER'S PROBLEM

The problems of each country in the Hindu Kush-Himalaya Region are generally similar and are related to economic under-development. In most countries of the Region the economy, as already indicated, is dominated by the rural sector and is based almost exclusively on agriculture which itself is heavily dependent on forestry for its sustenance. Whether forestry can continue to contribute to the economic and social good of the people needs serious consideration. This is particularly relevant because of deforestation, which is an aspect of environmental deterioration, and which has become a topic of widespread concern in recent decades.

In the past, the integration and balance developed by the hill farmer between crop production, livestock husbandry and forestry allowed the needed levels of agricultural productivity. There are numerous examples of hill farmers' adaptability to the pressure of population growth, fragile environments and parasitic rulers, through changes in technology, crops, migration and colonization of frontier lands (Banskota, 1985).

More recently, however, rapid population growth throughout the Region has resulted in increased competition for scarce resources, fragmentation of land holdings and the gradual but inevitable breakdown of the fragile but previously sustainable upland farming system. Forests in particular are increasingly mined to meet the requirements of fodder, fuelwood, leaf-litter for animal bedding and compost, thatching materials, timber and other products. As a consequence of the declining availability of forest products, farming systems dependent on free goods from the forest cease to be sustainable, farm productivity stagnates or declines (Blaikie et al., 1980). This high level of dependence on the forest is closely related to the ratio of land available per person. The declining farm productivity resulting from the declining land:man ratio is the root cause of the hill farmer's problem.

The declining land:man ratio, therefore, is perhaps the most fundamental problem of development in the HK-H Region. Arable land per capita is generally very low and crop yields are declining. For instance, in the Himalaya-Hengduan Mountain Region of China, according to Li Wenhua and Zhang Mingtao (1985), the average land holding per capita is extremely low, ranging from 0.1 to 0.16 ha. 90% of all crops produced are cereals. Crop yields per unit area of agricultural land are generally low, averaging 0.75 tons/ha, and grain production is insufficient to meet the demand in most areas. In Nepal, with only 16% of the land resource under cultivation, the average land holding in the hills for a family of 5-6 persons is 0.4 ha. The World Bank (1979) estimated that the ratio of persons per ha of arable land varied from 15.76 in the Middle Hills to 3.79 in the Terai. Although the total agricultural production increased during the 1960s and 1970s, largely due to the extension of agricultural land to the previously forested areas of the Terai, in fact crop yields per ha generally remained stagnant or declined (Blaikie et al. 1980). Similarly, in the Central Indian Himalaya Region, the population density averages 61.25 persons per sq. km. The number of persons per ha of cultivated land is 4.78. The available forest area per capita is on average less than 0.80 ha.

Generally speaking, the land:man ratio is low and crop yields are declining throughout the Hindu Kush-Himalaya Mountain Region. Most hill people, as a result, are being pushed to live further below the poverty line. Agricultural production does not last for the whole year. To make ends meet, the hill people seek additional income.

ENHANCING THE HILL FARMER'S INCOME

Although the hill farmers in the HK-H Region still produce many of the goods needed by the household, none are self-sufficient. The farmers, therefore, need cash to buy goods and services at the market. In addition, cash is needed for paying rent and interest, taxes and

fees, capital investment and improvements; and to cover the cost of children's education, many religious and social ceremonies, marriages and other expenses. Moreover, declining farm productivity in the hills exerts further pressure on the farmer to make up production deficits through additional income and higher investments.

The widening gap between the hill peasant's farm income and the needed cash for various purposes is resulting in growing tension within the hill farming economy. Enhancing the hill farmer's income, therefore, becomes the most important consideration.

The problem of enhancing the hill farmer's income is to a great extent, related to the dwindling of the local resource base. The main problem linked to the deteriorating forest resource base is related to population increase and demand for resources, the fall in the level of forestry contribution, and breakdown in system interrelationships and its effects. These problems are visualized as follows:

Problem of forest resource depletion

For hill farming systems to be sustainable primarily requires a net transfer of fertility from the forest through fodder and leaf-litter to stall-fed animals. The dung produced is mixed with leaf-litter to obtain the compost manure which is transferred to the fields and generally comprises the only means available for maintaining an already low level of soil fertility. The declining availability of forest-produced fodder and leaf-litter means that nutrient levels and soil structure cannot be maintained, thus resulting in a decline of per ha production. In the hills the picture is one of more frequent and widespread food shortages and declining per ha production and hence income.

Forests are also over-exploited for fuel-biomass, timber, poles, etc. In the Himalaya-Hengduan Region of China demand for fuelwood continues to be the main cause of deforestation along with fodder collection and grazing pressure. Up to 90% of the total wood harvest is consumed for domestic purposes such as cooking and heating (Li Wenhua and Zhang Mingtao, 1985).

In India, forests represent the most important land use in the Himalaya region and have a vital role to play in supporting agriculture, animal husbandry and horticulture. As a result they are increasingly subjected to severe livestock and human pressures. The current annual fuelwood demand stands at 140 million metric tons, whereas the annual supply from existing forests is only 20 million metric tons. Timber demand is 50 million cubic metres per annum with supplies currently at a level of about 30 million cubic metres. The annual fuelwood demand in the Indian Himalaya region was found to be 0.60 to 1.64 tons per capita and that 51.83 to 74.04% of total fuelwood requirements are obtained from the forests, with the deficit provided by crop residues, animal dung and trees on private land (Singh and Swarup, 1980). Thus, growing human and livestock populations continue to exert heavy pressure on available resources; forests are cleared for agriculture, horticulture and settlements.

In Nepal, with per capita fuelwood consumption at 1 cubic metre per annum and the population standing at over 16 million, the net annual increment, estimated at 8 million cubic metres from the existing forest resource, can no longer meet the demand so deforestation continues. In addition to fuelwood demands, the forest is used for providing fodder for a growing livestock population (approximately 1 large livestock unit per capita in addition to small livestock units). Forests also supply leaf-litter for compost and animal bedding and a number of other products.

Similarly, some of the major social and environmental problems faced in Bhutan are directly related to the conservation of existing forest resources. The annual per capita fuelwood consumption in Bhutan is estimated at 2.6 m^3, a substantially higher demand than in India or Nepal, and this again is a potential threat to the resource base if scientific management is not implemented (Dorji, 1984).

The northern Himalayan region of Pakistan occupies an area of 15,500 km^2 Within this area, crop production, livestock husbandry and forestry are the major land uses, with cultivated land occupying 19% of the total land area. Over 92% of the total population of the region is rural, a large majority of whom live below the poverty line. Population density is very high, 125-150 persons/km^2 Fragmentation of land holdings has made farming uneconomical. Crop cultivation and grazing on steep slopes has led to soil erosion (Chima, 1978; Qureshi, 1981 and 1985; Mian, 1983; Noor, 1985).

Problem of ecosystem degradation

Degradation of the Himalayan ecosystem is seen to be essentially caused by increasing pressure on vegetative cover by the large and ever increasing livestock numbers accompanying the high human population. Such biotic pressure manifests itself in over grazing and browsing and other associated problems in the form of soil compaction, excessive run-off, direct trampling of regeneration, fire, excessive lopping, etc. Grazing and crop cultivation on steep slopes has led to soil erosion. This results in the loss of productive topsoil in the hills, with decreasing productivity due to deposition of eroded soil, widening the river and stream beds in downstream areas. This means more hardship for the hill farmer and problems for plains dwellers also. However, there are powerful natural forces at work that contribute to environmental degradation in the Region, and in many cases mass-wasting of soil is unavoidable (Carson, 1985).

In the Himalaya Mountain region of Pakistan, a recent survey showed 33% of the region's total agricultural area as being subject to 'moderate' or 'severe' soil erosion (Khattak, 1985). Moreover, with human and livestock populations growing at a rate of 3% per annum, a man to cultivated land ratio of 4 to 17.2 persons per ha, and a livestock ratio ranging from 1.5 to 3.1 animal units per ha, pressure on available crop, grazing and forest lands is increasing at an alarming rate (Chima, 1978; Qureshi,1981 and 1985; Mian, 1983; Noor, 1985). Similarly, the hilly regions in India are severely threatened by the accelerated pace of development and the subsequent increased pressure on land, forest, permanent pasture, grazing land, etc. The problems include: limited availability of land resulting in the extension of agriculture on to previously forested steep slopes, soil erosion and landslides; lack of irrigation facilities and dwindling water resources; poor transportation and communication networks.

In China, population increase has led to the extension of cultivation onto marginal, easily eroded land and to growing grazing pressure on the fragile upland pastures. As in other countries of the Hindu Kush-Himalaya Region, forests are rapidly being depleted to meet fuelwood, fodder, timber and grazing requirements. This removal of forest cover has accelerated topsoil erosion, lowered soil fertility and consequently decreased crop yields (Li Wenhua and Zhang Mingtao, 1985).

The problem of a deteriorating eco-system is thus common to all the mountain areas and is the primary cause of rural poverty in the Hindu Kush-Himalaya Region. Given the precarious ecology of these mountain areas the question of human welfare cannot be isolated from that of ecological conservation.

THE HILL FARMER'S RESPONSE

In response to the pressure of population growth, a fragile environment and most importantly the declining crop yields, a number of options including changes in technology, crops, migration, agricultural colonization of new and marginal lands, off-farm (casual, seasonal or permanent) employment, etc., are tried by the hill farmer. He may adopt one or more of the following strategies:

Agricultural land extension

From historical times agricultural land extension by clearing of forest has been the first response to meet additional needs of food production. Much of the clearing in the beginning must have been to meet the local subsistence needs. Government legislation also fostered conversion at times to generate agriculture surpluses for the state through maximization of land taxes and timber revenues (Mahat et al. 1984).

How much forest land is still cleared for agriculture extension is a controversial question. Undoubtedly, at least in the case of Nepal, large areas of lowland Terai forest have been cleared for agricultural colonization and resettlement and timber revenue. The situation in the Hills, however, could have been different.

Many authors have claimed that the principal means of increasing agricultural production in Nepal has been the extension of agricultural area. According to Pant & Jain (1972), the yearly growth in food production between 1962 - 1970 was 2.09% as compared to an annual increase of 3.06% in the area of cultivated land. Shrestha & Jain (1978) ascribe an increase in food grain production of 5.5% between 1965 - 1970 and 9.5 % during 1970 - 1975 during which period the area under cultivation was extended by 6.3% and 8.3% respectively. It is clear that during this period the overall production of food crops declined. Bajracharya (1983) suggests that agricultural land extension

(through forest clearance) and not an increase in yield, was responsible for the increase in food production.

It is shown by Rana & Thapa (1975) that in 1951, 3.5% of the Terai population consisted of hill migrants, 5.95% in 1961 and 9% in 1971. This increased out-migration was principally due to declining farm productivity in the Hills. Malaria eradication, improved infrastructure and government sponsored settlement schemes in the Terai acted as 'pull' factors and encouraged the hill farmers to migrate to the Terai for planned or unplanned settlements there and extension of agriculture to forest lands.

Mahat et al. (1984) argue that the situation has been different in the hills, at least in Nepal. They assert that deforestation due to the clearing of forests for agricultural extension in the Nepalese Middle Hills region is largely due to historical government pressure in order to maximize land taxes. It is argued that most existing land use boundaries were fixed in the distant past and remain largely unchanged in the present century. Hence, although population pressure has been responsible for the declining productivity of remnant forest, further clearing of forest land for crop production has been greatly limited in the hills. This contention is also supported by data generated by others like HMG (Water & Energy Commission), 1983, the Land Resource Mapping Project (1985), Remote Sensing Centre (Malla, 1985), Tinau Watershed Project (Strebel, 1985), and other authors.

The presence of abandoned terraces in the higher hills region indicates past efforts of agricultural land extension in response to the additional needs of food production which failed however, due to the declining productivity of land. More recently, despite the overall gain in crop production mainly due to extension of agriculture in forest land in the Nepal Terai, crop yield per unit of cultivated area has been declining. A further decline in crop yields will force the farmer to look for other options. Thus new areas are cut and cleared from the forest so long as it remains feasible.

Agriculture intensification

Intensification of agriculture by increasing cropping intensity is another way by which the hill farmer responds to declining crop yields. The necessity every year to produce the maximum food supply from their small holdings motivates small farmers to raise the crop intensity on available land. An excess of labour over land resource permits them to do so. A higher cropping intensity, generally speaking, is more possible where irrigation is available because it permits one additional crop. Crop production activities are almost entirely carried out within the framework of traditional practices. Human labour, animal draught power, farm yard manure and compost, and monsoon rain water are the main inputs. Labour is used lavishly in making full and intensive use of the available land. The adoption of new technologies and inputs to maximize food productivity, however, has been constrained mainly by the hill farmers' inability to buy them, lack of irrigation facilities and 'know how' about their use.

Off-farm employment opportunity

Very high percentages of population in the countries of the Region are still dependent on agriculture and other rural occupations. Abundance of labour against a scarcity of skills is the characteristic feature related to rural employment and income structure in these hill areas. In the hills, there has been little development of the non-agricultural sector. Both economic and socio-cultural influences have not favoured a shift from agriculture. Economically, the non-agricultural sector has not been able so far to provide attractive employment and income opportunities for the increasing rural population. Traditionally, land is closely associated with wealth and status. Land is also almost the only asset owned by the farmer. These links discourage the farmer from a shift in occupation. Moreover, employment opportunities have not kept pace with population increase. Therefore, crop production remains the main source of income for all farms. Small farms obtain a relatively larger share of their income via the labour market, medium-sized holdings through livestock husbandry and large-land holdings through crop-production (Pachico, 1980). But income from the agricultural sector alone is not enough to maintain the farm household. Farm production is supplemented by selling spare household labour within or outside the agricultural sector. However, local employment opportunities are minimal and opportunities for temporary outside employment are decreasing. The HK-H Region as a whole is characterized by low level industrial development, limited employment and income opportunities. Local artisans and contract labourers, generally with little or no

land, provide their services for fixed annual payments in kind and rarely in cash. The major employer outside agriculture is the state. Thus, military pensions and salaries support a considerable number of households in the rural hill areas of Nepal and India. For instance, recruitment of Gurkha soldiers from Nepal into the British Army is highly selective, based exclusively on ethnicity and region, and is limited to Gurungs, Magars, Rais and Limbus. In Pakistan some money is sent back home to their families by people who work in foreign countries (Sheikh, 1985). But such opportunities are limited and provide a solution only for the few. Thus the tension within the farming economy grows further.

Out-migration

A widespread method of supplementing income in the hills has been out-migration: casual, seasonal or permanent. There is evidence to suggest that the average size of the poorest groups' land holdings is being eroded, with a subsequent increase in the number of landless (in Nepal currently 10% of the population). Blaikie et al., (1979) noted that a growing differentiation within the peasantry, both in terms of control over resources and income distribution, has led to an increase in the level of 'impoverished emigration'. According to Rana and Thapa (1974), 'push' and 'pull' factors are responsible for migration. The 'push' factors include declining economic conditions due to population pressure and environmental decline. Opening of off- farm employment opportunities and opening up of the lowlands for agriculture are among the 'pull' factors. In summary, migration is primarily a result of the need for cash to purchase consumer goods, reflecting a rise in the standard of living of many people in the hills.

SUMMARY

The declining land:man ratio is the most fundamental problem of development in the HK-H Region and declining farm productivity resulting from it is the root cause of the hill farmer's problem. To make up for production deficits, to face the growing economic pressure and in order to maintain a minimum standard of living, the hill people are adopting strategies which take into account some or all of the above factors. These, however, fail to deal with the basic problem. One of the most basic requirements, therefore, seems to be the opportunity to earn a cash income through off-farm employment and income generating activities. The most important and relevant consideration includes the involvement of hill people in re-establishing the local natural resource base, e.g. in improved management and utilization of forests and trees.

ADDITIONAL INCOME GENERATION THROUGH FORESTRY ACTIVITIES AND INVESTMENTS

Often, lack of appropriate technology and technical manpower are considered to be the major constraints to development. It is, however, clear from the foregoing that the problems faced by the hill farmers in the Hindu Kush-Himalaya Region are in general related to a dwindling resource base and deteriorating local environment. Forestry and allied development activities help to re-establish the natural resource base to meet the basic needs of the hill farmers in terms of fodder, fuelwood, leaf-litter, poles, and timber and thus sustain the hill farming system. Moreover, declining farm productivity forces the hill farmers to make up production deficits with additional cash income. Forestry and related development activities have a high potential for generating off-farm employment and income opportunities for rural hill people, thus enabling them to earn the much needed cash income.

In the past the allocation of development resources has been characterised by regional and sectoral disparities with funding and manpower concentrated on lowland development. As a consequence, the upland regions and the forestry sector in particular, received only residual investment. For example, in Nepal, forestry sector expenditure was scant, with the greater part directed towards revenue-oriented tree felling in the Terai. A review of past investment in terms of proposed and actual expenditure on forestry and related projects clearly illustrates that the full potential of the contribution that could have been made to hill economies and investment has not been realised.

Similarly, past research and development work has often been undertaken on an ad hoc sectoral basis and has proved largely inadequate given the integrated nature of the three components - crop production, livestock husbandry and forestry - of the hill farming systems. The present need is for an integrated sectoral approach to the problem that emphasises the total development of the system of which agriculture is a part.

The primary purpose of this study is thus the identification of forestry and related activities which with appropriate investment would make a greater contribution to upland farming economies.

Forestry, through appropriate investments, could contribute to the hill farming economies in a number of important ways. Forestry and related development activities such as watershed protection, erosion control, the protection and improved management of existing forests, and reforestation of large denuded areas in these hills and mountain areas have high potential for creating employment and income opportunities, particularly for the low income groups of the hill population.

An understanding of this potential has resulted in recent years in increased government expenditure in forestry and related sectors and a growing trend, exemplified in the case of Nepal, towards greater inputs from external agencies. The effects of increasing the hill farmer's off-farm income could be much greater if the emphasis were placed on production and labour oriented field (local level) programmes, rather than on capital-intensive and centrally based projects and organisation in the name of institution building. This approach would provide greater employment opportunities for the poorer disadvantaged section of the population.

More recently, forestry development in the hills has received relatively greater attention and the resulting forestry and related activities are creating more off-farm income opportunities for the hill farmer. Community/social forestry programmes in particular have received widespread acceptance and funding in Nepal, India and several other countries of the Region. A major justification for this acceptance and support is that these programmes offer potential for increased rural employment and income through local people's participation. In the case of Nepal, it can be said with certainty that the contribution of community

forestry to local employment and income in rural areas has been far greater than in the case of conventional forestry programmes. Similarly, social forestry programmes in India are claimed to be making greater contributions to employment and income than forestry programmes of a conventional nature (Sharma, 1984). The employment and income benefits from community/social forestry programmes accrue to the landless, near landless, small and marginal farmers and the weaker sections of the local populations, often with surplus unskilled labour.

Appropriate development and encouragement of various forest based and related cash crops create potential for expansion and provide the hill farmer with the much needed cash income, thus making a much higher contribution to the hill farming economies in the Region.

There is also a high potential for rural income generation in the forestry sector through the development of certain forest based or related industries. The importance of forest products related to such small scale industries can hardly be over-emphasised as they provide job opportunities to a large number of rural people. In particular, enterprises based on so called 'minor forest products' are usually household units which are scattered throughout the rural areas in the Region. Sheikh (1985) has produced a very useful report, pertaining to Pakistan, on the role of minor forest products in rural employment and income generation. Employment opportunities and supplementary sources of income generated by means of widespread development of these minor forest products related to small-scale cottage industries accrue largely to the people of lower income brackets in rural areas. Improvement in the quality of such traditional handicraft goods could also go a long way towards further developing a growing export market.

Some of such forest dependent local industries and manufacturing processes, most of which are already practised by the hill farmers of the Region to generate the cash needed by them and that have a potential for further improvement, are listed below: (Mahat, 1985; Sheikh, 1985).

- o Local industries using forest products as raw material
  - Village carpentry
  - Handicrafts
  - Wood carving, lacquer work and inlay work
  - Bamboo and cane goods manufacturing, basketry
  - Production of cloth, ropes, cordage, bags, nets from plant fibres
  - Sports goods
- o Local industries using fuelwood
  - Alcohol from grain, fruits and flowers
  - Brown (raw) sugar
  - Oil processing
  - Peanut roasting
  - Ghee processing
  - Cheese making
  - Wool washing, dyeing and carpet making
  - Fruit jam
  - Blacksmithing (iron)
  - Metal craft (copper, brass, bronze)
  - Aluminium utensils
  - Jewellery (gold and silver)
  - Brick and tile manufacture
  - Lime-burning
- o Local industries using forest products both for raw material and fuelwood
  - Charcoal making
  - Handmade paper making
  - Medicinal herbs processing
  - Processing of fruits, nuts and berries
  - Ghee, appetizers and other products from the fruits and seeds of tree species
  - Tannins and dyes
  - Gums and resins - rosin and turpentine, gums, lac, Shellac, essential oils, etc.
- o Miscellaneous
  - Mushroom farming
  - Medicinal plants development
  - Sericulture
  - Bee keeping: honey
  - Orchids
  - Tourism
  - Fish and meat smoking
  - Road construction

Data on the quantities of forest products involved in such local manufacturing processes and the economic returns from these to the rural household economy in the Region are

hardly available. The topic warrants further research even though the task is time-consuming and by no means easy. However, industries located in nearby bazaar-towns, semi-urban and urban areas, and using forest products as raw materials and fuelwood or both, also provide considerable employment and income to the people of the rural areas in these hill areas. These provide some estimate of the quantities of forest products involved and the scales of income and employment generated to the rural people in the vicinity of these industrial areas. Industrial use of forest products for raw material and energy seems to be increasing and with it the contribution of forestry to the local economy is also increasing.

Future investment priorities

Greater emphasis on and higher priority to the forestry sector in hill regions is clearly the need. The objectives and target population of any planned investment should clearly be defined at the outset. Future investment in the forestry sector should primarily aim to supply the basic forest products needed by the poor hill communities on a sustainable basis. Investment should assist in the development of practical methods of ecosystem management based on sound ecological principles. Therefore, a prerequisite of any investment programme should be the undertaking that forestry or related activities will at all times aim at maintaining or improving existing ecosystems. An understanding of the interactions within the system would assist in the formulation of better programmes for the integrated development of agriculture, livestock husbandry, forestry and related development activities.

A closer integration of the various components of the hill farming system would provide a cash income to supplement farm produce and increase the potential for self-sufficiency in the hills. It has to be borne in mind that the small farmer is often a risk avoider with a comparatively low level of access to inputs and information. Therefore, investment plans should attempt to spread the risk by generating a greater number of community-oriented projects. The target community should be involved in the initial selection of investment priorities and be represented throughout the implementation phase of the programme.

Potential areas of investment in forestry for employment and income generation include:

- Investments related to forest products development (Table 1)
- Investment related to forestry institutional and infrastructural (organisational) development (Table 2).
- Investment related to forestry and farming system linkages research, including in- depth participatory research and observational studies.

Table 1: Areas of investment related to forest products development

	INVESTMENT RELATED TO SOURCE OF PRODUCT PRIORITY	PRODUCT AND END USE	PERCEIVED INVESTMENT
o	New planting and improved management of existing forests and trees for single trees, blocks on private/communal/government/waste and leased lands.	FODDER	1, 2
o	New planting and improved management of existing forest and tree for single trees, woodlots, on private/communal/government waste and leased lands:	FUELWOOD	1, 2, 3
o	New planting and improved management of existing forest and tree for single trees, woodlots, on private/communal/government waste and eased lands:	POLES AND TIMBER	1, 2, 3
o	Bamboo and Nigalo on Private/communal/ government waste and leased lands:	BASKETS, FURNITURE, PAPER PULP, CONSTRUCTION MATERIAL	1,2,3
o	Multiple use trees development. Single trees or blocks on private/communal/ government waste and leased lands:	FODDER, FUELWOOD, FRUITS, EDIBLE VEGETABLE OILS,	1, 2
o	Improved grass and legume species:	THATCH, MATS, FODDER	1, 2
o	On-farm horticulture, fruit production: Orchards, single trees:	VEGETABLES, SOFT FRUIT, JAM, ALCOHOL	1, 2
o	Herbs and spices (export potential).	MEDICINES, SPICES	1, 2
o	Herbs, medicinal plants and other cash crops in new tree and forest plantation areas on private/communal/government waste and leased lands:	MEDICINES, SPICES/ FODDER/FUELWOOD/POLES AND TIMBER	1, 2
o	Fibre-producing plants : Daphne Nettle, Lokta, Allo, Broussaonetia, (*Grevia opposite-folia*), cactus, phasro, etc.	PAPER, ROPES, CORDAGE, TEXTILES	2, 1, 3
o	Charcoal production	CHARCOAL (metalwork)	1, 2
o	Mushroom growing	MUSHROOMS	2, 1
o	Willow planting	BASKETS, MATS, FURNITURE	2, 1, 3
o	Walnuts, chestnuts, hazelnuts, etc.	NUTS, FURNITURE	2, 1
o	Tree and legume crops (e.g. chiuri ghee)	EDIBLE VEGETABLES	2, 1
o	Sericulture (Mulberry Morus spp.)	SILK, FODDER	2, 3
o	Softwood plantations (e.g. poplar)	PAPER PULP, MATCHES, PACKING CASES	2, 1, 3
o	Game management and conservation	MEAT, SKINS, FURS, HORNS	1, 2
o	Orchards	MEDICINE, PERFUMES AND TOILET PRODUCTS	2
o	Acacia catechu plantations	KUTCH AND KATHA	3
o	Cardamom	SPICES	2, 1

KEY: 1 = Product for domestic consumption
2 = Product for cash sale
3 = Industrial product

Table 2. Investment related to forestry institutional and infrastructural (organizational) development.

METHOD	TARGET	OBJECTIVES
Training, workshops	Mainly weaker sections of hill rural populations: landless/near landless, marginal/small farmers, generally with surplus unskilled labour, and women	Skill development and to better prepare for off-farm income and employment opportunities.
Public education and extension	Progressive farmers Community leaders	Self-help, improve technical skills.
Formal education Field projects	Primary school pupils	Consciousness raising.
Formal education Field projects	Secondary school pupils	Incorporation of forestry and allied subjects into curricula.
Specialized courses rural development work	Undergraduate university students.	Community service, Development of practical skills.
Incentives: financial and others, e.g. training	Individuals from rural communities	To train individuals as community extension workers.
Incentives: financial and others, e.g. training	National (government) project personnel	To encourage govt. staff to work in remote/rural areas.
Study/observation tours within and outside the country	Particularly for progressive farmers and local peoples' representatives, e.g. local,district and regional leadership	For demonstration, observation, inter action and people's encouragement and motivation.
Formal seminars; informal consultation and negotiations	National, regional, district and local level political and social leadership	Interaction Motivation Participation of people in decision-making, programme planning and implementation.
Establishment of efficient, appropriate data base	Policy makers, planners/ programme/project implementors, researchers, students, etc.	To facilitate the dissemination of relevant information.

CASE STUDIES

In many developing countries there has been a continuing trend towards capital-intensive technological modernization and large-scale industrialization. This kind of economic policy seems to stem from the view that dependence on industrialized countries can only be prevented through industrial development. However, this type of industrialization, based on patterns derived mainly from the 'developed' countries of Europe and North America, leads to new forms of dependence on external skilled manpower and technologies. More often than not, technological modernization produces more problems than it solves through the implementation of over-ambitious development programmes unsuited to the country's socio-economic situation.

More recently, attempts have been made to provide intermediate or appropriate technology solutions to problems faced by developing countries. However, many of these solutions are generated externally and as such, are often inappropriate.

A different approach to problem solving is needed which should be based on local involvement and aimed at developing existing indigenous technologies. Firstly, the wealth of existing local knowledge of the system and of traditional rural technologies should be documented and evaluated. Secondly, ways of encouraging, up-grading and re-instating them should be explored. These factors are also important in re-establishing a local natural resource base for meeting the local people's basic needs and generating additional off-farm income.

Given the fact that the problems faced by hill farmers are less related to a lack of technology or technical expertise and more to a dwindling resource base, it is high time that professionals adopted a broader, multi-sectoral integrated approach to solving problems that are not merely environmental. In the past, foresters, agriculturists, agronomists and horticulturists have made little effort to co-operate in an inter-disciplinary manner. For instance, until recently forestry development activities were largely focused on the commercial exploitation of natural forests and the establishment of fast growing mono-culture plantations to meet industrial requirements. As a result, the daily basic needs of the rural population and the economic contribution the small cottage/rural industries can make to the hill rural economies have been neglected and the importance of 'minor forest products' undervalued. Thus increased emphasis should be given to re-establish the local forest resource base and to developing small-scale, forest-based industries in rural areas for enhancing the hill farmer's income through off-farm employment generation.

The following case studies of relevant projects selected from the Region attempt to illustrate this approach and to justify investments in forestry for rural income generation in the hills.

- Projects for reforestation and improved management of existing forests and trees:
  - a. The Nepal-Australia Forestry Project, Stage-2, (NAFP-2).
- Projects for the development of small scale cottage industries:
  - a. Bast paper making industry.
  - b. Bamboo and allied industries.
  - c. Cloth production from the fibres of the Himalayan Nettle: Allo.
- Fruits and other cash crops production projects:
  - a. Fruit growing.
  - b. Medicinal plants development.
  - c. Mushroom farming.

REFORESTATION AND IMPROVED MANAGEMENT OF EXISTING FORESTS AND TREES

The case study is aimed at showing the benefits derived by rural people from reforestation projects. Such programmes, in addition to the conservation of forests and the reforestation of denuded areas, also generate employment and income in the hills. The following case study of NAFP-2 tries to illustrate these points.

The Nepal-Australia Forestry Project, Stage-2, (NAFP-2) (Mahat et al., 1986)

The Nepal-Australia Forestry Project, stage-2 (NAFP-2), under review is a joint effort between the local people, His Majesty's Government of Nepal and the Australian Government.

Australian involvement in forestry in Nepal started in 1963. At first, attached to the Bagmati Zone Afforestation Section and based at Kathmandu, it was run on a rather ad hoc basis and its main activity focused on the practice of technical forestry: mainly species trials, nursery work and establishment of small scale trial plantations, mostly of exotic species. All this phase until 1978 in retrospect is considered as phase 1 of the Nepal-Australia Forestry Project (NAFP-1). The old project (NAFP-1) was discontinued in 1978-79 and the new project was launched in an entirely new area of endeavour (Shepherd, 1981). The new phase of the project, now called the Nepal-Australia Forestry Project, Stage-2 (NAFP-2), was developed on the foundations provided by the Community Forestry Programme initiated and successfully developed in the Chautara Forestry Division (Sindhu Palchok & Kabhre Palanchok districts) area since 1973 as an exercise in productive partnership in forestry between the local people and HMG Forest Department. NAFP-2 also chose the Chautara Forestry Division area as its own geographic area of activity. (Campbell and Mahat, 1977 a & b, 1978; Griffin 1978; Midgley and Mahat, 1978; Shepherd, 1981; Gilmour, 1984; Gilmour and Applegate, 1984; Mahat, 1985a & b). Through the NAFP-2, the Australian side thus joined the partnership of the local people and HMG Forest Department in the Chautara Community Forestry Programme. The project has since channelled much greater flow of resources in the form of funds, technical manpower and research inputs for the promotion of community forestry in Sindhu Palchok and Kabhre districts of the erstwhile Chautara Forestry Division. An extended phase-2 of the Nepal-Australia Forestry Project (NAFP-2) was completed in 1985 with a very creditable level of successful performance. The next phase of it (NAFP-3) commenced in early 1986 on similar lines as the NAFP-2 and it is hoped will continue to provide increasing and tangible benefits to the rural population of the two districts. The focus of this study is, however, limited to the NAFP-2.

Table 3: Plantation Established by NAFP (1979-1983)

Planting Season	HMG Fiscal Year	Area of plantation Established (ha) HMG Yearly Total	HMG Cumulative Total	PF Yearly Total	PF Cumulative Total
1979	1978/79	100	100	-	
1980	1979/80	100	200	280	280
1981	1980/81	219	419	233	513
1982	1981/82	479	898	220	733
1983	1982/83	200		400	

Source: NAFP-2. Report of the Evaluation Team, 1983.

Objectives

The NAFP-2 had three main objectives:

- To provide assistance to implement the National Forestry Plan in the Chautara Forest Division.
- To make contributions to training and education in forestry in Nepal.
- To help in the construction of an adequate seed storage and testing unit in Kathmandu.

Activities

The activities of NAFP-2 include nursery establishment and seedling production, plantations on panchayat and government land, encouraging private planting and training. These activities are briefly described below:

Nursery establishment and seedling production have been important activities of the project. Besides supporting HMG nurseries the project has assisted in establishing community and school nurseries. Community nurseries involve the rural communities while the school nurseries involve school teachers and students. Nurseries, seedling production and seedling distribution for private planting have accordingly increased over the years since the beginnings were made by the Chautara Community Forestry Programme.

Plantation

Although the data on earlier planting (between 1973 - 1978) in the project area are not provided, Table-3 below shows that the planting rate in terms of area has been increasing over the years. The increase in annual planting rate in HM Government land has resulted from the accumulation of experience and know-how on the part of forestry staff and greater flow of resources from the NAFP-2. The increase in Panchayat Forest (PF) planting is directly proportional to greater participation by the local communities due to increasing awareness in more and newer areas, as well as the increasing flow of resources from the NAFP-2.

Fodder is one of the most important products from community forestry. The project has realized the need for growing more fodder trees and has planted several fodder species, of which some had satisfactory growth. Fodder species need more careful site selection and handling insofar as site availability for growing fodder is low compared to other species such as the Chir pine (*Pinus roxburghii*) and Pate sallo (*P. patula*) which can survive even in poor sites.

No fencing

Also continuing from the earlier Chautara Community Forestry Programme, establishment of plantation without the use of fencing was perhaps the most unique and outstanding achievement of the project.

Private planting

Although the project has not initiated specific private planting programmes, it has been encouraging private planting in an informal way by distributing free seedlings and technical advice. There is a high potential for expanding private planting.

A very important contribution of the project has been to train people on forestry programmes at various levels.

Another contribution of the project is the Tree Seed Unit (TSU) at Kathmandu. The TSU coordinates and arranges collection of tree seed within Nepal. For use in achieving reforestation objectives within the country:

- It aims to collect, import, export, and distribute seeds according to the requirement.
- It also aims to carry out research regarding seed collection, cleaning, storage and distribution.

Considered a 'model pilot project' for hill forest management, the Chautara Community Forestry Project - subsequently the NAFP-2 has made a very impressive impact at the village level. Its main features can be summarized as:

- Establishment and running of panchayat nurseries to provide seedlings for PF and PPF and private planting.
- The regeneration of PF and PPF through planting programmes.
- Large scale and scattered plantations without fencing.
- Provision of seedlings free of cost for PF and PPF and private planting.
- Employment and training of local people in nursery and planting techniques and forest protection.
- Maximum use of land technology, materials and skills.
- Encouragement of local participation in nursery and planting programmes.

Socio-economic effect of NAFP-2

The general socio-economic effect of NAFP-2 can be seen by the employment generated in the area. A significant amount of skilled and unskilled employment has been generated by the extension and construction of

several buildings and roads. Similarly, several people of the rural community have had the opportunity of being employed as forest workers, porters and workers on other forestry activities. It is estimated that the cash input of the project is Rs. 1100 per planted ha for 200 ha of panchayat forest. Much of this cash input would go to the local people and stay in the area.

The economic analysis of the project is not available. Only preliminary information on the cost-benefit analysis of the project based on many assumptions is available because of lack of data. In this cost-benefit analysis three planting strategies were developed, each of which would occupy 59,000 ha when completed. The annual yield from this total area would be 325,000 cubic metres. The three strategies were:

1000 ha per annum for 62 years,

1500 ha per annum for 45 years,

2000 ha per annum for 36 years.

This analysis considers the benefit of fuelwood only. IRR for different strategies is shown in Table 4. However, due to limited data, this is a very tentative analysis and has not included other benefits. It can be expected that IRR would have been high if other benefits could be included in the analysis.

Table 4: Internal Rate of Return of Various Planting Strategies

PLANTING RATE (ha/annum)	YEARS	YEARS OF NEGATIVE CASH FLOW	IRR
1000	62	16	7.00
1500	45	14	8.78
2000	36	13	10.35

Source: NAFP-2. Report of the Evaluation Team.

THE DEVELOPMENT OF SMALL SCALE INDUSTRIES

Bast paper making industry in Nepal
(Jeanrenaud, 1984; Mahat et al., 1986)

Paper making has been traditionally practised as a cottage industry in Nepal. Locally made paper was extensively used in old Buddhist and Hindu literature and government records. Use of hand made paper is still popular in Nepal today, despite the increasing imports of industrially manufactured paper from India and abroad.

Throughout the Middle Hills region of Nepal hand made paper is commonly made from the inner bark (inner bast) of Lokta or *Daphne* species - *D. bholua* and *D. papyracea*. In some places a third species - *Edgeworthia gardeneri* is also used for the purpose. Both the commonly used *Daphne* spp. grow wild as understorey shrubs in the moist coniferous and broad-leaved forests of temperate zones in the Nepalese Himalaya, with the highest densities growing between the elevations of 2100 - 2700 m above mean sea level, generally on northern aspects.

Lokta harvesting

Lokta harvesting takes place in the agricultural slack season and begins by mid-October and often continues into late spring in May. Usually harvesting is suspended in the two coldest months between mid-December and mid-February. During Lokta harvesting the whole plant is cut and removed to strip off the bark from the stem and the operation greatly limits the natural regeneration of the species. Moreover, observations show that one third of the usual inner bark (inner bast) still sticks to the discarded outer bark after the cleaning or separation process is complete. This is a wasteful method of harvesting.

Wood Requirements

The bast paper making process requires relatively large quantities of wood per production unit for wood ash and fuel. Wood is used for the following purposes:

- **To provide wood ash**: Wood ash is used for making the lye (alkaline liquor) used in the cooking/digestion process. *Quereus semecarpifolia* is often the preferred species for the purpose. Wood ash is also obtained as a by-product from cooking/digesting and drying fires once the production process is in full swing.
- **For cooking/digestion**: The current method of pulp preparation usually

requires two periods of cooking/digestion lasting up to four hours which is traditionally done over open fires and requires large quantities of fuelwood.

- **For paper drying**: Large quantities of wood are required for the purpose. Often at higher altitudes large size logs are used to fuel the big drying fires. In some areas studied, so great was the consumption of wood for the drying fires that the paper-makers had to move to another site every 3 or 4 months (Trier, 1972). In some areas a ratio of 1 kg of Lokta to 10 kg of fuelwood is standard, particularly if wood ash rather than caustic soda is used in the digestion process. The use of caustic soda can reduce fuelwood consumption to as little as one- third (Forestry Services, 1984).

- Wood is also required for construction of the temporary workshops, living quarters for labour and basic manufacturing equipment used in the paper making process.

Economic potential

Recent increased demand for Lokta paper suggests a high economic potential for this local industry. Increased demand has induced Lokta cutters and paper makers to set a higher price for raw Lokta and the finished paper sheets. This means higher income opportunities for those involved. For example, Lokta cutters in Kalinchok forest, Dolkha District, are receiving Rs.10/- per dharni (2.4 kg) of Lokta harvested. They harvest up to 3 dharni (dry weight) per day, thus earning a daily wage of Rs.30/- which is higher than the average wage of labour, which rarely exceeds Rs. 20/-.

Similarly, Acharya (1984) examined the HMG/UNICEF 'Community Development through Production of Greeting Cards Project' in order to analyse the economic benefits of Lokta harvesting and paper making.

The project commenced in 1981 among the paper making communities of Pang and Naglibang panchayats of Parbat District, Lokta collection areas of Tara and Hatiya Panchayats in Baglung District, and the paper finishing community in Bhaktapur. The Agricultural Development Bank undertook the management of the project under its Small Farmers' Development Programme.

The main objectives of the project were to improve the quality of life of the paper making families by supporting hand made paper production and improving community based services.

Scattered paper makers and cutters were organized into groups to facilitate collection, production and marketing. In total, 15 cutters' groups in 6 panchayats were organized to supply the paper makers; 143 members out of a total of 170 were exclusively engaged in Lokta collection.

At 1984 production levels, 60-65 metric tonnes (dry weight) of Lokta were required. Collection involved 140 farm households for an average of 60 days per annum totalling 8,400 man days. The gross income of these households at 1984 market prices was Rs. 250,000 with an average of Rs. 1,800 per household. Other employment totalling 6,000 man days was generated through transportation of raw material to the paper makers. The employment and income derived from Lokta collection are given in Table 5.

In addition to the collectors, 370 farmers from the two panchayats were organized into 33 paper-making groups, of these 316 farmers and their families were exclusively paper producers. Table 6 gives income, employment and investment figures for paper production. It is seen that an investment of Rs. 2,466 for production can generate 300 man days of employment and a gross cash income of Rs. 5,699 for each participating family.

Acharya (1984) concludes that the collection of Lokta and the production of paper are valuable sources of rural employment and income.

Environmental considerations of bast paper making process

The increasing demand for Lokta paper is also resulting in inevitable pressure on the resources and a growing concern for its conservation and management on a sustained basis. Therefore, despite the increase in demand for the *Daphne* bast paper and its economic potential, its promotion and development should not be considered in isolation but in the wider context of the forest ecosystem.

Increased demand for Lokta paper exerts greater pressure on the forest ecosystem due to increased use of *Daphne* bark and fuelwood on the one hand, and on the other, Lokta cutters may be encouraged to resort to wasteful practices in order to gain quicker and higher returns. The bast paper making process requiring very high quantities of fuelwood, in some areas a ratio of 1 kg of Lokta to 10 kg of fuelwood, often results in serious degradation of surrounding forest areas. There is a two-fold threat to the future conservation of the natural stands of *Daphne:* 1) over-exploitation of the resource itself, and ii) the destruction of the forest types constituting its habitat. Moreover, increased demand for Lokta paper induces Lokta cutters and paper makers to seek higher remuneration which in turn may encourage wasteful practices. Field observations suggest that up to 1/3 of the usable bark (inner bast) still adheres to the discarded outer bark after the completion of separation/cleaning process.

Table 5: Lokta Collection: Employment and Income (Acharya 1984)

PARTICULARS	1980/81	1981/82	1982/83	1983/84
No. of Lokta cutters	21	51	86	140
Duration/day	60	60	86	60
Total man/days employed	1,264	3,050	5,150	8,333
Lokta cutting per day in dharni	3	3	3	3
Total prodn. in dharni	3,792	9,149	15,400	25,000
in kg.	9,102	2,195	36,959	60,000
Price / dharni in Rupees	7.50	7.50	8.	10.
Lokta cutters' total income in Rupees	28,440	68,617	123,000	250,000
Wage per day in Rupees	22.50	22.50	24.	30.
No. of man/days employed in transportation of Lokta	1,000	2,300	3,850	6,000
Investment in Rupees*	Nominal	Nominal	Nominal	Nominal

* A small advance on labour cost was extended by SFDP to the cutters

Table 6: Paper Production: Employment and Income (Acharya 1984)

PARTICULARS	1980/81	1981/82	1982/83	1983/84
No. of farm families engaged in paper making	100	180	220	316
Paper prodn. in kories (20 sheets)				
#1 paper	2,356	5,518	8,759	13,500
#2 paper	1,392	2,792	2,905	3,500
#3 paper	1,018	3,540	9,408	18,000
Total kories	4,766	11,850	21,072	35,000
Total price in Rupees	234,540	562,900	938,500	1,901,000
Avg. family income Rs.	2,345	3,130	4,266	5,699
Employment prodn. unit equals 3 persons/f'mly.	-	540	660	948
Loan investment Total				
Paper making	-	180,000	348,000	773,000
Agriculture	-	22,000	179,500	129,000
Loan investment per family				
Paper making	-	1,000	1,581	2,446

Therefore, the resources should not be over-exploited for short term economic gains. Moreover, domestic fuelwood requirements should take priority over those for industry. It is unrealistic also to expect any local rural community, already suffering from fuelwood and other forest products deficit, to support the expansion of such an energy demanding industry whose product does not bring direct benefits to the local community as a whole. Hence, any planned expansion of the bast paper manufacturing industry through either the improved management of natural stands of *Daphne* or an introduction of fibre producing species should address the problem of present and future fuelwood shortages. Prior to the approval of any plans for increased production, therefore, the government authorities have a responsibility to the local community, and thus to the nation as a whole, to ensure that the expansion will not promote and increase destructive and exploitative forestry and allied practices, and bring further hardship on the local people in mountain communities by placing unreasonable demands on already scarce local resources.

Bamboo and allied industries
(Mahat et al., 1986)

Bamboo is of great importance to the people of the HK-H Region. The hill farmers make practically everything they need from bamboo except the ploughshare. Because of its fast growth, versatile nature, light weight, strength and straightness, bamboo finds a variety of uses. Bamboo technology is widespread and processing skills have been traditionally practised and mastered by large sections of hill rural communities among whom a high level of traditional skill still exists. Bamboo and bamboo products, besides providing the local people with their various needs, also provide them with additional cash income. Development and encouragement of cottage industries based on bamboo have, thus, a very high potential of providing the hill farmers with much needed cash income and making a very important contribution to hill farming economy. However, lack of sound management and over-exploitation of the species has resulted in the dwindling of the resource base. This in many areas of the Region has greatly reduced the benefits the hill farmers have been deriving from bamboo and bamboo products. In some areas where bamboo is still available and reasonably well managed, the local people derive considerable amount of benefits, including cash income from them.

Bamboo Utilization

Bamboo is utilized in many ways, e.g., for:

- Handicrafts: Bamboo finds its widest use in the form of handicrafts. Hand-peeled veneered strips of bamboo, of varying widths upto 25 mm and about 1.0 - 1.5 mm thick, are woven into trays, baskets and mats of various shapes and sizes, hats, cradles, beds, various pieces of furniture, blinds, etc.

- Household utensils and general utilization: Segments of larger diameter bamboo cut below each node form cylindrical vessels which are used as household and farm utensils for keeping water, milk and milk products, tea, etc., as well as to measure out many liquid and solid food stuffs. Bamboo is also used for making brooms, brushes, combs, fish traps and fishing rods, toys, kites, bows and arrows, sports goods, nails, shoes, pens, flutes, masks, coffins, etc. Various farm implements are also made out of bamboo.

- Building construction: Bamboo finds use in house and other rural construction particularly in areas of wood shortage. Bamboo is used in building material, particularly for roofing and ceilings, mats, scaffolding, ladders, shutters, bridges, boats, fences, etc.

- Food, fodder and fuel: Very young and delicate shoots of some of the bamboo are eaten as a vegetable or made into pickles. Bamboo has many uses in medicine. Bamboo foliage is commonly used as livestock fodder, especially in areas and periods of fodder scarcity. Similarly, bamboo easily substitutes for fuelwood in domestic energy requirements. Charcoal from bamboo is generally used for gold and silversmithing and is considered superior to the charcoal obtained from conventional sources.

- Cordage: Bamboo is commonly used for cordage such as ropes, twine, hammocks, strings, bags, brushes and slippers.

- Pulp and paper: Bamboo is also the principal raw material for paper production in India and Bangladesh. Large scale bamboo plantations have been established in these countries to supply pulp.

As a result of technological developments new uses of bamboo and bamboo products have also been developed.

Ecological characteristics

In the Hindu Kush-Himalaya Region, Bhutan and India still grow relatively abundant varieties of bamboo. In India, a rich belt of bamboo, both in density and variety, occurs in Assam, West Bengal, Arunachal Pradeh, Manipur, Meghalaya, Tripura, Western Ghats and Andamans. Estimated area of forest under bamboo in India extends over 10 million ha. The principal economic genera include *Dendrocalamus*, *Arundinaria* and *Bambusa*. Most bamboo in the Region grows between the temperatures of 8°C and 36°C and a minimum annual rainfall of 1000 mm. They form an important component of many evergreen and deciduous forests and are widely dispersed from the flat alluvial plains of the tropics to the temperate high mountains upto 3000 mm. Generally speaking, the *Dendrocalamus* and *Bambusa* genera are found under tropical conditions, whereas *Arundinaria* occurs in temperate regions and is most common at high elevations in the western and eastern Himalaya. A majority of the species are light demanders: growth is poorer when they occur as understorey. Silviculturally, bamboo is easy to maintain once established. Clumps renew themselves after cutting and it is generally adequate to ensure regeneration even though the seeding is infrequent.

Productivity

Seedlings generally form clumps in 3-4 years in plantations of 5m x 5m spacing, if soil and precipitation patterns are favourable. Utilizable culms are produced by about the sixth year. On average, five new culms are produced per clump per year. One hectare of land can be stocked with up to 300 productive clumps. A good plantation, when harvested on a three year cycle, may yield 3 to 4 tonnes of bamboo per ha at the first cut, 5 to 6 tonnes at the second cut and 8 tonnes from the third cut. Assuming a 32 year life cycle, in all 8 cuts can be made with an expected final clear-felling yield of 15-16 tonnes per ha. Thus, the total projected yield is 70-74 tonnes per ha (Suri and Chauhan, 1984).

Economic potential of bamboo development

With a multitude of uses for bamboo, a large number of cottage industries have been developed in the HK-H Region. Particularly in China and Bhutan the refinement of bamboo skills and industries has led to the production of highly valued handicraft goods. In Nepal, common knowledge indicates that farmers have a consistent interest in bamboo, centred on its multiple uses as poles, handicraft goods, farm and household utensils and containers, and for fodder, fuelwood and cordage. Due to its not too difficult establishment, fast growth, high regenerative capacity, potential for high density culm production per unit area and other multiple uses, bamboo development has very great potential to provide needed goods and raise cash income through the promotion of cottage industries.

However, as in the case of other small scale local industries, any proposal to expand bamboo based cottage industries must primarily consider the availability of raw material. In this context, re-establishment of the resource base becomes the prime consideration for which improved management of existing natural bamboo stands and establishment of new bamboo plantations is very important. Investment by government agencies in bamboo plantation and development is thus well justified. Community forestry programmes have the potential to greatly promote cultivation and development of bamboo plantations on private as well as community managed lands. Providing credit and other necessary inputs to the hill farmers for smaller scale bamboo cultivation on their otherwise unproductive and vacant private land can prove to be a useful investment for rural development. Leasing land to private individuals, households, communities and organisations and providing them with necessary credit facilities and other inputs for bamboo plantation and development in larger denuded areas in the hills, presently under state control and lying unproductive as wasteland, could go a long way towards re-establishing the resource base. Re-establishment of the resource base would provide the hill farming populations with their basic needs and additional cash income, necessary raw material for home based

small scale cottage industries and even for bigger industries and in addition, reduce soil erosion by providing necessary cover to the bare soil on denuded hill and mountain slopes of the Region.

Cloth production from the fibres of the Himalayan Nettle: Allo (Source: Dunsmore, 1985)

In the Koshi hills of Eastern Nepal the principal emphasis of the Government development programme is on agriculture, forestry and roads but support has also been given to a number of cottage industries including basketry, weaving and the development of the traditional uses of the fibre of the indigenous nettle *Girardinia diversifolia*, known locally as 'Allo'.

Allo grows at altitudes from 1200 - 3000 metres on land which is unsuitable for cultivating food crops. It thrives in the moist temperate broadleaf and conifer forests of the Region with a distribution range extending from Pakistan through India, Nepal, Bhutan, and Burma to China. It tends to favour shady conditions but is also occasionally found in shrubberies, on wasteland and at the edges of cultivation. It is a robust herbaceous, nettle- like perennial growing to heights of 4 metres. The plant seeds freely and also regenerates by means of root-suckers and basal stem shoots. The bark of the stem contains fibres that possess unique qualities: strength, smoothness, and, if appropriately treated, a silk-like lustre and lightness. An individual fibre can be up to 60 cm long and is amongst the longest in the plant kingdom.

Local economy and Allo

In Sankhuwasabha District of the Koshi Hills the local economy is characterized by small scale subsistence farming; most land holdings are between 0.25 and 0.5 ha in size and only a small number of families own rice land at lower altitudes. The main food crops grown are maize, millet, potatoes, with some beans and other vegetables. Roots and fern shoots gathered from the forest supplement the diet, as do young Allo leaves and shoots which are boiled and eaten as a green vegetable or used to make soup. For centuries the Rai people in the Koshi hills have extracted and spun Allo fibres to weave strong, hard-wearing bags, sacks, mats, jackets, porters' headbands and fishing nets. As land holdings are too small to support the family for the whole year, off-farm employment such as portering, selling Allo products, wool or livestock, is even more crucial today to generate some form of supplementary income.

Allo harvesting

This begins at the end of the monsoon season in August and continues until December when the plants begin to flower. Most villages have traditional harvesting areas either on communal or government land.

A person can harvest about one maund (37.5 kg), equivalent to a porter's basket load, in a day. The fresh bark of a mature stem can weigh up to 100 gm with the average stem yielding 5 to 6 gm of dry weight, utilizable fibre. Only mature stems are harvested, the smaller ones being left to seed. When harvesting, hands are protected from the stinging spines on leaves and stem by wrapping them in a bundle of cloth which is also used for rubbing off the leaves and spines. The bark is then stripped from the stems and either dried and stored in bundles or processed while still fresh by boiling for three hours in a lye (alkaline) solution and being left to simmer overnight. This aids in separating the fibres which are then beaten, washed and while still wet, rubbed with clay so as to make final separation and spinning easier. The fibre strands are then sun dried.

Spinning and weaving

Prior to spinning, the dry clay rubbed fibres are opened up and, under tension, the fibres are gently pulled apart. Fibres are traditionally spun using a hand spindle. Weaving is done by women on backstrap looms, mainly during the winter months when agricultural labour demands are low.

Economic analysis

In the past, returns for labour in fibre extraction, spinning and weaving were very low, about NRS 2 to 3 per day (US $ 0.10). However, several important steps have been taken towards assisting weavers to produce higher quality, more marketable products and higher returns for labour.

The Koshi Hill Area Rural Development Project (KHARDEP), jointly sponsored by HM

Government of Nepal and The United Kingdom, conducted field research at Bala and Sisuwa in 1984. The people of Sisuwa and Bala are amongst the poorest in the Koshi hills because of the topography and very limited scope for increased agricultural production; therefore, the expansion of cottage industries to remote areas is particularly relevant to the needs of these communities. The research was undertaken to study and record methods of Allo processing and to ascertain whether the weavers were interested in producing a wider variety of Allo items on adapted loom equipment. The response to these enquiries was enthusiastic and after further trials a workshop was held for 13 weavers at Bala in April 1984. The most remarkable feature of this workshop was the skill with which the weavers adapted their traditional cotton and wool weaving patterns to Allo, which previously had only been woven in a plain warp-faced weave on backstrap looms which restrict production to narrow lengths of cloth. Although the traditional bamboo looms were adequate for weaving Allo, with the new designs and textiles (wool + allo; cotton + allo), frame looms (particularly the Sherpa loom) were found to be more suitable for weaving longer (6m+) and wider (50 cm) cloth.

Following the workshop trials the weavers created many new designs, some cloth lengths were made up into coats, jackets, waistcoats and topis (traditional Nepalese cap) and others were used for upholstery. Allo yarn has also been used to produce knitwear and crochet items. At a recent craft exhibition held in Kathmandu a range of Allo products were displayed - sweaters, jackets, waistcoats, hats, handbags, coats and upholstered furniture. These evoked an enthusiastic response from both local and overseas buyers; all the samples on display were sold and a number of firm orders were placed with the manufacturers.

Table 7: Allo Cloth Production: Cost Breakdown

ITEM	DAYS*	COST Rs.
Warp and weft production (harvesting, processing, spinning	3-4	60
Firewood	1	
Chemicals (bleach)	3	
Warping and weaving		75
Washing, rolling, beating	1/3	5
Soap	1	
Porters' wages @ Rs. 15/- Man/day	2	2
Transport and handling		5
TOTAL:	152($7.50)	

* Daily wages calculated at Rs. 15/-

Marketing presents major problems as Kathmandu is a five or six day journey on foot and then by bus from Sankhuwasabha. However, even with the added cost of transportation (portering and bus or plane) the sale of Allo products would still be profitable, especially given the attractive new range of cloth and manufactured garments which have a high market value. The turnover time for products, from the weaver to the Kathmandu buyer, is estimated to be six weeks.

Table 7 provides an estimated breakdown of costs per 6m x 0.5m length of patterned Allo cloth (equivalent to 1 coat length).

The estimated cost price of all patterned Allo cloth would be Rs 25 per metre (US$ 1.25). This represents a considerably greater return to the weaver than that derived from the production of traditional Allo cloth at Rs 10 per metre (US $ 0.5). The wool-Allo tweed-type cloth works out to be more expensive, at Rs.35 per metre, due to the high cost of wool in the district and the longer processing time required.

Investment potential and priorities

Recent workshop trials have shown that with improved processing methods, a high quality yarn can be spun from Allo and that the sophisticated techniques used by the local weavers can be adapted to produce a wide range of value added goods and thus increase local employment opportunities and incomes. A preliminary assessment of export possibilities has indicated a promising potential.

Small scale cottage craft and large scale production could develop simultaneously, with the cottage weavers catering for individual orders for unique, high value products and those in the centre dealing with larger orders that can easily be repeated using larger looms (weaving cloth widths of up to 1 metre). Retail outlets could be developed through private, government or non-government charitable or-

ganisations e.g. the Oxfam supported Mahaguti shop already selling Allo products, or the Project of Nepal Leprosy Trust. Private entrepreneurs, such as boutique owners, have expressed interest in obtaining Allo cloth jumpers and other products.

Several agencies in Nepal are already working on different aspects of Allo fibres and cloth production. These agencies include: The Panchayat Development Training Centre at Jhapa (Allo processing and spinning), The Research Centre for Applied Science and Technology (RECAST) of Tribhuvan University (dyes and paper- making from Allo stems and oil extraction from seeds), The Integrated Hill Development Project (IHDP), (Allo carpet and rug manufacturing) and the Department of Cottage and Village Industries (DCVI),Dhankuta, (flyshuttle loom weaving trials with cotton and Allo).

Investment priorities

Among investment priorities the establishment of a pilot programme should take the lead in order to:

- examine the feasibility of increasing production based on a survey of the existing resource, and to examine ways of improving product quality.
- examine the potential for growing Allo commercially.
- identify the best methods of fibre extraction and processing.
- determine the indigenous and international demand for the range of Allo products.
- identify marketing constraints and solutions.
- assess environmental impact of Allo exploitation.

Environmental considerations

Increasing exploitation of Allo fibre from the forest will have direct environmental implications. Its economic potential alone should not, therefore, overwhelm the wider context of the forest ecosystem and the larger interests of the mountain communities themselves.

FRUITS AND OTHER CASH CROPS PRODUCTION PROJECTS

Fruit growing (Mahat et al., 1986)

Farmers in the hills and mountain regions grow some trees on their farms. They grow mainly fodder, fuelwood and fruit trees. Besides fodder and fuelwood trees, fruit trees are considered very important by the farmers. The fruits are consumed domestically as well as sold in the market for cash income. For this reason there is a high potential for fruit tree growing in the hills and mountain regions.

This case study concentrates mainly on apple and some other temperate fruits growing in Mustang District of Nepal and is based on the studies conducted by the Tropical Products Institute, London (Thomson et al. 1978), and Vinding (1984). The former presents an overview of the fruit growing industry in the whole of Mustang District, while the latter analyses how fruit growing in the Thak Khola Valley assists the local farmers to make their living by providing them with substantial additional cash income.

The policy of His Majesty's Government of Nepal is to encourage fruit production in the higher Himalaya Region. Apple, peach, apricot, almond, pear and walnut have recently been introduced to the Mustang area. The quality of apples grown in Mustang is high compared to that of the imported Indian apples. The yields are also satisfactory. There is enough market for fresh fruits as well as the processed products such as dried fruit, jam, jelly, juice and alcoholic drinks. Four market locations can be identified for Mustang fruit and fruit products, namely: 1) Local market in Mustang, 2) Pokhara, the nearest city and other town centres in the vicinity, 3) Kathmandu, the capital and other cities in the country, and 4) export market. However, no motorable roads to the area exist at present. Most of the goods are carried by mules or porters. An alternate but very expensive and unreliable way of transporting goods is by aeroplane.

Fruit and vegetable growing in the Thak Khola Valley

The Thak Khola valley is located in the southern part of the Mustang District. Situated between the Dhaulagiri and the Annapurna Mountain Ranges, The Thak Khola valley runs

north-south 30 km in length along the Kali Gandaki River and inclines between 2700m and 1900m. Villages are nuclear settlements situated near the bottom of the valley, which for administrative purposes is divided into 6 village panchayats: Thimi-Jomsom, Marpha, Tukche, Kobang, Lete and Kunjo. More than two-thirds of the population are Thakalis. In 1964 the government established a small agricultural farm in Marpha. The farm, now covering an area of 8.5 ha, has been a great success and fruit and vegetables are now a major source of income for many Thakali people.

Apple growing is well suited to the ecological conditions in upper Thak Khola valley (Panchgaun) and the apples are of excellent quality. Conditions are, however, not as favourable in the southern part of lower Thak Khola valley (Thak-satsai or Thaksai). Apples being the most important fruit grown in the district, there are about 30,000 trees in the Mustang District and 75 percent are grown in Thak Khola. In addition, there are an estimated 3,000 peach trees, and 2,000 apricot trees, and almond, pear and walnut are also grown in the district.

Seedlings are available from the government farm and a private nursery. Farmers continue to grow grain in between the newly planted trees for the first two years or so, and then shift to vegetables. The apple trees yield fruit after the third or the fourth year with an initial harvest of 20 kg. The yield increases to 70 kg after eight years. In 1983 the total apple production in Mustang District was estimated to be 250 mt, with government farms producing 32 mt and the remainder by private farmers. In Thak Khola there were 546 orchards with a total of 22,947 apple trees in 1983 (Table 8). As apple cultivation was introduced to the area only two decades ago, this represents a major achievement, indicating the success of the entire enterprise. More than half of the total number of households in Thak Khola have adopted fruit cultivation. More than three-fourths of the orchards have less than 50 trees. Small orchards located near the farmers' houses average 14 trees and the biggest has 2,000 trees. Many of the bigger orchards are to be found in forest fields.

Income to the local people

Currently, small orchard owners derive some additional income from apple cultivation, whereas substantial income accrues to the owners of big orchards. In 1983 a dozen farmers produced more than five mt each and had an income of Rs. 40,000. Apple production has yet to reach its maximum. Presently only an estimated 25 per cent of the trees are producing

Table 8: Orchards and Apple Trees In Thak Khola (Vinding,1984)

	THINI		MARPHA		TUKCHE		KOBANG		LETE		KUNJO		TOTAL	
No. of trees per orchard	No. of orchards	No. of trees	No. of orchards	No. of trees	No. of orchards	No. of trees	No. of orchards	No. of trees	No. of orchards	No. of trees	No. of orchards	No.of trees	No. of orchards	No. of trees
1-49	103	1,575	87	1,459	36	722	55	969	83	928	50	296	414	5,949
50-99	14	943	21	1,437	19	1,378	18	1,086	6	449	3	217	81	5,510
100-149	5	468	9	1,073	4	478	4	523	2	240	3	319	27	3,101
150-199	-	-	2	305	-	-	2	370	-	-	-	-	4	675
200-249	3	647	1	217	2	433	3	678	-	-	-	-	9	1,973
250-299	-	-	1	277	3	790	-	-	-	-	-	-	4	1,067
300-349	-	-	2	627	-	-	-	-	-	-	-	2	627	
350-399	-	-	-	-	-	-	-	-	-	-	-	-	-	-
400-449	-	-	-	-	-	-	-	-	-	-	-	-	-	-
450-499	-	-	-	-	1	450	-	-	-	-	-	-	1	450
500-	1	2,000	2	1,015	1	600	-	-	-	-	-	-	4	3,615
TOTAL	126	5,633	125	6,410	66	4,849	82	3,626	91	1,617	56	832	546	22,967

fruit. Within the next 10 years the production is expected to increase from its present level of 250 mt to 3,000, when the income will also rise.

Marketing

Farmers sell their apples to the tourists (trekkers), the Government farm, Government employees, local people, a private distillery in Syang, a small fruit processing plant in Tukche and to traders. Apples cost Rs. 4/- to Rs. 7/- per kg in autumn and up to Rs. 12/- by spring. The Government farm distillery uses 25 - 30 mt of fruit for liquor production and the private distillery in Syang uses 20 mt. Private traders buy apples in Thak Khola to sell them in Pokhara and Kathmandu. The Government farm may also buy apples for resale. In 1982, the farm sold from its shop 25-30 mt of fresh fruit, selling up to 1.2 mt in a single day.

Rapid growth in production is, however, posing problems for the farmers regarding the sale of their products. The situation improved with the construction of cold storage facilities in 1983-84. In order to accommodate a further increase in production a small fruit processing plant has been started in Tukche by the newly established Fruit Growers' Association of Thak Khola with UNDP assistance.

Marketing problems

Fruit growers in the area are facing some problems due to high winds which cause damage to fruit-bearing trees. Maintenance of soil fertility is another problem because of the poorly decomposed compost manure used. But the most dominant problem from the fruit grower's point of view is the problem of marketing. The seasonal nature of tourism in Mustang limits the local demand for fruits to some seasonability also. The 8 month period from September to April is the trekking season. During these months 92 per cent of the total trekking occurs. The peak months are October to November and the leanest is the monsoon season. The high demand during September to April coincides with the harvest season for apples and nuts. The annual rate of tourist increase is estimated to be 20 per cent. Therefore, the main monetary earning is obtained from sales to trekkers which is done either at the farm gates or at hotels, lodges, restaurants and shops. For the processed products also the main consumers in local areas are trekkers. Estimates show that after the mid 1980s the surplus will grow. The minimum surplus is estimated to be 1,000 tonnes. It is also estimated that the disposal of 1,000 tonnes could represent 11,000 mule journeys or nearly 700 flights in an aircraft.

Pokhara and Kathmandu have big markets for these products both for local consumption and consumption by the tourist. The standard of living in these cities is higher and tourist inflow is also very high. There are several big hotels with increasing demands. At present large amounts of fruit are imported from India. If local produce could be marketed in these cities, in the other cities of Nepal and in the export market, it will help not only to substitute the import, but also increase foreign exchange earnings, thereby giving higher income returns to the fruit farmer.

- **Short term marketing and transportation problems**: As already mentioned, once the planted apple trees bear fruit the production will exceed the local demand. There is a good prospect of selling these products in Mustang, Pokhara and Kathmandu valley. The market for apples in Kathmandu valley was estimated at 250 - 325 tonnes in 1978 and the national market is between 460 and 575 tonnes (Thompson et al., 1978). The present market would certainly be higher than this. The price of Mustang apples is considerably lower than the prevailing price of imported Indian apples for which the demand is unlikely to increase.

  Due to immediate transportation problems only limited quantities can be transported by air. This is the easiest, but very expensive and highly unreliable, means of transportation. There is also the problem of packing associated with transportation, particularly mule transportation. Traditional type of packing in sacks damages the fruit greatly, rendering them unfit for market. Wooden boxes and paper cartons are in limited use. Packing and storage facilities are undeveloped and inadequate. Much needs to be done to develop and facilitate storage, packing, transportation and marketing of apples and other fruit grown in the Mustang region. The Mustang Horticultural Association aims to better organise packaging and marketing.

- **Long-term marketing problems**: Improvement of transportation facilities is a prerequisite for the marketing of fruit in the long run. Aircraft facility for fruit transportation could also be improved; only then could the fruit be brought to the market soon after harvest. Unless there are good transportation facilities, prices will not be reduced. Demand for these products will increase with the reduction in their price. Reduction in price and stringent control will make the product competitive in export markets. To strengthen the market for processed products like juices, jams and alcohol, canning and bottling facilities have to be developed. As the production is expected to exceed the demand in future,export markets should be explored.

Environmental considerations of fruit growing

Even with much improved transportation facilities, motorable roads, ropeways, etc., the question of suitable packing facilities for transporting apples and other fruit to the market remains important. Paper cartons will continue to remain relatively expensive in so far as the paper/cardboard material is not manufactured locally. Both the material and the technology to be used will have to be imported from outside, thus rendering their use economically less feasible for the local fruit grower. The use of locally made wooden boxes would perhaps become a popular choice for fruit packing. This, however, will not be the best choice, especially from the point of view of the further damage that can be done to the local environment by much greater competition for already scarce resources. Vinding (1984) describes the already existing competition for scarce forest resources in the area thus:

"In Thak Khola villagers use pine, juniper and cyprus for fuelwood and timber. In Thaksai.... forests are found close to the village while in Panchgau forests are situated up to 1,000 m above the village. Forest resources are being over-utilized due to an increased demand for fuelwood from the local population, outside labourers, civil servants, military personnel and tourists. There is also an increased demand for timber for construction; for example,the administrative building complex under construction in Jomsom (under RCUP) requires 12,000 cubic feet of timber. In addition to an increased demand for forest products, the forests are being depleted due to poor management and failure to replant."

Therefore, if wooden boxes become the choice for packing cases, adequate steps will have to be taken well in advance for the development and improved management of forest resources which are already chronically in short supply in the Mustang Region. The requirements of wood for fruit packing cases and the associated environmental problems could easily be visualised from the experience in Himachal Pradesh in India wher more than 50% of tree volume is wasted in the manufacture of packing boxes and each ha of apple growing area needs 3 ha of silver fir and spruce forest for supplying wood for fruit packing cases (and as much as 10 ha of Chir pine forest to support each ha of tomato cultivation), (Singh,1984, 1985a & b).

Keeping such environmental considerations and the marketing problem in view, it is important to concentrate on small, portable, high value processed fruit products rather than on heavy raw fruits.

Conclusion

Mustang area is very suitable for apples and other temperate fruit cultivation. The fruits of this area are also considered to be of good quality. Most of the supply of apples and other fruit are imported because domestic production has not been able to supply at the national level. However, domestic production will soon be greater than the present demand. Due to increase in population and standards of living, there will be some increase in demand within Nepal, but exploration of export markets is essential for surplus supply and foreign exchange earning.

Various inputs should be provided to develop fruit farming and the industry. Financial, technical and research inputs are essential. The most important requirement, however, remains the development of a transportation network to supply the national and international market. Fruit packing for undamaged delivery to the market and the environmental considerations associated with fruit development have to be kept in mind. Fruit development will help to substitute the amount of import and will bring additional foreign exchange to the country. Most importantly, the development of fruits and processed fruit products will increase the level of earnings of the local

people and thus help to sustain the hill farming economy. It is, however, essential to ensure the improved management and development of the local forest resources upon which not only the development of the local fruit industry depends but also the farmers.

Medicinal plant development in Nepal
(Mahat et al., 1986)

Medicinal plants are important products of the forest. These provide important means of income for rural people in these mountains. They also generate a significant amount of revenue and foreign exchange earnings for the government. Medicinal plants are very popular in traditional medicines and are extensively used in Ayurvedic, Unani and herbal medicine in the rural areas of Nepal as also in other parts of the HK-H Region.

The problem

These plants have, however, a very limited market in western countries even though a considerable amount is exported to India from Nepal. Some of the plants exported to India are re-imported in the form of processed medicines. The overall export of medicinal plants from Nepal is declining now.

As with the other forest products, there is a depletion of medicinal plants associated with the declining forest resource base. Moreover, as roots and other vital parts of the plant are harvested, the whole plant is destroyed during harvesting. Replanting or growing of these plants in the forest is almost non-existent.

Production and trade

Collection and trade of medicinal plants is a useful source of income for rural people and tradesmen in Nepal. Most of the medicinal plants grow wild in hill forests, and some in the Terai (Plains) forests. Domestic consumption compared to the exports of these plants, mainly to India, is very low. They are mainly used for Ayurvedic and herbal medicines. More than 90 per cent of the plants are sold to India. Export of these plants is in a crude and dried form. There is a lack of cleaning and quality grading for the export to India and the overseas market is also minimal.

Overseas export of Nepalese medicinal herbs for 1978 - 79 was recorded to be 118.767 tons, worth Rs.4.14 million (Burbag, 1984). Hong Kong, Japan, Malaysia, Singapore, U.S.A., the Federal Republic of Germany, Belgium and Canada are the main overseas importers of Nepalese medicinal plant products. The medicinal plants exported to India are almost nine times greater in volume than the quantity involved in the overseas trade.

Though a significant amount of processed Ayurvedic and herbal medicines are imported from India, there are several private manufacturers in Kathmandu. Many rural families also prepare their own herbal medicines. There are government sponsored manufacturers like the Singh Durbar Vaidya-khana and the Unani Aushadhalaya. Government Herbal Farms, Royal Drugs Limited and Royal Drug Research Laboratory are the important institutional bodies involved in the development of medicinal and herbal plants in Nepal. The cultivation of medicinal herbs started following the establishment of the Department of Medicinal Plants in 1960-61. This department has been actively promoting development of medicinal plants in Nepal and has established seven experimental herbal farms in various zones of the country.

Economic significance and benefits of medicinal plants development

In the rural areas, people have more faith in traditional Ayurvedic and herbal medicines and know-how. The main reasons for the popularity of these traditional medicines are availability in the rural areas and their traditional usage. Collection and trade of herbal plants is also an important source of income for subsistence hill farmers.

Medicines are imported from India and other foreign countries. Private and institutional manufacturers of herbal medicines would help to substitute the imports of these medicines. From the export of processed medicinal herbs the country can earn foreign exchange. Even if Nepal cannot take a bigger share of the export market, it can certainly benefit by meeting domestic demand with domestic production and by substituting the import by local production. This would increase the opportunity for employment and utilization of local skills in the rural areas. Promotion of medicinal plants production and development, combined with improved marketing facilities, has a particularly high potential of income

generation for hill farmers and represents a good case of diversified employment and income through forestry activities.

Data regarding employment and income generated by medicinal plants collection from the forest is hardly available. Nor can the quantum of collected material be ascertained. According to Sheikh (1985), however, an estimated 50,000-55,000 man-days of secondary employment is generated annually in Pakistan for those engaged in medicinal herbs processing, manufacturing, distribution and medicinal practitioners. Malla (1982) has provided a cost-benefit analysis of Belladonna cultivation by farmers in the hill and mountain areas of Nepal. According to him :

Cost of cultivation of Belladonna:	Rs.8,000/ha
Returns per ha:	Rs.20,000/ha
Profit:	Rs.12,000/ha

The costs and benefits of cultivation of the main cereal crops like rice and wheat are as follows:

Cost of rice/wheat cultivation:	Rs.4,000/ha
Returns from rice/ wheat:	Rs.10,400/ha
Profit:	Rs.6,400/ha

Although profit from paddy growing is lower, people prefer not to switch from paddy cultivation to other crops in so far as rice is a staple food. However, farmers could be encouraged to plant Belladonna instead of wheat.

Development potential

Without affecting paddy cultivation farmers can earn extra income by setting apart a portion of their land for the cultivation of medicinal plants like Belladonna in the hills and Rauwalfia and Solanum species in the Terai. Replacing one winter crop by medicinal plants and setting aside a small portion of land for medicinal plants is one way of introducing medicinal plant cultivation.

Another way of encouraging the cultivation of medicinal herbs is by way of agro-forestry. In Nepal, the Community Forestry Development Programme is being implemented throughout the country. This programme can greatly help to promote the cultivation of medicinal plants at minimal additional cost by intercropping with medicinal herbs, fodder, fuelwood and fruit trees. These could be introduced in community controlled panchayat forests and panchayat protected forest areas which are managed by panchayat communities with the help of local people. At the same time the Community Forestry Programme could also motivate and encourage local farmers to take up such agro- forestry practices on their private lands. As the gestation period in tree plantation is long, inter-cropping with medicinal herbs and other agro-forestry practices would look more attractive to the farmers from the point of view of quicker returns and additional income opportunities.

As most of the farmers in the rural areas are at subsistence level, hardly any of them have a marketable surplus to earn the needed cash income. Introduction of medicinal herbs as a cash crop would provide them with direct tangible benefits. Medicinal plant cultivation could help to solve, to some extent at least, the problem of disguised rural unemployment and provide farmers with additional income.

Mushroom farming

A variety of edible mushrooms grow wild in the forests of the HK-H Mountain Region. However, not all species are collected.

Mushrooms are a food item of the local people and are considered nutritive like fruits and vegetables. Mushrooms are, moreover, marketable forest products with high potential for additional cash income generation for rural people. There is high demand for mushrooms in the urban areas and prices are going up. As in the case of other forest products, rapid depletion of the forest has, however, affected the supply of mushrooms.

Collection and processing

Collection from the forest and all further processing of mushrooms including drying, destalking (removal of stalk) and packing for transportation, is all done manually. The whole operation is highly labour intensive.

Mushroom development potential

Although detailed data are not available on mushroom growing, it could be a paying cottage industry for the rural people in these mountains. Instead of depending solely on the forest for mushroom yields, increasing production through artificial methods seems to be desirable. There is a demonstrably high potential of cash income generation through mushroom growing in India, Nepal, Pakistan, Bhutan and the other countries of the HK-H Region.

Economic significance

In the hills and mountains where a majority of the farmers depend on traditional agriculture, mushroom farming can be an alternative food crop which can also be grown as a cash crop. As the potential for increasing cash income through mushroom growing is high in these mountain areas, the farmers should be encouraged to grow mushrooms. The mushroom industry is highly suited for developing countries such as those of the HK-H Region because of its labour intensive nature. Mushrooms of high quality are exportable items and have the potential of earning foreign exchange. Rural people in the mountains can benefit directly from good quality mushroom collection. Most edible mushrooms are, however, highly perishable goods and marketing facilities are essential prerequisites for their development on a commercial scale.

In Pakistan, collectors get as much as 5-6 US dollars for one kilogram of mushrooms (Sheikh, 1985). Similarly, in India mushrooms, particularly the artificially grown ones, are very expensive. China is already a major producer of mushrooms and supplies 10% of the world market. The Federal Republic of Germany, Canada and the Middle East countries are the principal importers of mushrooms in the world, with hardly any production of their own.

Economics of mushroom growing for a small grower

This is illustrated by the following example from a mushroom development project in Kashmir (India).

The Kashmir Project has envisaged establishing 1000 small farms for mushroom cultivation, each having a capacity of 200 trays per crop, taking 3 crops a year. Another lot of 1000 small farms as mixed farms would take only 2 crops a year. There are also provisions for establishing medium and large size farms. The medium size farms (with a capacity of 1000 trays per crop) can take three crops a year while the large size farms accommodate 5000 trays per crop and can take 4 crops a year.

Economics of a small mushrom farm: 3 crops of 200 trays in a year

The farmer shall provide land for the construction of the room and compost yard and shall prepare compost at site.

A. **Fixed investment**

	Rs.
Crop room	10,800.00
Carpenting yard	2,000.00
Wooden trays	3,000.00
Spraypump, Thermometer, Spawn Bottles etc.	2,200.00
Total	18,000.00
Margin money to be provided by the farmer	2,000.00
Term loan component from institute	16,000.00
Total	18,000.00

B. **Working capacity ingredients for one crop**

	Rs.
Paddy straw	--
Labour	3,000.00
Fuel, Spawn etc.	
Margin provided by the farmer	500.00
Crop loan from institute	3,500.00

C. **Returns**

	Rs.
1. The expected yield is @ 3.25 kg. per tray to be valued at average price of Rs. 7.50 per kg. i.e. for 650kg mushroom	4,875.00
2. Value of compost for 200 trays.	70.00
Total returns per crop	4,945.00

D. **Income analysis for 3 crops a year**

	Rs.
Returns from mushroom cultivation @ 12% for 3 months = Rs. 9,000 / + Rs. 270/	9,270.00
Net Returns	5,565.00
Income retained by the farmers	1,000.00
Amount available (balance)	4,565.00
Forecast reliability factor @ 20%	915.00
Amount available to repay loan	3,650.00

Source: Agricultural Finance Corporation Ltd. 1977. "Integrated Horticulture Produce Marketing and Processing Project", Bombay.

SUMMARY AND CONCLUSIONS: POLICY IMPLICATIONS

The economy of the Hindu Kush-Himalaya Mountain Region of Asia is dominated by a rural sector based exclusively on agriculture. Although the linkages have only recently started to be understood, hill agriculture is heavily dependent on trees and forests.

The analysis of the inter-relationship of forestry with agriculture and livestock husbandry shows the need for integrated management of resources in mountain watersheds and the important contribution forestry is making to hill farming economies in the Region. An attempt has also been made to analyse whether forestry can play a role in the economic and social development of the rural people and thus establish the place of forestry in development. This is a difficult task because forests in the HK-H Region have never stood apart as a separate sector in so far as they have always been closely interwoven with other land uses and with social, economic, political and demographic change in a country.

In the past decades the Region, besides being a political hotspot, has become the object of growing environmental and socio-economic concern. Environmental deterioration, which has attracted increasing attention, has resulted from increased competition for scarce resources. This competition is represented by several levels of conflict such as heavy human and animal pressures, national goals versus local interests, competition for forest and mineral resources between rural subsistence farming communities and urban commercial enterprises, etc.

The forests in the Region represent one of the most important land uses. They sustain the hill farming system by supporting agriculture and livestock husbandry in these hill areas. Their contribution to the hill farming economies is very important and substantial. They are, as a result, also subject to heavy human and animal pressure. Forests support agriculture and sustain the hill farming system directly by supplying fuelwood, fodder, leaf litter, poles and timber, etc., to the rural population. These products of the forest are generally obtained by the local people as free goods.

The pressure on forests to meet the demand for these products, therefore, is ever increasing. The forests are in the process further degraded and may ultimately disappear. The ratio of forest to agricultural land at present is very low, resulting in overgrazing of forest floors, damaging and destroying seedlings, thus inhibiting forest regeneration.

Poorly stocked forests with very low productivity are not only unable to meet the daily needs of the local people in terms of fuelwood, fodder, leaf-litter, timber, etc., but are also less effective in conservation of soil and water which is widely perceived as one of the primary functions of forests in mountain watersheds. Some of the forestry practices taken up in support of agriculture, horticulture, etc., are damaging to the standing trees, damage and destroy regeneration and other undergrowth and cause serious soil erosion.

Deforestation and sometimes the use of faulty forestry and agricultural practices, have led to soil erosion, loss of soil fertility and ultimately to the loss of cultivated land. Developmental pressures such as road building and high dam construction activities in these mountains have aggravated the problem. The resulting enormous run-off and accompanying soil loss during the monsoon not only causes reduced agricultural production in upland areas, but also results in siltation of reservoirs and floods and poses a serious threat to agriculture down stream. Thus, for the protection of agriculture and the wider environment, the integrated management of whole watersheds becomes essential. Forestry through its protective role in these watersheds also, therefore, makes a major contribution to the hill farming economy of the Region.

Declining land:man ratio is the most fundamental problem of development in the predominantly rural hill areas of the Hindu

Kush-Himalaya with the economy based exclusively on farming. Declining farm productivity is the root cause of the hill farmer's problem. A number of options have been tried which, however, fail to adequately address the basic problem.

Farm productivity in the hills is declining due to the high level of dependence on forest, low forest to agriculture land ratio and declining forest productivity. The farmers need cash for various purposes. The decline in farm productivity means widening of the gap between the hill peasants' farm income and needed cash and results in growing tension within the hill farming economy. Enhancing the hill farmers' income, therefore, becomes the most important consideration.

There are, however, problems in enhancing the hill farmers' income. The problems faced by them in this connection are, in general, related to a dwindling resource base and deteriorating local environment. The hill farmers try to make up the production deficits due to declining farm productivity and augment their cash income through extension of agricultural land to marginal areas, intensification of agriculture and adoption of improved technology, resorting to off-farm (casual, seasonal or permanent) employment, or by migrating to urban or newly opened-up rural areas.

How much land is still open for agricultural extension in the hills is a controversial question. However, it is clear that crop-yield per unit area of cultivated land has been declining which has forced the hill farmers to look for other options. The farmers have been compelled to raise the cropping intensity on available land in order to produce maximum food supply every year from their small holdings. However, these intensified crop production activities also continue to follow the traditional agricultural practices in which human labour, animal draught power, farmyard manure and monsoon rain water are the main inputs. The adoption of new technologies and inputs to maximize food productivity per unit of cultivated area has been constrained mainly by the hill farmers' economic inability to buy these. The characteristic features related to employment and income structures in these hills are: a very high proportion of the population still occupied in rural occupations dependent upon agriculture, abundance of labour against a scarcity of skill, low levels of industrial development and limited employment opportunities, the State as the major employer and a remittance economy. Out-migration is yet another way by which the hill farmer responds to declining economic conditions due to population pressures and environmental degradation. The attractions of off-farm employment opportunities and opening up of the lowlands for agricultural colonization are among important factors that encourage out-migration. Some form of cash income must, therefore, be derived by the hill farmers, as far as possible locally, to make up production deficits and contain the growing tension within the hill farming economy.

Forestry, through appropriate investments, could contribute to the hill farming economies in a number of important ways. Forestry development activities and the promotion and development of forest based and allied cottage industries, handicrafts, and cash crops have a high potential for creating off-farm employment and income opportunities for the hill rural population within the Region itself. This is evident from the few case studies examined.

People-oriented forestry development activities, such as the protection and improved management of existing forests and the forestation of denuded areas through the involvement of local people, have particularly high potential for creating off-farm employment and income opportunities for the rural hill people, while also supplying their basic needs and reducing environmental deterioration.

Development of non-wood forest products and minor forest products such as mushrooms, fruits, nuts and berries; medicinal plants; beekeeping, etc., have high potential of creating off-farm income opportunities for the people in these mountains.

Similarly, promotion and development of bamboo and bamboo products, sericulture, etc., and small scale cottage industries dependent upon such forest products, also have great potential, thus contributing to the hill farming economies of the Region.

Logging and other commercial harvesting operations when undertaken with proper safeguards to avoid and if necessary, repair any environmental hazards, may still be relevant in some areas to create off-farm income for local people.

The main conclusions, therefore, are:

- hill farming economies of the HK-H Region are heavily dependent upon forestry,
- farming alone cannot provide adequate livelihoods to the hill people, and
- forestry through appropriate activities and investments can generate diversified income and off-farm employment opportunities for the rural people in the hills.

For forestry and allied practices to make maximum contribution to the hill farming economies, while keeping in view the environmental considerations and distant market problems in the Region, it is important to concentrate through appropriate investments on the following activities:

- short term rather than long term, e.g. fodder, poles, fuelwood/charcoal products rather than saw timber.
- Occupation outside busy agricultural periods e.g. winter occupations.
- Small, portable products rather than large and heavy, e.g. carved products (quality goods) rather than large timber.
- Bamboo and cane products.
- Wood turning.
- High cash products rather than low.
- Specially edible products - fruits, nuts and berries.
- Medicinal plants, sweet smelling herbs etc. - especially if they can be dried and packed to be transported.

POLICY IMPLICATIONS

Important policy implications derive from this study for the HK-H Region.

- There is an urgent need in the countries of the Region to re-orient forestry policies from entirely government revenue-oriented forestry to one which is local peoples' need-oriented forestry. The objectives of forestry development programmes should not, therefore, be limited to the production and harvesting of commercial sawlog timber and industrial pulp wood, but should first satisfy the basic needs of local farm households. Special emphasis should, therefore, be placed on production of livestock fodder, fuelwood, leaf-litter, poles and small timber for rural construction, farm implements and bamboo rather than on revenue-oriented commercial sawlog timber and pulp wood alone. In addition, plantations of fast growing multiple-use species should be established to meet the above needs.
- While forestation of denuded areas should, without any doubt, continue to be taken up vigorously, it is essential that the improved management and conservation of existing forest resource be accorded a much higher priority in forest development planning and that they be more effectively managed.
- The need for local people's participation in such resource management activities should be recognized and encouraged through community/social forestry programmes. For motivation and greater participation of the local population, these programmes should be designed and implemented so as to transfer the control of local forest resources to the local communities themselves. Moreover, community/social forestry programmes should aim at achieving a productive partnership in forestry between the local people and the state rather than creating a new situation of confrontation between the local people and government forestry departments for the control of local forest resources.
- Agro-forestry, well understood by the hill farmers as a part of traditional farming wisdom, also has a potential of making important contributions to hill farming economies in the Region and as such should be promoted through encouragement and appropriate investments. New innovations in agro-forestry will enhance its contribution to the farming economies of these mountains.
- Improved management/conservation of forests is also important for its protec-

tive role and vital for the sustenance of the hill farming system and down stream agriculture. The still existing high altitude montane forest belt, above the heavily populated and terraced agricultural zone of the mid-hills region, has a very important role to play by way of providing vegetative cover to regulate water flow and protect the soil and as such should be maintained undisturbed. These forests should be excluded from commercial timber harvesting and other exploitative and destructive forestry operations. It is important, however, to consider during forestry development planning and management, their socio-economic importance to local mountain communities.

- Research should be oriented towards a clearer understanding of the interlinkages between the various components of the existing hill farming system that combines crop production, livestock management and tree husbandry, and to develop land use systems capable of reducing environmental deterioration while meeting the basic needs of the local people on a sustainable basis.

- Development of forest based and allied industries have high potential of contributing to hill farming economies. The objectives of a forestry development programme should also be, therefore, to supply raw materials for forest product-based industries so as to enhance subsidiary sources of income for the rural population. It is, however, necessary to take adequate steps well in advance so as not to harm the local environment due to these activities.

- Development projects on forestry financed by multilateral and bilateral agencies should not be limited only to commercial plantation and exploitation of timber but should include other tree crops such as fuelwood, fodder, fruit, fibres, and raw material for cottage industries.

- The conventional role of foresters has been necessarily limited to the policing function, commercial timber production and control and regulation of timber harvesting. There is more than just this that the forester can do for society. The scope of activities and the role of the forester should be increased to plantation, conservation, and people's need-oriented forestry, while encouraging allied activities by soliciting community participation in planting and managing forests for fodder, fuelwood, fruit, timber and poles on community owned and private lands also.

- Training of foresters: The scope of forestry training should be broadened by including in its curriculum the study of forestry-farming interrelationship.

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As the Divisional Forestry Officer, CHAUTARA (1973-80), Tej Mahat developed the concept and pioneered the practice of Community Forestry in Nepal-the establishment of productive partnership in forestry between people in local communities and the government. He has served His Majesty's Government of Nepal for over two decades involved in forestry research, management and planning.

Dr. Mahat was involved in planning the new phase of the Nepal-Australia Forestry Project of which he was also the Project Manager during 1978-80, and was a team member for the preparation of the World Bank/FAO Nepal Community Forestry Project.

Founding of ICIMOD

ICIMOD is the first International Centre in the field of mountain area development. It was founded out of widespread recognition of the alarming environmental degradation of mountain habitats, and consequent increasing impoverishment of mountain communities. A coordinated and systematic effort on an international scale was deemed essential to design and implement more effective development responses in each of the countries concerned.

The establishment of the Centre is based upon an agreement between His Majesty's Government of Nepal and the United Nations Educational, Scientific and Cultural Organization (UNESCO) signed in 1981. The Centre was inaugurated by the Prime Minister of Nepal in December 1983, and began its professional activities in September 1984.

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- Burma
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