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WARNING SIGNALS FROM HILL FARMERS AND FARMING

ADDRESSING CONCERNS

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[This study is commissioned by the Farmers Commission of India]

The Study

The wake up call highlighted in the first report of Farmers Commission, "Serving farmers and saving farming" rightly points to acute agricultural distress arising from inadequate public investment and insufficient public action. It lists five basic cause factors that are central to the crisis; unfinished land reforms, water scarcity, technology fatigue-access-adequacy, institutional support and opportunities for marketing. The report also highlights that it is the small and marginal farmers of India who are worst affected by this crisis. It has rightly stated that foundations of Indian agriculture sustainability (land, water, biodiversity) are shaken and the threat is for real. To quote from the report, " Our agriculture is at the cross roads economically, environmentally and socially and technologically and every thing else can wait but not agriculture". The report has already suggested several remedial steps to be taken at the national level and the efforts of the Indian Farmers Commission continue to go deeper, for getting a better understanding of the causes and effects of this over all agricultural neglect.

It is in this context, this study was commissioned by the IFC to have a better understanding of the concerns of the hill farming and farmers.

The study titled, " Warning Signals from Hill Farmers and Farming: addressing concerns" makes an indepth analysis of the challenges and opportunities. The first draft of the study has focused much on the larger issues facing the Himalayan farmers, along with describing alternatives which are available.

The issue of sustainable livelihoods of mountain farmers, has been a concern of policy makers, for a balance is sought between economic development and environmental protection in the hills and mountains. This geographic region is invariably called by different names hills, mountains, highland, uplands and in this study report we shall also be using the terms hills and / or mountains invariably while referring to the Indian Himalayas. It is an ecologically sensitive agro-ecological zone, very often suffering from widespread soil erosion and land degradation. Small and marginal mountain farmers of India have traditionally used valleys and surrounding sloping uplands for subsistence farming despite poor yields and low farm productivity.

While there is wider consensus about taking initiatives to improve the quality of livelihoods of hill / mountain farmers, what remains at the centre stage of debate, the right approaches to farming based livelihoods of the mountain people. Range of initiatives of development agencies seek to define and implement environmentally stable and economically productive development strategies but how far it has been possible for them to address the root cause of poverty and environmental conservation of our hills and mountains. Certainly, it is not as easy as it appears, for there are a range of interlinked issues.

The focus of this study is on highlighting these issues concerning sustainable hill and mountain agriculture, specifically in the context of Indian Himalayan region. The first chapter of the study report dwells on the marginal land perception about mountains/ hills. Why it is wrong to think so ? It explains various dimensions of the new thinking and implications. In India, prevailing perception is that sloping mountain landscapes can only support subsistence farming and which results in deterioration of the economy and environment. Various dimensions of this aspect are elaborated. In one of the chapters, the report outlines guidelines for sustainable use of mountain landscapes, another chapter discusses lessons which can be learnt from success stories of farming and livelihoods in the mountains which have provided hope of economic prosperity and ecological stability to mountain inhabitants. Some of the examples from other countries have been included to highlight the fact that we may need to bring appropriate changes in our thinking, perceptions, policies and technological

applications to enable mountain farmers practice farming that brings them economic prosperity and to the environment ecological stability. The last chapter sums up issues and general recommendations which can be adopted as broad guidelines by the national and state government agencies/ institutions and local institutions/ agencies, working for the welfare of the marginal mountain farmer.

There is an acknowledged saying in the international development circles, " the mountain development is a knowledge intensive business" and we feel truly so. The broad analysis presented in this report and the possible alternative mountain perspective based path ways shall need further, deeper knowledge and information from across the Himalayan region, call it ground data or impirical information. Therefore, before suggesting concrete specific measures along with cost estimates, the authors feel that more impirical information from the hill states will be need to be collected, analysed and presented in the final report. The final report will also include perceptions and information gathered during the interactions, that have been organized by IFC in Barapani and Shimla in the coming weeks of April and May. Therefore, in this draft, we have deliberately avoided making action plan type efforts.

Contents

Chapter 1.

The State of the Himalayan Farmers and Farming

Among the 34 million people that inhabit the Himalayan region, large percentage is of hill, mountain and highland farming communities. They sustain on largely subsistence farming which they practice on marginal rainfed and some irrigated farmlands occupying 15.8 % of the total area of the Himalayas i.e. 53.8 million hectares. Rest of the Himalayan landscape, includes rangelands, pastures, wasteland (support land) the so called bush lands- the grazing areas and actual forests accounting for nearly 69 % of the Himalayan area. Another 15.2% is under permanent snow cover and rocky mountains and serves as perennial source of clean water to the hill people as well as to rest of the nation.

The mountain farming communities are widely spread over the hill and mountain landscape in varying densities or 2- more than 100 per sq.km. Agriculture is their main occupation providing direct employment to about 71% of the working population. Agriculture is the primary sector of the economy, contributing 45% to the total regional income of the inhabitants (Tulachan 2001). The net cultivated area is higher in the western Himalayan region (15.8%) than the north eastern region (9.8%). Even this has large variation within each region, e.g. 2.9% in Arunachal Pradesh to 40.9% in the Darjeeling district.

The Himalayan hill and mountain agroecosystems have been classified by NARS broadly into five agroecological zones. The western Himalayan agroecological zone in the south of Great Himalaya, the trans Himalayan cold and arid agro-ecological zone, The central Himalayan agroecological zone and the warm and humid north eastern Himalayan agro-ecological zone. The agroecological zone comprising hot dry foot hills and valleys are represented by Shiwaliks. They represent wide variations in climate from cold arid to warm and humid. Annual rainfall in the region varies from <150mm to 2600mm, and the mean annual temperature from 8C to 22C. The growing periods for different crops range from 90 to 270 days in a year.

The great majority of the farming households in the Himalayan states are marginal subsistence farmers with landholdings of less than 0.5 ha or small landholders with farms of 0.5 to 1.0 ha. While average land holding in Himachal Pradesh is about 1.2 ha it is even smaller (0.97ha) in Uttranchal .

In the north- eastern Indian Himalayas the predominant land use system is shifting cultivation or "jhum" accounts for 85% of the total cultivated area of NEHR region. It supports over 1.6 million farming communities (represented by several indigenous

upland communities- the NE tribes) over an area of 426 million hectares (Partap and Watson,1994).

Shifting cultivation is an agricultural system in which the area to be cultivated , forest area, is cleared by fire, and cultivated for a period of 2-3 years and then fallowed for several years (10-15 years). Not that whole land is crop land but the very nature of shifting cultivation underpins the philosophy of using natural land mass in rotation. There has been a trend of increasingly reducing fallow periods, i.e. from 14 to 5 years. Families once food self sufficient are now barely able to produce enough food for the whole year.

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The production system is a response to the difficulties of establishing settled agriculture in the humid tropical region and an extremely successful human adaptation to the regours and constraints of the humid tropics. The swiddeners have developed an agroecosystem that is diverse and is able to respond to environmental uncertainities. The swiddeners of NE spread over several states used their knowledge of the natural environment to identify most suitable sites for swiddens. Knowledge of both the environment and the needs of the tropical crop repertoire is used to develop and manage the micro sites of their fields. Specific crop needs are matched to specific soils- a diversity of crops meshed with a diversity of micro climates.

Cropping systems – food grain crops

About 76% of the gross cropped area of entire Himalayan region is under staple food grain crops. Therefore, the main cropping systems in the different agro-climatic zones are largely food grain dominated. The analysis shows that the production of food grains has not declined in the Himalayas as much as is often thought. The production in many areas has increased as a result of improved input supplies, and wheat in the best example of it.
There seems little prospect that the area under food grain production will increase. Infact over the years, the per capita food grain production may decline, for many reasons, such as shift to cash crops farming, of decline in over all production of food grains and the population increase in hills and mountains.

However, the two Himalayan regions, west and east, show distinct crop preferences. In the western Himalayan region, wheat is the main crop occupying 37% area followed by rice 30.7% and maize 26%. The major food crops grown in the area rice, wheat, maize, millets, barely and buckwheat. In addition variety of pulses are also niche crops of the Himalayas, such as beans, peas, kidney beans, black gram, horse gram, black soybean, lentils, green gram, and the oil seeds include rapeseed, mustard, sesame seed, and linseed.
In the north east rice is the staple food crop and occupies about 81% of the cropland area under food crops followed by maize. a diverse mixture of 8 to 10 crops is grown

in a mixed farming system . Over the years both productivity and production levels have been declining under the shifting cultivation for various reasons.

By and large valley bottoms and river basins with assured irrigation are used for growing rice and wheat as summer and winter crops, respectively. Maize is cultivated on upland rainfed sloping crop lands and terraces. Central Himalayas- Uttranchal is unique in the sense that it has more area under millets and pulses. In addition, potatoes and variety of vegetables off season vegetables, spices, and fruit are widely grown too.

Tulachan (2001) analysed the general trend of cultivation of major food crops in the entire Himalayan region. He picked up paddy, wheat and maize crops and three states Himachal, Uttranchal and Meghalaya and using time series data assessed comparative economic indicators of the state of food grain crops. His assessment showed that the area under paddy and maize is declining all over but area under wheat has not changed. This reduction in area is largely because of shift towards cash crops like fruits and vegetables.

Horticulture and cash crop

The Himalayan ecosystem has a sub tropical to temperate climate favourable for growing a wide range of fruits, vegetables and other cash crops. Small areas with their own micro climatic conditions can provide suitable sites for growing particular crops. The products include fruit such as apples, citrus fruits, walnuts, plums, peaches, bananas, mangoes and pineapples; vegetables such as tomatoes, radish, potatoes, cabbage, cauliflower, other cash crops like ginger, chillies, cardamom and saffron; and flowers such as orchids, gladioli, marigolds and chrysanthemums. The total area under fruit and vegetables in the Indian Himalayan states is around 16% of the gross cropped area. It is much higher than the all India average of 4%, but not even. Infact , the proportion of farmlands under fruit crops is much higher in the western Himalayas (20%) , then in the central and eastern Himalaya(5%).

Himachal Pradesh is case in example (also described later as a success story) in fruit production. It started with an area of 792 h in 1950s and by 2004 had over 200,000ha of fruit orchards. In the 4.4% of the farmlands that fruit crops occupy apples account for over 40%, such is the significance of this one fruit crop for Himachal Pradesh. (more data ?)

In Uttranchal too there has been considerable shifts in land use towards fruit farming. The climate of the state is suitable for growing a range of temperate, subtropical and tropical fruits as well as vegetables, flowers, ornamentals, mushrooms and medicinal plants. (Data ?)

J&K is yet another fruit state of India . Horticulture contributes significantly to the states economy. The variety of agroecological zones state comprises and the agro climatic conditions are just perfect for growing all kinds of fruits, vegetable, flowers and medicinal herbs. Saffron, apples, walnuts, cherrys are already its niche crops. And produce of a wild shrub seabuckthorn has also entered the market from Nubra valley of Ladakh, under the brand name of LEH BERRY. .

Over all, one finds trends of increasing crop diversification and introduction of horticulture crops and other cash crops. There are good prospects for the development of niche based horticulture in the Himalayas. These present trends towards rapid expansion of horticultural crops will have positive

implications for the future development of mountain agriculture, for increased food and economic security and improved living of mountain farmers .

One problem that will keep confronting is the declining productivity trend of the cash crops, which raises concerns about the long term sustainability of these options. Jodha (1995) pointed out that reckless exploitation of mountain niches might result in their elimination. A study shows (Tulachan, 2001) niche based farming of horticulture crops has shown both spatial and temporal dimensions in terms of sustainability. High economic benefits induce a spatial dimension: a particular crop spreads quickly over time. Resulting soil nutrient losses and the appearance of diseases introduce a temporal dimension, with a reduction in the cultivation of a particular crop over time, intensification of land use excessive use of chemical fertilisers and pesticides. In the land mark study by Partap and Partap (1998 ?) " warning signals from the apple valleys", serious problem of pollination failures making a dent on productivity of apples has been highlighted.

Thus with the diversification of farming in the hills many second generation issues of unsustainability are also emerging. Perhaps more importantly, the second generation problems of ecological and social issues need to be understood prior to whole sale promotion of high value cash crops. Impact on equity of class, gender and ethnicity, in particular, need to be further explored.

The key challenge facing national and state policy makers, planners, researchers and fiend workers is how to address emerging environmental and socioeconomic issues in order to ensure that this diversification process stays on course. Steps are needed to further harness the mountain niches, more appropriately, leading to enormous benefits to mountain people

Livestock

Indian Himalayas support about 50 million domestic animals (1.6 animal/ ha). Cattle are the most common (47.5%) followed by goats (15.8%), buffaloes (12.3%) and sheep (10.4%). The livestock produce comprises, dairy products, wool, and manure. Certainly livestock is higher in the Himalayas than in the plains but it also remains a fact that the region has a niche for livestock based livelihoods that one finds in the large area under rangelands and highland pastures.

A large proportion of livestock species is raised under mixed cropping systems. The land holdings are small and livestock supplement the family income. Animal dung and bedding material provide manure and compost for the crops. Almost the entire draught energy requirement of hill agriculture is met from bullocks (Rao and Saxena,1994, Singh 1997). In most of the low and mid hill areas, traditional use of dry dung as fuel is a wide spread practice. This area simply uses animals (specially buffaloes) as energy machines to convert fodder grass and crop refuge into dry dung fuel source for cooking food. Even though many castigate it as a wrong practice, the insights into the conversion of grass into fuel source for cooking using animals as machines is a traditional practice, we should not be ignoring or rejecting outright.

In Himachal livestock contribute about 13% of the gross domestic product. The state presently has the highest levels of milk availability among the Himalayan states.

Over a period of decade, the number of cattle has started declining while the buffaloe population is increasing. Similarly the number of sheep is declining but the number of goats is increasing. It is largely because milking goats are replacing cows in fodder scarce areas (Tulachan, 2001).

Many reports have been indicating a declining trend in the livestock holding per house hold but because of increased families over all numbers may not have changed much. The indicators have therefore an important message – the recognition by mountain farmers that maintaining larger

livestock holding is not longer profitable. When herd size is reduced there also has been simultaneous shift fro local breeds to hybrid cattle and other animals which induced widespread stall feeding trends.

Constraints to hill agriculture

Hill agriculture has some inherent constraints of remoteness and inaccessibility, marginality, and fragility in terms of moisture stress and the poor soil conditions and a short growing season. Added to these are socioeconomic constraints such as small holdings, poor productivity, poor production management, labour shortages, poor post production management, poor marketing and networks (lack of market development) and lack of entrepreneurship. All these have led to underutilization of resource bases in the hills/ mountains and the limited generation of surpluses I nthe agriculture sector that could be used to invest in and support the growth of the hill economy. Nevertheless, the Himalayan hills/ mountain areas also have specific advantages that can be harnessed to good effect, in particular the wide diversity and the presence of niches particularly suited to certain crops say e.g. the apples in Himachal and saffron in soppore valley of Kashmir, pashmina goats and yak in the highlands of Ladakh or mithun in Arunachal Pradesh. It offers hope to develop these comparative advantages , promote investment in such niche areas as part of the efforts to improve farm economy in sustainable ways.

All across the Himalayas, declining size of landholdings has seen virtual invasion of farming communities on the non farm CPR land—waste land, rangeland, forest areas etc for conversion into cropland. Even then many farming families have not been able to sustain livelihoods on agriculture alone. So, there is an increasing trend of out migration, more specifically from the central Himalayasn region, It has created a unique situation in which sizable percentage of women are today heading farming households and economy of these households is at best known as money order economy.
In states like Himachal increased accessibility and focus on horticulture has created conditions to harness the local mountains to the benefit of farming communities, enabling them better cash income for sustaining and improved livelihoods. With few exceptions, in general, the major constraints to improving horticulture crops in the Himalayas include poor orchard management practices, quality plant material, seeds, and other inputs, little access to extension services and marketing. Across the Himalayan region, farmers face problems in accessing market information, post harvest processing and value adding skills. Because of lack of regular markets and reliable marketing, hills farmers I many areas, despite most suitable agroecological conditions, would find it too risky to diversify into more lucrative high value crops. In the central Himalayan region i.e. Uttranchal, poor orchard management is one of the factors contributing to the poor quality and acceptable productivity levels. The Kashmir farmers also face low productivity problem because of planting material, management and irrigation.

The constraints relating to livestock centre around shortage of fodder and feed quality, specially in the winter months. Even though grazing is open, poor productivity of grasslands means longer migration periods and distances. The rangelands and grasslands are operating at one fourth of their productive potential. The reason is most of the grazing areas and fodder production areas have been infested by non platable invasive species, such as lantana, eupatorium and congress grass. Tulachan (2001) estimates that there may be 40-60% shortage of fodder/ feed being faced by the Himalayan farmers. How is it being coped ? Dry fodder import and migrations.

Overgrazing and open grazing are commonly cited reasons for poor regeneration and degradation of forests, rangelands and pastures. One finds that there is line of thinking in the Himalayan states which a case for reducing livestock, restricting open grazing and encouraging farmers grow fodder. Got interventions are mostly influenced by this thinking line and projects and incentive services are derived from this philosophy. But is it so ? Is the thinking line justified --- may be not. One has to realize that a land resources of the Himalayan region (10% cropland and 70 % non cropland) hold

imperatives to sustainable livelihoods development. The solution lies in not increasing pressure on cropland for fodder resources, not in restricting access to non cropland and leaving them degraded and with poor productivity. There is need for a new thinking, which looks at abundant non farmland as a great resource and strategies are put in place to unleashed the potential of this huge land resource to support livelihoods. An example, only if we could take steps for restoring grazing and fodder productivity potentials of lantana and other weed infested support lands of the Himalayas, there will be fewer reports of fodder shortage.

Table 1. Land and Livelihoods in the Himalayas

Land Category	Estimated Area	Livelihoods & landuse practices	Imperatives of managing hill livelihoods
1. Range lands / pasturelands	41 %	Pastoralism /Nomadism Subsistence Systems	Explore niches of pastoral systems to make these systems ecologically and economically sustainable
2. Forests, shrub land/ marginal waste land "support land"	32%	Fodder fuel timber, grazing and subsistence livelihood needs of farmers	Integration of support land management planning with agriculture and livelihood development planning for proper use and management
3. Cropland	11%	Food grains and high value crops, declining fertility and increasing non agricultural use	Improve/ maintain soil fertility through SWNM , intensify land use and diversify cropping to high value crops. Taking institutional initiatives to halt the process of crop land loss through conversion for non agric. Purposes
4. Shifting Cultivation Area	3%	Slash and burn agric. land degradation, falling productivity and food insecurity / poverty	Exploring alternative production systems which can link NRM with improving food security & livelihoods.
5. Marginal Farmland	6.5 % of crop land	Mixed crop-livestock farming systems	Exploring marginal farmland niches for alternative production options that are economically more productive and enhance ecological stability
5. Cropland >5-25 ^{0} Slope	35 % of Cropland	Extensive cropping with & without terraces	Improve SWNM along with niche based farming options
7. Cropland >25 ^{0} Slope	14.2 % of Cropland	Cultivation of land races of mountain crops / poor production/ food insecurity-poverty	Initiating search for steep sloping land niches oriented production systems combining NRM with adequate economic benefits to farmers
8. Very shallow soil	60%	Wasteland / grazing land- poor productivity	Change perspective to support land , identify production niches to improve biomass regeneration and economic outputs
9. Shallow soil	25%	Range lands/ grazing lands/ waste lands	Identify production niches to improve biomass regeneration and economic outputs from support lands
15. Deep soil	15%	Farming , community lands	Explore ways for expanding and intensify cropping on this land Conserve the deep soil crop lands
16. Crop land holding- 0.25 to 1h	75%		

Sources: ICIMOD publications and ????

Chapter 2

The Livelihood Concerns of Hill Farmers

As the world is entering into a regime of globalization; nations, states and the farming communities find themselves under unbelievable circumstances of opportunities and challenges. IN the coming times, traditional agriculture and livelihoods systems may become increasingly unsustainable largely because the region is entering into an environment of opportunities. However opportunities will need to tapped and for that to happen it will be necessary to redesign our systems according to the new challenges. This chapter makes an analysis of the changing circumstances in agriculture and farmers' livelihood needs across the Himalayan region and about opportunities which might be waiting to be harnessed by farming communities of the Himalayas.

Crop land scarcity – inadequate small & marginal farms

Livelihood of the majority of the population in the Himalayan region revolves around agriculture. Here land is the nucleus of all socio-economic activities. For majority of the small and marginal farmers their wealth and poverty is associated with the ownership of the size of land holdings (Partap and Watson, 1994; Partap 1995, 1999). For large number of small and marginal farmers of the Himalayan region, shrinking cropland holdings is a key concern for managing food and livelihoods (Pokhriyal and Bist, 1988; Partap 1998). Rural development efforts across the Himalayan region face a serious challenge of finding a solution to this problem (Partap, 1998). Even though the population density per sq km (2-200 persons per sq km) is not much. However, as a matter of fact, calculating the population density this way for the mountain areas is misleading. The actual picture of human pressure in hills / mountains is revealed by the number of people depending on the available cropland. An overview of state of land resources presented in Table 1, clearly indicates that much of the land resources in the mountains, both in India and elsewhere , are sloping and steep lands and only limited percentage is cropland. While calculating population pressure on total land area it is low to medium. Contrary to this, data in Table 1 shows that per capita available cropland in hilly areas across Indian Himalayan states and even in other countries of the region is already too little to sustain livelihoods. The consequences of this situation to sustaining livelihoods and management of land resources may be serious.

GIS based digital elevation models of the Himalayan region reveals the true picture of the proportion of farm land located on various degrees of sloping terrain (ICIMOD 1998). It provided an idea of the state of available crop land in the region. The 11% cropland available to support livelihoods of disproportionately large number of mountain farmers is further divided into a range of flat and sloping land types. Partap (1999) also reported that 37% of the cropland is sloping land of various degrees, and the Himalayan farmers are even cropping sloping lands beyond 25 and 30 degrees.

Constrained by policies and main stream perceptions, which emphasize promoting forestry on sloping lands, improving farming on sloping farmlands has never been included in the research agenda of the national agricultural research system (NARS). As a result there has been general lack of technological options for promoting sustainable and more productive farming on sloping lands. It is also partly for this reason that the mountain farmers share the blame for land degradation. The new human settlements, urbanization, industrialization and government infrastructure development activities, all are competing for converting the flat valley cropland into non-farm use.

The flat valley land may have served as the food bowl for the hill / mountain people but today, farming on these lands is under transformation. The two emerging scenarios are; first, cropping pattern is changing from grain crops to cash crops like vegetables, floriculture and fruit farming, and the second, across the region valley areas are loosing crop land to non agricultural purposes. The new human settlements, urbanisation, industrialisation and government infrastructure development activities, all are competing for converting this valley crop land into non farm use.

Researchers have reported that in the mountain areas a nuclear family in the hills needs 2.08 ha of rained cropland or 0.54 ha of fully irrigated productive cropland, provided it is put under intensive cash crops farming, for food and income security (Koirala and Thapa, 1997) . By this estimate, large number of mountain farmers in most of the hill and mountain districts are presently operating land holdings and their supporting system of non crop lands, which are much below the critical size needed for sustenance at the present technological levels It is partly because of small farmland size and under utilization of support lands, that many families of small and marginal hill farmers may be presently experiencing food deficits of varying degrees.

It needs to be emphasised that we do have laws in place to protect conversion of forest land into agriculture or any other use but there is hardly any national or state law / policy in place about hill mountain crop land conservation. Certainly it could have helped contain the ongoing dangerous process of crop land loss. In the absence of laws, farmers find it hard to resist the lucrative land market for non agricultural purposes. Gardner in his land mark study (1996) has issued a serious warning about the implications of global trends in cropland loss to food security and livelihoods of people. In his aassessment he indicated that marginal areas, such as the hills and mountains, will be the worst sufferers of the negative implications of cropland loss.

Implications of cropland scarcity in mountain areas are reported in the crisis area studies (Table 2.) by Jodha and Shrestha (1994) These studies give documented evidence of unsustainability of upland agriculture in respect of land resources, production and livelihoods. The documented unsustainability indicators are in fact hidden responses of farmers to lack of access to cropland of adequate size and quality. The state of croplands in the hill region and its impact on the food insecurity and continuing poverty paint a grim picture for sustainable hill/ mountain agriculture. The key issues that emerge are, shrinking size of land holdings, erosion from sloping farmlands and decline in soil fertility and above all widening cycle of inadequate food production-food insecurity-poverty-resource degradation.

It highlights the fact that *"unless solution is found to cropland scarcity, agriculture as a source of sustenance for the small and marginal farmers may loose its significance".*

Underutilized support land (wasteland)

To cope with the crop land scarcity, the ray of hope lies in finding ways to use available marginal land present in the form of non crop support land, in private possession or as common property or government controlled land. Most of this land lies in between the cropland and actual forests. It is known by various names in different countries of the region, such as waste land, grazing land and range land, shrubland and unclassed or c category forests. Much of this land either common property, government land or even owned privately and used to meet subsistent household needs of the farmers such as fodder , grazing and fuel wood etc. In the present discussion we call it support land which provides crucial support to farming and livelihoods of hill/ mountain farmers.

A study by ICIMOD (1998) revealed that there is relative abundance of the support land in the region. Information gathered from field studies by other scholars (Pokhriyal and Bist, 1988) indicated trends of increasing support land area at the expense of cropland. In the central parts of Indian Himalaya, 14.5 % of the crop land was converted to privately owned supportland, in a period of one and a half decades. In India it is called as *"Culturable watse"* and is defined by the Indian National Commission of Agriculture as the land that is culturable but not cultivated for years (National Commission on Agriculture, 1976). The studies are indicative of the trends leading to increase in privately owned support land area.

The reasons may be many, including falling productivity of subsistence farming, migration of families in search of better livelihoods or absence of able bodied family members in the households for better management of farmland. Above all it reflected the lack of technological options and institutional support to manage the marginal farmland productively to support food security and a better living for the families. For example there is enough field evidence and knowledge about regeneration of support lands through biomass type production approaches focusing on fodder and fuel wood needs (Hazara et al. 1996; Joshi, 1997). However, in the changed economic context and crop land scarcity, farmers are wanting to put emphasis on harnessing high values products even from the support land (Jodha ,1992, 1998). For that matter they manage the economically productive support land better, which brings them economic benefits, than the unproductive portion of it (Jodha,1992).

The precondition for permitting productive use of support land will be the availability of appropriate technological options that ensure its use in accordance with the ecological principles. To take steps in that direction will mean that mainstream society and institutions will have to get convinced of the necessity to make land use changes in respect of marginal land/ support land. The follow up actions may involve changes in land use policy, investments in research and technology development and other necessary support to the farming communities.

Himachal Farmers livelihood concerns : A representative case study of hill farmers wider concerns

In order to capture the emerging issues in hill agriculture, this section analyses the changing circumstances of hill agriculture in Himachal, the farmers livelihood needs and the emerging opportunities. While these are specific to Himachal but they by and large represent the concerns and opportunities of western, central and east Himalayan farmers. The overview in this section, is intended to understand the complexity of concerns and steps needed to harness.

Agriculture diversification in Himachal : the turning point

Himachal is presently known as a success story of hill agricultural diversification. Its Rs 700 crore annual fruit and vegetable farming has helped improve the livelihoods of small and marginal farmers in several districts. However the present agricultural diversification is already facing second generation problems and the challenge of sustaining and widening benefits of hill agricultural diversification is beset with range of new problems highlighted by the stakeholders.

Large proportion of marginal farmers yet to benefit from agricultural diversification

Food and income security of large number of small and marginal farmers, falling outside the fruit and vegetable zone, will depend very much on the crucial technological inputs which can change the generally perceived limitations of rainfed marginal lands. Promoting alternative high value cash crops farming on these lands, which are most suitable such as medicinal and essential oil plants, holds the key. However, the question is are there off the shelf technological options ? And who will take the lead? Organic agriculture is most suited on such farmlands but major institutional initiatives are presently wanting.

Second generation problems in cash crops farming

The crop diversification in Himachal has largely focused on fruits and vegetables farming and during recent years vegetables have even taken over fruits. However, initial success in many valleys have over the years led to increasing crop husbandry costs and crop failures. Crop pollination based productivity decline in apples, root disease based ginger crop farming failure etc are some examples.

Over the years, the market forces have taken over as decision makers and companies are now supplying seed and decide what farmers should grow. The role of the universities, is thus drastically changing from breeding and releasing crop varieties to advising on crop husbandry and natural resources management. How far institutions are geared to provide

this support is reflected in increasing dimension of the multifarious second generation problems.

New generation of farmers: the educated unemployed youth exploring entrepreneurship opportunities

Today, Himachal has nearly a million (889,000) educated unemployed youth in the state, both men and women. Interestingly majority of them are from the farming families and may be helping their parents/ families in continuing farming while waiting for the jobs. Comprising both men and women, this educated class of young farmers holds great potential for opening self employment opportunities in agriculture / enterprise and boost farm economy of Himachal. Even though many of these educated unemployed youth have acquired traditional knowledge of farming from their families, yet they need to be equipped with necessary knowledge and skill in farming, entrepreneurship and agribusiness. Who can assist in unleashing this dormant agri-enterprise potential of hill farming ? Given success of this initiative, will provide food and income security to a million farming families.

Unexplored comparative advantages of hill agriculture

One of the key benefits that hill agriculture will enjoy due to WTO and liberal markets , will be the comparative advantage of unique farming niches and unique products because of typical mountain climates. Certainly mountain farmers specializing in producing unique hill products will have an edge in the markets. Development experts believe that if the farming communities and governance systems in the hills and mountains are smart they should start focusing on developing their local farming niches for unique products.

If organic farming has natural niche anywhere, it is in the hills and mountains. To organize small and marginal farmers, to help them benefit from comparative advantage of organic farming, building competency for certified organic farming will be the most desired initiative. Market channel for organic produce are fast developing.

Marginal farmlands of Himachal provide excellent advantage for cultivating medicinal and aromatic crops. However the challenge remains for providing access to organic farming technologies, inputs, post harvest operations, value addition, certification and marketing.

Constrained livelihoods because of biological degradation of support lands – the waste lands

Most of the non crop land in the hills is commonly known as waste land. Presently most of the land under this category is under various degrees of biological degradation. All across the Himalayas one finds widespread infestation of such lands by four obnoxious weeds, such as lantana, eupatorium, ageratum and congress grass. The has taken serious proportions in several low and mid hill areas, where people depend on these lands for

grazing and fodder. It is now a nightmare of the hill farmers who own livestock--- there are green grazing lands which can not be grazed.

The impact of shrinking grazing lands is clearly visible, not only in Himachal but in Uttranchal also. Local communities report herds of abandoned cattle in several areas and the new problem of invasion of crops by these cattle during night. In several villages people are not sowing crops simply because it has become difficult to protect them during the whole season. It appears a simple problem but it is not—it is of much wider scale, is cause due to shrinking grazing, further caused due to biological degradation of support lands. While the number of such cattle is growing, opportunity for livelihood dependence on cow and dairy framing in these areas is diminishing simply because of fodder scarcity cause by biological degradation of the support lands. Which agenicies take the lead, remains to be seen.

The hill and mountain farmers confusion over climate change

Hills and mountains will be one of the geographic regions where climate changes will make crucial impact on farming and livelihoods. Here, crop zone is moving upwards because of general warming and availability of crop growth periods at higher altitudes, where it was not possible to grow crops earlier. Likewise valleys and other low and mid hills are becoming warmer forcing several crops to be phased out of these areas. Foe example, apple belt in Kullu district of Himachal has already moved upwards by 50-100 kms. This has opened up new opportunities for highland farmers of Kinnour, Lahul, Spiti but it also meant that existing apple valleys are no longer the favourites.

General warming of the valleys has changed rainfall patterns, increased disease incidence in crops and created water scarcity. Usually good farm income opportunities due to fruits and vegetables enjoyed by Himachal farmers are under threat indeed. In the lower and mid hill areas crop failures and high cost of crop husbandry have become common due to general warming up of weather.

Every where in the hills , mountains and highlands water for irrigation is becoming scarce. Farmers wonder and expect to have new crops, cropping patterns which require less water and endure warmer climates. Because of the warming, farmers also are experiencing unpredictable periods of rainfall. Farmers remain confused, looking for access to technological information to cope with unpredictable rain fall behaviour. Their worry is— are their steps being taken to prepare them for upcoming warmer times ?

Weak mountain agricultural research and extension support services

India has so far missed the opportunity of creating a strong mountain/ hill agricultural research, education and extension system. The universities and other research institutions located in the hills have not been able to acquire the necessary hill perspective in the mandate and functioning. Focus on developing professional capacities for hill oriented research and extension fell much short of the needs. This neglect has another dimension

i.e. the lack of understanding of the special needs of mountain environments and farm economies. That is the reason why green revolution technologies were extended to mountains/ hills as such without necessary modifications, imposing similar farming criteria and success was limited to valley areas only. Universities, these days complain of absence of research norms for hills and scarcity of funds. A decade of experience tells that research and extension system required special attention for their integration but that did not happen. Therefore the outcome has been the less than expected performance.

To sum up, concerns of the hill and mountain farmers are many. Every problem, though points to one thing that there has to be a paradigm shift in agricultural research and extension for hill, mountain and highland farming. In all the hill states, efforts are needed to address the current and potential problems of the farming communities by reframing research, extension, policy and incentives support.

Table 2. Sloping Lands and People in the Hindu Kush-Himalayan Region

Country	Mountain area (Sq. Km)	Sloping Land (8-30%) per cent	Sloping Land (>30%) per cent	Agricultural Land (%)	Per Capita Agricultural Land (ha)	Population Inhabiting Marginal Areas (million)	Population Density (per sq. km)
Afghanistan	390,475	35.1	41.9	10.0 %	NA	13.8	35
Bangladesh	13,189	60.5	12.2	7.8%	0.097	1.2	57
Bhutan	46,500	12.7	88.4	7.6%	0.173	1.2	30
China	1,647,725	10	50.7	1.2%	0.150	19.6	20
India	**482,920**	**30.7**	**21.1**	**8.3%**	**0.293**	**35**	**73**
Myanmar	280,862	37.4	29.1	7.7%	NA	5.8	21
Nepal	147,181	12.7	66.3	18.0%	0.133	18.5	126
Pakistan	404,195	29.3	35.6	7.8%	0.158	22.7	56

Source: Partap (1998)

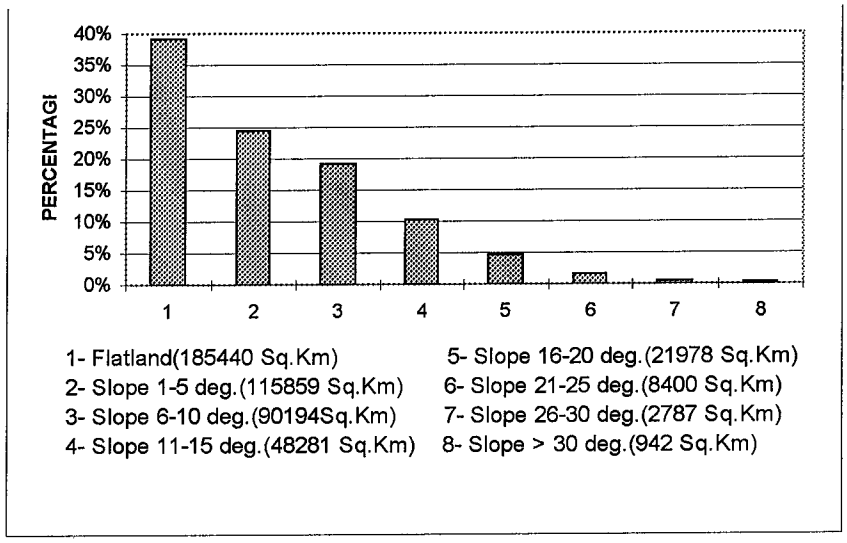

Fig 1: State of farming on the sloping landscapes of the Himalayas (Partap, 1998)

Table 3: Indicators of Unsustainability of hill farming and livelihoods
(Time Frame 1954-1991 = 37 Years Approx.)

Indicators Reflecting Problems Relating to Resource Base / Production Flow and Resource Management	Range of Changes
3. Soil Erosion Rates on Sloping Lands	+20 to 30 %
4. Abandonment of Agricultural Land due to decline in soil fertility	+3 to 11%
5. Appearance of Stones / Rocks on Cultivated Land	+130 to 100 %
6. Size of Livestock Holding per Family (LSU)	-20 to 55%
7. Area of Farmland per Household	-30 to 10%
8. Forest Area	-15 to 85%
9. Pasture/ Grazing Area	-25 to 90%
10. Good Vegetative Cover on Common Property Land	-25 to 30 %
11. Fragmentation of Household Farmland (in number of parcels)	+20 to 30%
12. Size of Land Parcels of Families	-20 to 30 %
13. Distance between Farmland Parcel and Home	+25 to 60%
. Food grain Production and Self- Sufficiency	-30 to 60%
15. Permanent Out migration of Families	None to 5%
16. Seasonal Migration	High to High
17. Conversion of Irrigated Land into dry land farming due to water scarcity	+7 to 15 %
18. Average Crop Yields on Sloping Lands a. Maize and Wheat b. Millets	 -9 to 15% -10 to 72%
19. New Land Under Cultivation	+5 to 15%
20. Human Population	+60 to 65%
21. Application of Compost (organic manure)	-25 to 35%
22. Labour Demand for Falling Productivity	+35 to 40%
23. Forestry Farming Linkages	Weak to Weak
24. Food grain Purchases from Shops	+30 to 50 %
25. External Inputs' needs for Crop Production	High to Medium
26. Fuel wood Fodder Scarcity in terms of time spent in collection	+45 to 200%
27. Fodder Supply from a. Common Land b. Private Land	 -60 to 85% +130 to 150%
28. Emphasis on Monocropping	High to High
29. Steep Slope Cultivation (above 30 %)	+10 to 15%
30. Weed and Crop Herbaceous Products' used as Fuel wood	+200 to 230 %
31. Conversion of Marginal Land into Cultivation	+15 to 40%
32. Fallow Periods	From 6 to 3 months

Note: A positive sign (+) means increase and negative sign (-) means decline/ decrease

Source: Shrestha, 1992. 'CRISIS AREAS STUD, Mountain Farming Systems Program, ICIMOD.

Chapter 3

Lessons to Learn from Other Asian Nations Experiences

The story of mountains of Japan

Sloping lands in the hills and mountains account for 68 per cent of total area of Japan. Country has over 30 per cent cropland on slope lands. However, agriculture and people inhabiting the upland areas face uncertain future. Sloping land agriculture in hills and mountain areas of Japan is facing difficulties of social nature. Nakagawa (1998) and Sugaya (1998) report that an alarming rate of households is abandoning sloping farmland in the mountain areas. The abandoned farmland increased from 93,000 hectares in 1985, to 162,000 hectares in 1995. It was almost 3.8 per cent of the nation's total farming area. Rate of abandoning sloping farmland has gone as high as 9.3 per cent in some areas. As a result, upland farming communities of Japan face problem of extinction due to decrease in agriculture and forest areas, depopulation and aging of residents. As industrial growth offers ample job opportunities for younger generation of hill and mountain farmers, in the urban areas, they are no longer interested to continue farming their family land. On the contrary, the farmland near the cities and in the plains of Japan has been already converted to non-farming use e.g. industrial purpose. Agriculture in these areas has already become a marginal activity. Today Japan faces a paradoxical situation, where 91 per cent of its agriculture land and 40 per cent of agricultural resources actually exist in the mountains. It is these areas where the nation is witnessing an accelerated process of abandoning agriculture and farmland.

Sugaya's study (1998) listed following factors responsible for declining agriculture on sloping landscapes of Japan; decline in the number of farmers and their age; concerns over future prospects of liberalized agriculture trade; decline in job opportunities; delay in social capital infrastructure development; small land parcels making mechanization difficult; intricate topography and small size of land holdings; lack of adequate access roads limiting use of farm machines; higher costs of land grading, irrigation etc. Sugaya's study (1998) also reported range of implications of the rising rate of abandoned farming. These include increasing national food insecurity; loss of crop resources; loss of indigenous knowledge of farming.

Serious moves towards corrective measures

Today, ***"as a matter of new policy, Japan considers declining mountain agriculture scenario as a national loss"***. Judging from the policy and investment initiatives one may say that nation is making serious efforts to reverse this trend. The **Depopulated Areas Emergency Act** and **the Mountain Villages Development Act** have been put into effect for maintaining/ conserving mountain agriculture. The policy aims to realize balanced development of industry through improving the environment, social welfare and traditional agriculture. To support niches based high value farming and income generating options for the mountain farming communities R&D support is focusing on; vegetable farming and floriculture with special highland products; animal husbandry on grasslands; labour intensive organic farming; developing forestry; micro enterprises development – food processing etc adding value to the local farm produce; changing tourism development approach to build stronger tourism- farming linkages ***"farming for tourism"***. The **Shikoku National Agricultural Research Station has been mandated to focus its research on " slope land agriculture"**. The thrust of current research has been focused on reversing the trend of declining mountain farming communities and conserving the agriculture on the sloping lands. This research station has already made substantial efforts in slope land farm mechanization.

What has happened in Japan and the steps that are being taken as corrective measures, carry very important message for future of hill and mountain agriculture in India. We may face similar problems in not so distant future with the growth of national economies, advancement of urbanization and liberalization of agriculture trade. The adverse impacts of abandonment of farmland on the national food security scenario of Japan serves a warning to those who like to see in hills and mountains only the strategic ecological interests of the nation. Should the ongoing processes of poverty and resource degradation in the hills and mountains of India continue to be neglected, then in few decades the story of Japan will be repeated in India too.

The story of South Korean uplands

Korea has 66 per cent mountain area and 33 per cent of farmland of the nation consists of sloping lands. The 1994 Farmland Law identified 735,000 h of good irrigated cropland (60%) and 193,000 h of marginal sloping cropland (33%) and 99,000 h of other land (Gim, 1998). In the last three decades, Korea has experienced rapid economic growth, which was accompanied by industrialization, urbanization, and large migration from uplands to cities. The fall out was that abandonment of farming in the uplands took serious proportions.

Additional reason was that Korea has been promoting the policy of ***"Agricultural Promotion Area* (APA)"**, which favoured only plain areas for agricultural investment priority. For this reason the sloping land agriculture falling under ***"Less Favoured Areas* (LFA)"** was neglected for investment. As a result, Korean farmers living in the uplands found it harder to survive under poor production conditions. The quality of life in the uplands was certainly lower than in cities, encouraging younger generation of farming families to leave farming and farmland for jobs and better livelihoods in the cities. Gim (1998) feared that the tendency would accelerate, if the current agricultural development policy continued to pursue Agricultural Promotion Areas approach. The hardship of upland farmers is further compounded by the shortage of farm labour because of job-induced migration of young upland folk to urban areas. It was a key factor that contributed to accelerated abandonment of agriculture and farmland in the Korean uplands. As an example, in 1993 alone over 66,500 hectares of cropland was abandoned, which accounted for 3.2 % of the cropland (Gim, 1998). By this rate nearly half a million hectares of cropland in the uplands will have become abandoned by the year 2000.

The emerging thinking in Korea is that even though sloping lands in the uplands are less productive, continuing farming on these lands may yield higher positive externality to society than favourable production condition areas. Higher the positive externality of these marginal areas, higher is the price and percentage of "*Willingness To Pay (WTP)* " among the Korean Society, so as to maintain farming in the marginal upland areas (Gim, 1998). **The trend has encouraged government to consider reshaping of the policy of agricultural promotion zone for investment and now it has included sloping upland areas also in it.** Korea has adopted a unique tax policy for city dwellers, called "**Willingness to Pay**" and use the revenue generated for improving farming and livelihoods in the uplands.

Isolated Area Development Law (IADL) of 1988; was the first measure to pay attention to upland farming. Under the policy less developed and low income rural upland areas received special investment focus for integrated development (1990-1999) to boost income and welfare of the inhabitants. Farmland Law of 1994 and Rural Improvement Law of 1994 were other steps taken by the government. One of the more relevant programmes was – "*the marginal land improvement programme* (MALIP)" for hilly and mountain areas. It was two-dimensional. One, it was to improve the use of marginal upland as productive land; two, it was to promote use of marginal upland for other farm and non-farm purposes; such as, rural resorts, livestock farming, fruit farming, and industrial development (Gim, 1998). Further, a scheme for compensating mountain farmers through direct cash

payment to continue farming their farmlands was also introduced. It had two key objectives, increase food supply and preserve traditional farming areas on hill/ mountain landscapes.

The lessons of the Korean experience are summed up by Gim (1998) as follows," **When the agricultural policies and measures consider only economic values, they are not sustainable and future generations may suffer access to resource base. Therefore, the policies favouring direct and indirect support to maintain farming on sloping uplands, are necessitated by both ecological and economic considerations."**

Farming in the mountains of Taiwan

Major part (73%) of Taiwan consists of hills and mountains. It is categorized as slope land by soil and water conservation law. Farming on sloping uplands of Taiwan is largely focused on raising cash crops, such as, betel nut, tea, mangoes, plums, Japanese apricots, apples, pears, citrus, peaches, cattle pastures, pineapples, persimmons, passion fruits, bamboo shoots and highland vegetables (Chang, 1998). Heavy rainfall and typhoons make soil erosion from sloping farmlands a serious problem. There also is limited scale shifting cultivation on sloping lands that is associated with declining soil fertility. Government has launched a long- term development support under integrated soil conservation and land use programme for sustainable farming on sloping uplands. The thrust areas of this development programme include strengthening technology development for soil and water conservation, enforcing restrictions on construction on sloping uplands, emphasize on proper resource planning and conservation management, adopt integrated watershed management approaches, strengthening maintenance of developed slope lands, and support education and training of farmers for sustainable farming in sloping uplands.

The programme has successfully completed construction of farm roads, irrigation and drainage facilities. In addition wider use of soil and water conservation practices by farmers on sloping farmlands has been promoted successfully. Successful efforts have been made to develop machines suitable for slope land agriculture (Chang, 1998). There has also been frequent use of sloping uplands for other purposes, such as golf courses, mining and road development, which many consider harmful to the environment.

Experiences in the uplands of Indonesia

In Indonesia a large percentage of people live in the watershed areas because of easy availability of water and other natural resources. Population growth has made people move upwards on to the sloping uplands and farming on sloping uplands has increased substantially during the past few decades. Consequently, over 12,500,000 hectares of farmland has been identified as critical land i.e. marginal sloping upland (Djadi, 1998). Sloping upland is both terraced-irrigated as well as rainfed on which crops like maize, peanuts, pulses, potatoes, cabbage and soybeans are grown. Farmers grow a combination of these annual crops with perennial tree crops such as coffee, cloves, vanilla, coconut, cocoa and several other tropical fruit trees. National land rehabilitation and soil conservation programme has launched several projects promoting sustainable farming on the sloping uplands. Although little consideration has been given to people participation but few projects i.e. natural silk farming and social forestry credit provision are inclined to encourage people participation for enterprise development.

Experiences in the mountains of Iran

In Iran the problems of sloping and marginal upland farming appear different. Over 52% of its total area of 165 million hectares is mountainous and largely dry. There is very little rainfall and irrigation is necessary for farming. Thus, out of 17 million hectares of crop land 50% is irrigated and rest is rainfed. If irrigation water was available there is potential to expand farming and agro-pastoral

systems to additional 28.5 million hectares of marginal land. Sloping upland in Iran is largely under fruit farming and water is harvested in several ways for irrigating the perennial plantations. Under agro-climatic conditions of Iran uplands attract attention of development planners for expanding farmland through developing irrigation facilities. The uplands are considered to hold great potentials for supporting fruit farming and livestock production systems (Rouhani, 1998).

Chapter 4

Lessons to Learn from the Success Stories about the Mountain Farmers Food, Economic Security and Natural Resources Management

Sustainable Farming and livelihoods on sloping lands - Horticulture in Himachal

This case study is illustrative of the example of promoting perennial crops based production system on the marginal farm lands and support lands on the mountain landscapes. How such production systems have helped address problems of poverty alleviation and environmental conservation.

Himachal Pradesh is a small mountainous state in the Indian Himalaya with altitude ranging from 350m - 6975 m. Its five million population is widely spread on the marginal sloping lands, barring a few valley areas, of low hills, mid hills and high mountain wet and cold and dry zone areas. Considered as a poor mountain state, the past two decades have seen a rapid economic transformation, in some of the more marginalised mountain areas, where subsistent farming communities were living on small parcels of land cultivating mountain crops and rearing livestock. How marginal mountain lands farming were transformed by farmers from non viable situation to ecologically and economically viable condition is illustrated here.

Improvements in the farm economy and ecology of fruit growing mountain districts of Himachal Pradesh, Kullu, Shimla and Kinnaur, is widely acknowledged as successful example of appropriate land use for the hily and mountain areas (Sikka and Saraswat 1990) . The majority of apple growers (75%) of Himachal Pradesh are small and marginal farmers owning 0.5 - 2 hectares of land and studies revealed that farming on these land holdings was already a non viable proposition in terms of food self sufficiency and food security. More and more people were turning to forests or looking for off farm employment for maintaining family livelihoods.

Decades later, the same farmers now earn around US$ 4500 per hectare from the fruit farming; the marginal farmers (0.5-1 hectare) earning US$ 1600 and small farmers (1-2 hectares) up to US$ 4000. These incomes are much higher than any farming means possible on their marginal land parcels. This fruit based production system helped alleviate poverty from these mountain households. Because of this change in the production system in large part of the mountain slopes, the net domestic product of the state increased two hundred times and net per capita income twenty six times during the last two decades. The quality of life has improved dramatically. Over 86% of the population is now literate and there is almost 100% literacy below 14 years. More than 95% people have access to safe drinking water. The study commissioned by ICIMOD to

understand the quality and range of options reveals interesting facts Sharma (1996) . It highlights that from the view point of employment and income generation, fruit and vegetable farming are high quality options for mountain farmers. The high quality of production options is also evident from their backward and forward linkages generated by them. The traditional options such as livestock rearing, dairy farming, weaving, traditional agriculture, weaving and agricultural labor were all distress driven and undertaken primarily with a survival motive. At the household level, factors such as the availability of land, labour, amount of assets, and number of educated members in the family, were significant in determining the choice of livelihood options adopted by the household (Sharma 1996). Equity, in terms of per capita household income, one of the important prerequisites for sustainable development, is o.37 among the fruit growing farmers as compared to others (0.4).

Evidence regarding impact on the natural resource base, the important aspect of sustainability, is also positive. The process of transformation in the production system has not led to deterioration in the natural resource base. On the contrary, because of better management of demand factors processes have been generated that have lessened the burden on natural resources (Sharma 1996), such as Making available alternative energy sources, better ways of livestock management etc. On the supply side livelihood opportunities are in complete conformity with the development imperatives of mountain specificities- marginality, fragility, inaccessibility, diversity and niche . Fruit crops farming in Himachal has helped address following major environmental and livelihood concerns of the people living on the largely sloping mountain landscapes;

It promoted productive use and management of marginal land resources

Small land holdings pose a challenge to farmers to make optimum use of their privately owned marginal lands, known as non crop land / cultural waste/ *ghasni i.e. fodder land etc.* The salient feature of fruit farming in Himachal is that more than 80 % of the fruit farming has been promoted on barren, uncultivated marginal agricultural and / or non agricultural sloping land . *(Chinese use the term economic forestry for fruit trees farming).* Sharma (1996) concluded that because of good ground cover soil erosion from the sloping fruit orchards was minimal.

- *It helped convert non-viable subsistent farming into viable farming through harnessing of appropriate niche potentials of marginal mountain lands*

In Himachal the percentage of small and marginal farmers has increased to over 75-80% during the past three decades and their food grain based subsistent farming brought too low incomes. e.g. incomes computed for each of the common food grains was as follows; maize US $ 25 / ha, paddy US $ 15/ ha, wheat US $ 35/ha, barley US $ 3/ha, oil seeds US $ 45/ha, and pulses US $ 30/ha (Vaidya and Sikka, 1992). Meeting both farm expenditure and consumption expenditure of the household was just not possible and farming became a non viable but unavoidable option.

However, fruit farming reversed the trends in favour of food security and improved livelihoods of the marginal farmers. All farmers benefited from fruit farming be it marginal farmers owning 0.5-1 hectares, or those with 2 hectares or more. These incomes are much higher than the gains from the grain crops farming on these land parcels. The fruit based production system helped alleviate poverty and widespread education in these mountain households. It also helped promote no tillage farming on the sloping farmlands. Unless cropped, most orchards have a good grass cover on the floor which supports soil conservation and fodder for livestock, taking pressure off from the forests. Fuel wood needs of the families were also met largely from the twings pruned annually from the fruit trees, thus saving the forests. Likewise, fruit farming improved the employment opportunities for the land less and women. Those not having their own orchards also benefited, by ways of increased employment opportunities. Need for more people for post harvest handling operations created employment opportunities as well as raised labour wages ten times to the benefit of the poor (Sharma, 1996).

The people of the area now afford better access to health care, housing and Communication facilities. There is increased conscious of the need for family planning and better education to children. Most farming families have changed to improved breeds of livestock and lesser numbers for stall feeding because fodder is now available from orchards. Additionally, orchards have helped reduce pressure on forests for fodder, fuel wood, timber and open grazing in these areas. Thus, fruit farming not only brought economic benefits but also contributed to ecological stability on farm as well as of the surrounding environment.

Evolving organic relationship between people and environment.

What is interesting is that farmers are investing 30-40% of their income in technologies and practices concerning soil and water conservation on marginal lands. There are good examples of several villages where the process of improving land husbandry continues with ever more efforts as capacity to invest more is increasing (Sharma, 1996. These efforts over the past few decades have seen increase in the area of orchards in Himachal Pradesh. The sloping landscapes appear fully covered with new type of economic forests. Encouraged by the experiences, the people and government agencies of Himachal Predesh are continuing their efforts to afforest part of their high mountain cold dry zone marginal lands with fruit trees. More details of this success story can be accessed from the ICIMOD publications by Sharma (1996) and Partap (1995).

Forest Floor Farming of Cardamom in the forests of Sikkim

The subsistence dry land farming on sloping crop lands of north Sikkim, should be presenting the poverty cum resource degradation scenario for farmers. However, ethnic mountain farming cummunities of Sikkim had chosen a wild high value spice –cardamom for barter and cash income source. The farmers started farming it under the forest floor

like any perennial crop. For decades now cardmom, is their high value cash crop grown under the shade of natural forests as well as under alder afforestation.

Large cardamom is a native plant of Sikkim and the native ethnic communities were collecting its fruit from the wild populations since time immemorial. The large cardamom being a high value cash crop most suitable to the native area. Cardamom (*Amomum subulatum*) farming underneath nitrogen fixing alder trees and other forests on sloping lands of Sikkim is a unique traditional production system which has tremendously improved farm economy. Farmers of Sikkim have been able to achieve, not only food security but also a reasonable standard of quality of life because of cardamom farming (Sharma and Sharma, 1997). It requires no external inputs and is less infrastructure intensive like roads and thereby perfectly compatible with inaccessibility of mountain areas.

The study by Sharma and Sharma (1997) indicated that almost 75% farmers of north Sikkim have replaced the food grain agriculture on their farmlands with cardamom and alder tree plantations (Sharma and Sharma, 1997). cardamom- alder forestry plantation provided permanent green cover to about 23,000 hectares i.e. 23% of farmland. It was about 10,000 hectares (14% farmland) until 1976. Cardamom production in Sikkim increased from 23,00 tons in 1976 to 3600 tons in 1996 with a yield range of 153 kg/h to 230 kg/h. The contribution of cardamom farming to livelihoods ranges between 40-88%, depending upon the number of livelihood options farmers are adopting in different areas (Sharma and Sharma, 1997). However, among the various options for farmers, who have access to adequate crop land or support land, planting cardamom and alder tree plantation is a preferred option (Sharma and Sharma, 1997).

The ecological stability of the cardamom production system, spread on the sloping lands, has been ensured by the evergreen perennial nature of the plant species and need for forest cover to provide shade to it. On ecological accounting cardamom production system seems to be more suitable for the sloping marginal lands(Sharma and Sharma, 1997). The plantation combination of alder trees and cardamom as well as cardamom plantation in natural forests, is helpful in stabilising sloping crop lands. The system adds to soil water and nutrient management (SWNM) initiating a process of soil fertility improvement. For example, nitrogen additions to soil @ 84 Kg/h/yr are far greater than removal through cardamom fruit harvest @ 3 Kg/ h/yr. Similarly, Phosphorus is added @ 4kg/h/yr and removed @ 0.5 Kg/h/yr (Table 4). Net primary biomass production of cardamom crop is 10843 kg/h/yr but biomass removal is only 454 Kg/h/yr (Table 4). Rest of the biomass is added back to into the land. This high degree of nutrient efficiency and soil fertility improvement makes cardamom production system a rare example of a production system which has inherent quality of automatically enriching the nutrient resource base of the farmland. It indicates the technical feasibility of developing economically productive and ecologically stable production systems on marginal and sloping lands even without regularly cultivation.

Four key factors which make cardamom farming on marginal sloping lands useful are;

- It is ecologically adapted to farming on sloping lands and forestry system. Plants maintain permanent green cover on forest floor.

- Cardamom farming ensures ecological stability to fragile mountain slopes by requiring farmers to maintain a good forest cover of nitrogen fixing alder trees.
- Cardamom is farmer domesticated, low volume-high value cash crop.
- It generates employment for minimum of 80-100 days per hectare
- Globally almost 90% of cardamom is produced in Sikkim and its neighbouring valleys of Nepal and Bhutan alone, therefore, their region enjoys comparative advantage in marketing.

More details about different dimensions of sustainability of cardamom agro-forestry systems on the sloping lands are available in ICIMOD publication (Sharma and Sharma, 1997).

The cardamom farming system, confirms that there are indeed some traditional production systems within the mountains which are fine examples of sustainable livelihoods of mountain farmers and land use management. This example focuses on how non agricultural sloping lands can be used much more productively by the farmers without jeopardizing the ecological interests. Even though, some like to debate the appropriateness of cardamom farming, it fits in well within the mountain perspective framework of technological and land management choices for sloping mountain lands.

Forest Resources based sustainable Livelihoods – Chinese success story

The past efforts in practically all countries of Asia have emphasised reforestation / afforestation as a key component of mountain land conservation strategy. However, efforts met with mixed success. While these initiatives fully recognized natural convergence between attributes of trees or forests i.e. their resource conserving effects, and imperatives of fragility characterising mountain terrains, i.e. need for low intensity land use systems, they did not examine the resource intensive, high productivity, quick pay-off dimensions. This could have made the resource extensive system readily acceptable to the local people so as to meet their needs subsistent economic needs.

Seabuckthorn success story is quoted as one of the outstanding examples which combines horticulture and forestry to make an economically and ecologically productive and stable production system. Soil and water conservation institutions of China in association with local people through out the northern, the north western and the south western parts of China have are now using this production system very widely. Since 1980, Chinese institutions and people have been busy expanding Seabuckthorn forests which are already covering several million hectares.

Why did seabuckthorn draw so much attention to the exclusion of several other known promising plants for soil and water conservation. It was for one basic reason that seabuckthorn helped evolve a unique production system which represented characteristics of a good forest on the sloping lands and river valleys, as well as economically productive features of a fruit orchard. Local farmers of the areas have strong economic interests in maintaining the seabuckthorn (Hyppophae L) forests and

government institutions have long term strategic (ecological) interests in promoting it. Some details of the two features of Seabuckthorn are as follows;

For fragile and marginal lands in mountain regions, the environmental gains of seabuckthorn reflected through resource upgrading, i.e. building/binding of soil on steep slopes and conservation of moisture for productive use, may far exceed the commercial benefits described later. The root system, rapid prolification, nitrogen fixation, adaptation to harsh conditions of the highland environment and other attributes of the plant , amply equip seabuckthorn to play a conservation role in the fragile and marginal mountain lands (Lu 1992) . One of the most successful regions that has used seabuckthorn for soil and water conservation on the sloping marginal lands, non cultivated waste lands and degraded forest areas, is the Western Liaoning Province which is located in northeastern China. With a total area of 50,111 sq Km., of which sloping mountain lanscapes constitute over 70%. Originally the area had about 12 % of poor forests of humid and semi arid type climate. There was a vast degraded area of 33,188 sq km and erosion was continuing @ 2500- 8000 tons/sq km/year. These severely hampered the development of forests and livelihoods of a large number of farming families including acute fuel wood energy crisis.

The provincial institutions and people aided by Ministry of Water Resources and Conservation PR China, launched a major program of afforestation using Seabuckthorn in the mid 70s. By 1984, lush green seabuckthorn forests were already covering 26,700 sq km area, and the continued vigorous efforts expanded the healthy forests of seabuckthorn to over 113,300 sq km by 1988, of which 30% were mixed forests rejuvinated by seabuckthorn. Such was the degree of efforts and rate of growth. Provincial Government used all methods, people participation for shelter belt forestry, leasing out large areas to each family for setting up private seabuckthorn forests, government aided efforts along the water sources- rivers and streams , and community plantations around farm lands (50 m wide strips around patches of village agriculture land). As a result, planted seabuckthorn forest area in western Liaoning has become the largest one in the country and Jianping County, with most marginalised sloping landscapes and widespread poverty, has the largest (1000 sq km.) seabuckthorn forests in the country, now. This plantation has a potential of producing 25,000 tons of fruit per year, which have been used to transform the local farm economy by establishing several factories for producing seabuckthorn products. Jianping county offers another successful example of rehabilitating dry marginal and fragile landscapes of a region with mixed forests of seabuckthorn. A strategic need of the area and nation, in saving the habitat ecology, is met with excellent performance and impact.

But what did it mean to local people of Jianping county, where most agricultural land was marginal and land holdings are also small. People faced a major problem of fuel wood, good grazing land and no forest ecosystem in the vicinity to supplement the poverty stricken livelihoods. The farm economy of Jianping county, as a result of this effort, has changed tremendously, specially for the poorest of the poor. The scale of benefits local people gained out of this initiative is a telling story. The visible changes one finds is forest resource based income and employment generation, abundance of fire wood ,

abundance of grazing land in seabuckthorn forests, wildlife, soil moisture, and water bodies.

Seabuckthorn fruit based agro industries have become a strong base of the economy of Jianping county generating ample opportunity for income generation and employment including off farm employment. seabuckthorn became the backbone of the household economy, providing more opportunities to the poorest of the poor households. It provided new opportunity to the women, children and those who were unable to find jobs or off farm work. Since the times, the Jianping county farmers started earning cash income by collecting seabuckthorn fruits from the forests, the gross earnings of county farmers amounted to US $ 400,000 per year (Lu, 1994) the income increased to about US $ 800000 per year by 1996 and should be many times more today.

In China, seabuckthorn has provided a breakthrough in combining conservation needs of water and soil in most degraded areas of north and northwest China, a strategic ecological need of the nation, with development need of farm economy of the area, by way of on and off farm employment opportunities and agroenterprises development. The priority given to investments related to seabuckthorn plantations and R &D for post harvest processing of products, has made marvellous impact on both the household and regional economy. By 1990 whole China had seabuckthorn forests covering more than one million hectares and the total value of products had exceeded US $ 20 million. By the end of 2004 seabuckthorn agroenterprise was a multibillion agronterprise in China.

LEHBERRY OF INDIA A RESULT OF RELPICATION OF THIS CHINESE SUCCESS STORY BY ICIMOD. Ten years of efforts and international aid agencies support, ICIMOD initiatives and national private investment as led to the establishment of RS 100 crore LEH BERRY agroenterprise in India, benefiting farmers of Ladakh (Nubra valley) in J&K and tribal districts of Himachal Pradesh.

Lessons from success stories

Fruit farming on marginal farmland in Himachal Pradesh, cardamom plantations in the forests as well as conversion of sloping farmlands into forests for planting cardamom, and afforestation of support land with seabuckthorn in China, in all the three cases the technological options reflect understanding and incorporation of niche perspective. In these examples, marginal land was adopted as a given condition and agricultural development options were searched accordingly. Several commonalities in the goals and benefits of these three cases are listed in Table 3. These are protection and productive use of marginal farmlands and support land, soil and water management and harnessing of specific niches.

The three examples convey a message that marginal lands are not constraints to productivity if appropriate technological choices are made. Marginal lands have specific niches (comparative advantages). A proper understanding of the niches can provide clue to the potentials of marginal lands under given agro ecological environment. The three production systems use perennial plantations of different types with equal advantage- be it modern varieties of apples or a farmer domesticated perennial spice cardamom or a wild thorny shrub- seabuckthorn. All the three production systems were aimed at combining economic sustainability with ecological stability of the landscape and local environment.

These approaches indicate promising scopes for diversification of sloping upland agriculture to perennial plants based production systems. While making use of marginal sloping lands fruit farming enhances farmers' access to more farmland. Cardamom farming highlights two points, one is that local biodiversity can be a good source of niche based crops for marginal lands. The perspective behind the marginal land crops is that these are the plant resources adapted to edaphic and climatic conditions of marginal lands. These may not be the crops coming from experimental stations of research institutions but local plants whose economic potentials have been determined by the market or industry. Seabuckthorn story provides insights to technological scopes for combining soil and water conservation efforts on marginal and fragile land with food security and poverty alleviation. Seabuckthorn case is a unique example, which explains that forestry systems can be designed in such a way that while serving the purpose of good forests they can also provide benefits of horticulture plantation to local people. Seabuckthorn initiative also explains how forests can be made to serve as fruit trees farming in terms of offering livelihood opportunities.

The experiences described above add a new dimension to the thinking process about linking marginal mountain land management to improving livelihoods. The trends unfolded by these case examples, define a role for the biodiversity /agro biodiversity in enhancing use value of marginal land for sustainable mountain development strategies. Albeit in other contexts, scholars have indicated the need for adopting this alternative land use perspective (Jodha, 1992, 1995,1996, 1997; Critchley and Reij, 1996, Partap 1998).

For wider use of the perspective on managing livelihoods sustainably on marginal sloping uplands, it will need a change of mind sets from considering marginal sloping uplands as constraints to livelihood opportunities and poverty alleviation to that of lands of opportunities. In this context, each of the three technological approaches is a witness to new experimentation. Political commitment leading to strong institutional support is a common thread to the success of these initiatives.

Development thinking will need to be reshaped from considering marginal mountain lands as constraints to livelihood opportunities and poverty alleviation to that of lands of opportunities. In this context, each of the three technological approaches is a witness to new experimentation. Political commitment leading to strong institutional support is a common thread to the success of these initiatives. There was a strong political commitment in Himachal Pradesh to see that successive five year development plans ensure adequate promotion of horticulture development, backed up by good road infrastructure, technological research, extension, investment facilities and safeguarding farmers interests in the market. Cardamom farming florished in Sikkim because of provincial policy recognising and protecting the rights of indigenous farming communities to forest floor farming. Seabuckthorn afforestation is a success story because government in China made major concessions in land policy. Farmers have now the opportunity to take several hectares of land on long lease for planting and managing seabuckthorn forests for themselves. Huge investements made by the government of China in agro industrial research and development of seabuckthorn which led to over 200 marketable products and millions of dollars of trade, were key steps towards making it a success story.

Table 4: A Comparative View of Sustainability Factors of Success Stories

S. No.	Marginal Land Use Experiences, Goals and Impacts	Fruit Farming Himachal	Cardamom Farming Sikkim	Seabuckthorn Forests China
1.	Protecting and improving marginal farmlands for productive use	*	*	-
2.	Improving support lands for productive use	*	*	*
3.	Better soil water & nutrient management	*	*	*
4.	Economically productive farming system as primary goal and ecological benefits are by product	*	*	-
5.	Ecological restoration/rehabilitation as primary goal and economic benefits are by product	-	-	*
6.	Emphasis on biomass production	-	-	*
7.	Stability oriented location specific choice	*	*	*
8.	Harnessing niche for tradable item	*	*	*
9.	Use of indigenous knowledge practices systems	-	*	-
10.	External R & D inputs public interventions triggered successes	*	-	*
11.	Sole dependence on local resources	-	*	*
12.	Replicated successful experience from similar environment	*	-	-
13.	New generation crops from local wild biodiversity & adapted to marginal lands	-	*	*
14.	Larger scale community level community participation a prerequisite to upgrade scale of niche product	*	*	*
15.	Land ownership necessary prerequisite for success	*	*	*

Source: Partap (1999)

Chapter 5

What Needs to be done : the Recommendations

The issues concerning making hill agriculture relevant to sustainable livelihoods of the farming communities, are as diverse as the areas themselves, transcending different physical, topographical characters; racial ethnic and cultural diversity; bioresources diversity and administrative systems of different countries. An analysis of the issues discussed in the preceding sections/ chapters is summed up here in the form of felt needs, imperatives, implications, and specific or general recommendations.

Need for Hill Perspective in thinking and actions

The important conditions characterizing mountain habitats, which separate them from the plains, include inaccessibility, fragility, marginality, diversity, niche and human adaptation mechanisms (Jodha, 1990; Jodha et al.,1992) are in general recognized as *" the Mountain/ hill Specificities"*. And giving due consideration to these mountain / hill specificities in thinking and actions is in simple terms the Mountain Perspective. The six mountain specificities are briefly described here before discussing implications of their neglect and consideration.

Inaccessibility

Inaccessibility is a product of altitude and terrain and is a major constraint in the most mountain areas. It obstructs mobility, leads to higher costs of transport and other logistics for interventions, imposes isolation and closedness on production, restricts the scope for higher productivity of resources through enhanced use and intensity, higher use of linkages. The sustainability of human welfare or survival under such conditions is closely associated with local resource centered diversification of activities, and a focus on the regeneration, protection, and recycling of resources and products.

Fragility

Fragility is a product of verticality, steep slope, and other associated biophysical conditions. Fragility makes mountain areas most vulnerable to degradation, even with a little disturbance. Mountain thus offer limited resource use/ product options, which in turn have low pay offs. Fragility not only prevents the higher intensity of land use, but also limits both physical and economic input- absorption capacities. There is limited scope for the use of external inputs, as well as for resource manipulation or upgrading, because of physical limitations and high investment and maintenance costs. Fragility, therefore appears to be the most constraining factor in sustainable land use (implying high productivity through high use intensity) in mountain areas. The resource use options in the context of fragility need to focus on : land extensive systems; a combination of productivitiy and protection measures; resource upgrading using nature's own processes and intensification as permitted by adaptations of resource characteristics.

Marginality

Marginality, like other mountain characteristics discussed here, has both biophysical and socioeconomic dimensions. It is a product of both natural and man made factors. Marginality shares most of the implications of fragility: limited and low pay –off options, and the high cost of upgrading resources, make the marginality of resources and people a major constraint to sustainable resource use for high productivity. Accordingly, a dependence on nature's processes, diversification, and interlinkages of production activities is essential in such a context.

Diversity

Diversity or internal heterogeneity , resulting from spatial, temporal, physical and biological differences over shot distances, in an important feature of mountain areas. This is a basis for both current and potential activities with significant inter-linkages. However, a key requirement is such resource use system is the avoidance of narrow specializations and the use of a range of niche.

Niche

Niche represents the special situations in mountain areas where resource based and environmental conditions of the mountains create potential for products and activities that have a comparative advantage over the plains. Most of its implications are quite similar to diversity as it is a manifestation of the diversity of mountain resources. Niche offers a number of opportunities for resource and product centered activities which could enhance both productivity and human welfare on a sustainable basis. Harnessing with protection has to be the key focus of interventions addressed to niche. A large proportion of the multiple " niche" in the mountains is linked to land based activities.

Human adaptation mechanisms

Human adaptation mechanisms cover the traditional methods of adapting to the limitations and potentialities of mountain conditions. They involve either amending the circumstances to suit human need which could efficient use of diverse resources. Besides technological measures, the adaptations include institutional arrangements such as the provision of common property resources, and the employment of social sanctions to regulate the use of fragile resources.

Imperatives of mountain specificities to hill agriculture development, are not detailed here, because these are covered under various sections elsewhere (such as marginal lands, traditional knowledge of farmers, Himachals success story etc).

Need for rethinking about mountain development approaches

The development of sustainable hill / mountain agriculture systems requires that development planning processes follow certain guiding principles, i.e. ***"Approaches to hill/ mountain agriculture development will be sustainable if they are designed to mimic the land cover and other control mechanisms that occur naturally in a given mountain ecosystem".*** The guiding principles emerging from the above overarching statement are listed below. (For more details of guiding principles, please see Partap, 1998).

Recognizing diversity of land use opportunities: Structurally diverse land use systems can be developed for mountain areas to contain erosion impact. Varying the size and shape of the disturbance will create islands of cultivated land surrounded by natural vegetation. This will help trap soil from slopes. Agro ecological diversity also offers potentials for developing diverse systems. Preceding chapter has already described successful examples of this type.

Identifying and harnessing location specific niches: Because of variations in aspect and altitude, sloping lands are characterized by wide variations in sunlight availability, soil type and moisture regimes which change significantly within small areas. These variations play crucial role in determining sloping land cover and land use. For example, slope aspect determines that northern face of the landscape will be covered with the forest while the southern face will have grassland. It is important to realize that ***"hill and mountain valleys and landscapes are less suited for uni-dimensional land use"*** but more suited to multiple strategies that consider unique characters of smaller sites within the whole landscape. Farmers have been evolving farming systems by identifying these special attributes of micro-sites and harnessing the niches.

A number of examples can be quoted to confirm that in the past contributions, actual and potential, of mountain farming systems, to food security, poverty reduction, biodiversity – agro-biodiversity and environment have been under rated. In order to ensure long-term security of sloping land use investment it is necessary to legitimize agriculture and forestry use of mountain landscapes and make farmers eligible for collective action.

Ensuring a balanced relationship between people and land resources: There is evidence that population growth supported by needed technological and institutional tools, can lead to better conservation (Tiffin et al 1990). Conversely, there are examples that show that depopulation can lead to bad farming practices and degradation in mountain areas (Sugaya, 1998). Factors that influence mountain farmers decision making for sustainable use of land resources include land tenure relations, market access, access to technological and institutional innovations and local ecological conditions. Some researchers (Scherr et al 1995) suggest that population growth in these areas may induce people to invest in land resources improvement. By doing so, they create opportunities for farming these lands more productively so as to improve the returns from investment in farming. Evidence indicates that the factors, which contribute to poverty, also encourage farmers to intensify farming but employing better land husbandry practices. One of the key reasons why farmers do not employ sustainable farm management ways is the lack of property rights. In NE Himalayan states, shifting cultivators, which are a sizable chunk, have this problem (Partap, 1998).

Further, our land property rights are gender discriminating, which is crucial for sustainable land management. There are obvious benefits of developing and enforcing clearer rules that define rights and obligations among local people on the use of local land resources. In this context, there is increasing evidence that private ownership encourages improvements in land quality, whereas insecure land tenure will encourage less care and degradation of farmlands.

There is a gap in our understanding about economics of agricultural intensification and limits to economic well being of mountain farmers. Another important factor is the use of indigenous knowledge and skills. Unless farm research focuses on enhancing sloping land farming systems productivity by incorporating indigenous knowledge and skills of local communities, which are so diverse, there will always remain a gap in the efficient use of scientific methods for evolving sustainable production systems for hill and mountain areas.

Need for changing perceptions about marginal mountain lands and poverty linkage

Using conventional thinking we assess land types according to its agricultural production capacity. Consequently, even though without definition, many names are used to designate mountain/ hilly areas i.e. the sloping landscapes as marginal, low potential, resource poor, fragile, vulnerable or degraded lands, but more widely used term is – marginal lands (Partap, 1998; 1999; CGIAR, 1999). The difficulty in formulating a clear definition for hill/ mountain lands can stem from the fact that productivity varies according to the type of land use. A tract of mountain valley or sloping land that is "marginal" for crop production may be well suited for grazing or fruit farming. Fragile cold arid

valleys of the western Himalayas and the green sloping landscapes towards their south, may be sensitive to degradation under cultivation but can be sustainably used as rangelands and for forestry.

Further, development strategies for these areas need to be based on the fact that *"productivity is not only based in the biophysical characteristics of mountain lands, but also depends on the socio-economic parameters of a mountain environment (Partap 1999)"*. Technologies may be known but the other necessary incentives, institutions, or inputs may be missing. The range of possible productive and sustainable uses of sloping lands for providing livelihoods to mountain farmers, is so wide and socio-economic conditions of the mountain farmers so diverse that no definition can encompass all the relevant factors.

Marginality of hill/ mountain lands can be the result of a range of combinations of constraints. For instance biophysically "good" land can be marginal on account of its isolation from markets, the availability of inputs, or the "small size of holdings". The nature, composition and interaction of the factors, which determine marginality, thus differ widely. For practical purpose, three broad types can be identified:

i. relatively favoured mountain/ hilly lands with high-- present agricultural use value
ii. marginal lands with low -- present agricultural use value
iii. lands with low or zero intensity of – present agricultural use value

Any number of factors may lead to shifts of the mountain/ hilly areas from one category to another. These shifts may be upward, through applications of improved techniques, or downwards as a result of land degradation or inappropriate development of lands formerly at low use levels. Hence, *"marginality of mountain and hilly areas cannot be a static concept, it is a dynamic process"*. Therefore, while dealing with natural resources management, marginality of mountain and hilly areas, it has to be assessed in terms of specific types of land use. A rainfed sloping farmland that is marginal for a crop requiring continuous irrigation and moisture for whole growing period (e.g. rice) could be highly productive for perennial fruit crops which need less moisture and can even tolerate periods of drought in between rainfall periods. Also what is marginal land for cropping, because of terrain or short growing period; such as highlands in Ladakh in J&K, Kinnour, Lahul & Spiti in Himachal and other districts elsewhere, may support a productive and sustainable livestock production system, herbal medicines farming in the pastures and fruit farming.

A key characteristic of marginal sloping mountain/ hilly lands, as distinct from productive flat lands, is the location specificity of terrain, climate, soils and socio-economic conditions.
Using these criteria, large areas of mountain / hilly lands can be marginal depending on;

- its use- for agriculture or for forestry
- its natural biophysical characteristics- investments can alter
- its location relative to infrastructure- road access to the area can completely alter the economic returns from the same land
- the institutional and policy context- influence people's access to land resources and opportunities
- population pressure-size of land holdings (from nomads/ herders view point his/ her large area of land is not marginal even though the biophysical yield is low; at the same time a farmer with less than one ha of favoured agricultural land may feel that he or she is living on marginal land).
- technology development – perennial drought resistant crops adapted to such lands
- taking advantage of niche opportunities- high value crops/ plantations

A particular landscape or farmland in the hills / mountains, may move out of and into marginal status depending on which of the above dimensions are applied in the definition.

"Thus, it only makes sense to define mountain/ hill landscapes - as marginal land, only in terms of a clearly defined specific situation. Further, even though technologies to remedy biophysical marginality are well known, the marked shifts in productive use of marginal lands results only with necessary incentives to apply results of technological research. These incentives include, removal of range of policy and institutional constraints".

In its efforts to reorient research priorities to give more attention to marginal lands CGIAR (1998) attempted to define marginal lands as marginal agricultural lands (MAL). According to this perspective MALs include all those marginal areas including sloping lands, currently used for agriculture, grazing or agro-forestry. They are characterized by poor soil fertility - nutrient deficiencies, acidity, salinity, poor moisture holding capacity etc.; inaccessibility with all its social and economic implications; fragility; heterogeneity i.e. physical and cultural diversity with inherent constraints and opportunities.
Although when hill / mountain lands are viewed from the economic perspective these are less favourable for agriculture, yet sloping upland agriculture can have many values and potentials not available in flat land agriculture. By making use of intricate topography and rich biological resources, mountain farmers can take advantage of these factors. While large scale farming is difficult on sloping upland farms but it is possible that unique small scale farming niches with diverse products are developed.

Need to correct Institutional biases and neglect

As revealed by the scenario described above, hill and mountain farmers await for attention because the absolute number of people dependent on these areas for their livelihoods, are likely to increase and that high incidence of poverty in these areas requires focused attention. In the past, development planners may have underestimated the likelihood of population pressure that these areas will experience. Today, many valleys and sloping landscapes are already supporting dense populations, while others are going to be overcrowded in the near future.

Because of the widely held view that cropping is unsustainable beyond 15% slope, agriculture R&D ignores focus on such areas. Sloping landscapes are largely managed by governments to protect watersheds, under strict regulations which set aside forests on lands with slopes on 18-30% or forbid annual cropping on these lands (Blaike, 1987).

That means research will ignore finding solutions to farming in these areas despite the fact that people do cultivate these areas and need technological assistance the most. Partap (1998) highlighted the fact that large part of Himalayan crop lands are sloping lands of 8 -30%, and present farming R&D policies and strategies deprive farmers owning these farmlands of the necessary technological support to adopt sustainable farming practices on these sloping lands. Put in other words, " Does India need a mountain perspective based agricultural strategy and related policies for its hilly and mountain areas, so as to achieve the goals of poverty alleviation and economic security of mountain farmers as well as sustainable resource use -- the answer is yes."

One also finds that series of misconceptions have developed around maintaining forest cover on hill mountain slopes rather than farming. Although forests play important ecological role for maintaining the hydrology and soil movement from the sloping uplands, but they limit economic sustainability options. Unfortunately, "***the development***

planners and people in government institutions have nurtured misconceptions about the role of forests to the extent that they block opportunities for adopting better alternatives". Implications could be far reaching for improving livelihoods of people and sustainable management of these lands.

Over the next decades, populations in upland of India will undoubtedly increase to recognisable proportions. Ignoring the existence of communities that eke out a living on these fragile living could in fact lead to massive land degradation, unsustaiable land uses and more poverty in these areas. By redesigning development strategies to promote alternative non degrading land use systems, we can begin to conscientiously address the needs of communities who live here.

For several decades now, our hill development philosophy has been led by the belief that controlling potential negative downstream effects requires the maintenance of forest cover, have supported the hillside development policies focusing on forest cover through regulation or exclusion of local users, across a wide range of ecological and socio economic regimes. The fact that people are going to stay here demands that we look into the possibility of alternative production systems which provide both protection and production functions adequately.

Because of the widely held view that cropping is unsuitable beyond 10-15 % slope, scientists hold such areas unsuitable for agriculture. Sloping lands in many cases have been managed by governments to protect watersheds, under regulations which set aside forests on lands with slopes on 18-30 % or forbid annual cropping on these lands (Blaike 1985). In some states there is Government control over much of the sloping land non farm land even if there are no forests but because it has slope above 18%. That means research ignores finding solutions to farming in these areas despite the fact that people do cultivate these areas and need scientific help the most.

Interestingly, sloping landscapes of NE India experience unique meteorological conditions, specifically intense precipitation and high levels of solar radiation. These conditions create high potential for agricultural productivity, even though it may be at the cost of depleting soil moisture reserves and intensify draught effects. Soil characters of these hilly lands also vary widely. Although initial soil conditions, such as depth, nutrient content and structure may determine the relative impacts of land uses and the resulting erosion effects, but a combination of features ultimately determines the productive potentials and or fragility status of these soils. For example much of the highland soils in the Himalayan region are acidic and are a limiting factor for some production systems.

Although forests have impacts on hydrology and soil movement within an ecosystem, but series of misconception have developed around forests' role in sustainable land use in the hills/ mountains, such as that they are a protection against all forms of soil erosion, ensure constant water supply and protect from flooding in the low lands. Internalizing these public sentiments Governments vehemently support promotion and protection of forests in these areas. Even though many of the disasters blamed on deforestation can be

the result of extreme climatic events and other land use activities associated with deforestation, rather than to the loss of forest cover. The mainstream thinking so far remains the same. Under such circumstances, curative policy measures and projects to reverse deforestation get precedence over addressing livelihood concerns of farmers or inappropriate strategies are designed.

Contrary to conventional wisdom, there are farming systems which will be most appropriate to sloping landscapes. These systems have varying levels of intensity of cultivation and associated tree vegetation. Intensive land uses surely have higher potential to disrupt watershed stability than more extensive uses, but it does not necessarily lead to degradation.

Factors which influence mountain farmers farm management decisions

Farm size is a determinant. As farm size decreases, food insecurity of the farm family becomes vulnerable. This leads farmers to adopt desparate measures to sustain livelihoods. Farmers will more likely work on improving the farm land for two reasons; first to enable desired increases in cropping intensity and second to prevent decreases in yields.

The demographic scenario of hills and mountain areas of India indicates that there are bleak chances of depopulation in these areas. Aided by climate change, infrastructure development such as roads access and population pressure , People, farm and non farm, are even going to create settlements higher and higher. This will create further opportunities for economically productive farming based livelihoods, even in these remote high mountain areas. There are already good examples of such trends available from remote valleys of Himachal Pradesh and from elsewhere.

Contrary to general belief, the population growth in hilly areas can even lead to land conservation (Tiffen et al 1990) and also the depopulation from hills and mountains can lead to land degradation, because of neglect or lack of labor intensive landscape maintenance.

However, it will be wrong to assume that population growth alone would guarantee ecologically sustainable production systems. Many other conditions, such as land tenure relations, market access, access to technical and institutional innovation, and local ecological conditions, affect microeconomic incentives (Scherr et al 1995).

Strategic research is necessary to fill the vast knowledge gaps we have about micro economic reasons for intensification and to document the degree of economic well being associated with various land uses and technologies. Unless farm research focuses on systems and economic security, incorporating indigenous knowledge and skills of local people , there will remain a major gap in the efficient use of scientific information for sustainable production systems in the mountains.

Property rights is a very crucial issue in farm land management efforts. There are obvious benefits of developing and enforcing clearer rules that define rights and obligations among people on the use of the more valuable resources. Conventional wisdom tells us that private ownership encourages improvements in land quality whereas insecure land tenure- lack of title, limited transfer rights or non ownership of the cultivator- will encourage less care and degradation on sloping farmlands.

Demography and prospects

Although tremendous relationship in land man relationship exists in the Indian Himalayan region, the over all density of population is about 35 persons per sq. km. It ranges from 2 persons per km to more than 200 persons per sq.km. Some Himalayan states have more people per sq km sharing marginal land resources. Population density influences the types of farming and livelihood decisions that people living in these areas make.

Indian Himalaya, experienced growth rates of around 2.6 % . However, in the Himalayan states of India, people are moving into hillside areas at high rates. Hillside population is increasing even as urbanisation occurs at increasing rates. In this region migration may contribute to the already high natural population growth rate to create high population densities in the fragile hills of this region. A direct consequence of the rising population growth rates has been a rise in the labour force in most parts of the Himalayan region to about 40% of the population. But the growth in the labour force has not been accompanied by a transformation in the structure of employment and as a result high dependence on traditional agriculture has continued. The perpetuation of conditions for population growth and the limited proportion of cultivated land have meant that the per capita availability of land has declined over the years. At the same time the quality of available per capita cultivated land also declined, as more and more marginal land was brought under cultivation.

Experts believe (Rhoades, 1985) that increase in population of mountain farming communities generally accompanies increasing use of labour intensive technologies and ethno-engineering ingenuity. Past experiences reveal that a variety of adaptations, ranging from variations in farming systems, cropping pattern and intensity, crop selection, and crop mixtures helped in augmenting agricultural production. New crops created a new basis for sustaining population growth (Schroeder 1985). Population growth in the highlands was sustained through a mix of agriculture, pastoralism, and trade.

Migration in search of living space has been characteristic of mountain populations for long time. Increase in population led to changes in the form of this migration. For a long time such migration was restricted to areas and regions within the mountains itself. The future patterns and nature of migration may become more complex, by way of upland low land migration, intra and inter regional migration, seasonal and permanent migration and more people migrating into mountains rather than going out because of new opportunities. The guess is that farmers living in settled hilly areas for long may be

more constrained by the size of arable land for cultivation and consequently they will move into new areas that had previously been considered unsatisfactory for agricultural use and with marginal production potential. Small farm size may also constrain farmers' ability to produce adequate food and contribute to poverty in these areas.

Even though much attention is focused on the deterioration of watersheds because of increasing growth of population. As a result farming is spreading into areas where the natural conditions are not appropriate for sustaining plain area oriented production systems. Out migration is not visualized for the simple fact that those who have moved in will not go and the native ethnic minorities, accustomed to very special land tenure relationship, will never find a place in the already crowded lowlands.

Central Place of Women in hill Agriculture

Mountain women have traditionally been the invisible work force, the less acknowledged backbone of the family economy. In the hills, whether the men are in the household or have migrated elsewhere to supplement the family livelihood needs, the women have their major share of duties. Looking more closely at the type of work that women do, we can distinguish three main areas, all crucial to keeping the family and indeed the hill economy alive. These three areas are: survival tasks, work in the households and income generation.

Survival tasks are those essential for daily life, and it is for these that women are largely responsible in the poor mountain households. They grow the food crops, provide water, gather fuel and perform most of the other work , which sustains the family. Traditionally a certain level of division of labor is evident in the farming sector but what is happening is that with the male migration it has meant every thing for women. Household tasks , the activities performed at home, are almost exclusively the responsibility of women- food preparation, cooking for example is a good example. These activities return every day absorbing substantial time.

Throughout the highland / slope land areas (mountain areas), women contribute substantially to the family budget through income generating activities. This is particularly the case for the growing number of female-headed households where men have to migrate in search of work. Even where a woman is not completely alone, contribution of women to the household budget is of utmost importance to he family, the more so because women spend more of their income on family welfare. So, it is clear that women fulfill a great number of essential tasks and notwithstanding their important role, women have only limited access to and control over income, credit, land, education, training and information.

Gender-blind land use management will have another consequence: it may undermine ecologically sound traditional agricultural knowledge, which largely women possess. Women, as the most important food producers of the upland (highland /slope land) environments of Asia, are directly dependent on healthy environment. It may be recognized that not only that mountain women are conscious of this dependence, but

they also acquire deeper knowledge of their environment, soil conditions and production systems. Womens' agricultural methods, practised successfully for over centuries in countries like India and China, adapt to the environment and are sustainable. The knowledge and experience of generations permit women to have great flexibility in cropping practices.

For centuries women have gathered forest products. This remains an important activity for ethnic mountain communities (some like to call tribal societies) of India. Women folk of swidden farming systems are a good example. For others, the time spent in forests, gathering wood, has taught women many uses of plants, not usually known to men- be it providing fiber, food, vegetables, nuts, fruits, medicinal use or any other value. For women, trees and forests are multifunctional, whereas men tend to concentrate on their commercial potential for timber and other goods. Thus from the women perspective trees are sources of three Fs- fuel, food and fodder- with almost equally significance

Brief narratives of following two case studies are provided to further emphasize the need for making women the main partners for forest management in the mountains. The first study reveals a success story of forest management by women of a highland village in the Indian Himalaya and the second story is a case of failure to incorporate gender concerns in strategies for transforming hill production systems and the consequences on land use.

Experiences from all over the world show that women, despite their long and arduous working schedule have a great interest in defending and restoring the forest ecosystem. India's chipko Andolan movement is a famous example of women protesting against forest destruction. In the Reni forest of the Chamoli district, Uttrakhand, in Indian Himalaya, women were confronted with the prospect of 2500 trees being destroyed by commercial enterprise. The women were alone, for their men had migrated for labor and other services to the lowlands. The women confronted the contractors, by joining the hands and encircling the trees (chipko mean to hug). The women told the cutters that before cutting trees, they would first have to cut their heads. The contractors withdrew , forests were saved; but more significantly the women's action had given birth to a save forest movement- Chipko Andolan- which later spread into the Indian Himalayas- finally leading to fifteen year ban on commercial felling of trees in this region and now abolition of forest contractor system.

So wide was the impact of Chipko- that when women of a mountain village, Duagara Paiteli, learnt hat their community forest had been sold by the male-dominated panchayat (a village institution) to become a potato farm, they joined hands and protested together. Village men believed they would become employed on the farm and that many improvements, such as road, market access, would result from the project. But the issue turned wives against husbands and mothers against sons. The women refused to walk the extra five kilometres each day to fetch fuel and fodder. Inspite of strong opposition and threats from their men folk and the district administration, the women eventually saved the forest.

Village Gadkharkh, settled on the steep slopes in the remote mountains of Garhwal Himalaya at 1266m elevation, has 25 households and a population of 200. Grain yields from the marginal farmlands are hardly able to feed the family members, so most menfolk have to migrate to low lands looking for labor work and there are barely 20 men in the village to share the male work. In practical terms most house holds have become female headed, where women bear the multiple burden of tending the fields, domestic animals and carrying out other normal domestic chores of fire wood and fodder collection, cooking etc. As deforestation proceeds, the struggle to find head loads grows bitter and more arduous. Ban on tree felling- even broad leaved trees- has deprived them of feed for their draught animals, fuel for their ovens and water in the springs. Compelled by these circumstances, all village women formed a women's forum. These village women took up the issue of forest rights- and took over the management of panchayat forest (CPR) on their own- stating that when men governed the forest, it was destroyed: therefore, we have taken the responsibility for protecting the jungle into our own hands.

Initially the strategy was to protect the remaining forest- but later they were able to replant as well. Later, the women's forest was open for fodder grass and fuel wood to meet the domestic needs of the families. To save fuel- energy efficient smokeless ovens were brought in and use of pressure cookers was encouraged. Since then village women are now managing the forest well and the success of it has been picked up by other surrounding villages with similar problems. So the degraded forests on the sloping mountain terrains are once again regenerating, with efforts of women.

The Value of Incorporating Traditional Knowledge of Hill Farmers into modern technological options

Folk knowledge can be broadly defined as the traditional art and science of resource management and production evolved and inherited by rural communities through informal experimentation (Jodha 1986). The term can be used interchangeably with indigenous technical knowledge (ITK) , rural people's knowledge (RPK), traditional farming technologies and so on. Findings of a case study by Jodha and Partap (1992) are presented in this section which compare and contrast folk knowledge system to highlight its value for evolving resource management practices that will be most appropriate to a particular location, watershed, farming culture and agroecological zone.

The study finds that despite their greater suitability and relevance, farmers traditional resource management practices are losing their efficacy and feasibility in the face of changing demographics, institutions and technology. However, the rationale, if not the form of, of traditional technologies is relevant even today for they constitute potentially ideal input for modern research and development in mountain agriculture. The study indicates the steps necessary to facilitate the use of traditional knowledge in generating more relevant modern technologies for mountain agriculture.

Folk knowledge systems can be seen in a number of different practices. Each in responsive to the conditions of fragility and diversity found in mountain areas. Each represents a technological adaptation to farmers' aims. The following section highlights measures directed to all dimensions concerning hill farming and resource management.

Hill farmers land classification systems in mountain areas often relates to the degree of marginality. This may be simply in relation to elevation or through water availability or in relation to the number of stones found in mountain fields. Farmers make use of the differential availability of resources up and down slopes, requiring an approach to agriculture that rations the use of resources and diversifies activities on a location basis.

Similarly, hill farmers manage soils in different zones differently using a variety of indigenous techniques. Zero tillage under shifting cultivation and low ploughing frequency is practiced on fallow lands in the highland cold arid agroecological zone. This may be complimented by the management of snow (Lahul, Ladakh). Manure and composting practice differs in different agroclimatic zones. Fertility is major constraint of the Himalayan agricultural systems. Here lack of manure for soil fertilization may result in a shift to crop rotation or other fertility management practices, such as composting or plant centered green manuring. In some place farmers practice land resting due to long term declines in soil fertility.

Water is often limiting factor in mountain agriculture, its conservation and use regulation are key elements of adjustment strategies observed throughout the Himalayan zone. These include; the selection of appropriate locations for fields to conserve water moisture, the harvesting of spring water, the building of water channels, the development of cave tanks (shiwaliks), the construction of low cost irrigation systems etc. Mountain farmers have also evolved community level solutions to water management problems in many areas.

Inter cropping is widely seen as an approach to local resource regeneration and diversification. A range of intercropping systems can be found from standard systems of the Indian Himalaya to those involving legumes, relay cropping with maize to growing different crops of varying maturity together. Similarly a range of effective grain storage technologies are in practice in the highlands of trans Himalaya. Crop diversity is maintained by hill farmers, as crops are grown in a variety of agroecological conditions in a diversity of niches. Harsh selection pressures in this marginal environment result in a high level of crop genetic diversity in the mountain areas. There is thus a diverse and well adapted selection of seed varieties to be found.

In fragile and marginal zones, livestock often dominates the farming system. Diversified and integrated livestock farming activities are oriented to the extensive use of land with resultant high total system productivity. Animal migration and transhumance in the mountain areas is a response to local resource conditions and seasonal scarcity. Migration and transhumance allows the extensive use of natural regenerative process, the management of risk through movement options, and the exploitation of vertical and horizontal spatial linkages created by mountain areas' diverse landscapes.

Although **traditional practices reflect a complimentarity** of resource – centered and product centered technologies, they can be spelled out separately, the key feature of folk agronomy or traditional practices being their local resource orientation. In terms of resource usage, they emphasise diversification, flexibility and linkages or complementarities (eg. Between farming and forestry) . Different mountain conditions, such as inaccessibility, fragility and diversity tend to reinforce these conditions. Finally, most traditional practices are focused on productivity and the stability of the total system, rather than on individual components.

Seven Features of mountain relevant technologies

Seven central features that can make technology more relevant to mountain conditions are discussed here.

Resource and product centered technologies : complementary use of resource-centered and product centered technologies is a key feature of traditional farming systems in mountains. In fact, they represent two facets of the same process of survival and growth evolved by the mountain communities. As mentioned earlier, traditional technologies reflect a two way adaptation process, where either human activities are adapted to the specific conditions of mountain resources, or the latter are amended, upgraded and managed in a way to suit the human activities. Favouring the low intensity land use systems (e.g. pasture based livestock farming) to suit fragile and marginal mountain areas on the one hand and upgrading these resources through terracing and community irrigation systems on the other, are illustrations of the two way adaptations. In contrast modern technologies reflect a blend of independent development of crop and resource centered technologies, rather than focusing on blending them as an integral package.

Resource Centered Technologies: The traditional technologies relating to mountain / hill agriculture focus on different aspects of resources, such as their protection, conservation, upkeep, and diversified usage. They involve not only specific mechanical or biological treatment of resources but also resource based activities which besides adding to crop production, contribute to the health of the base itself. IN particular the practices involve regeneration, protection, conservation through terracing, ridging, upgrading or recycling of organic matter, farming forestry linkages etc. Te resource management practices under the traditional systems largely depend on local input (incliding regenerating, recycling, and complementarities of horizontally, vertically, and temporally linked systems of mountain resources) at the farm, village or watershed level.

However, within the modern technologies there is hardly any scope for recycling, regeneration and the primacy of local resources (as in the use of spatial and temporal resource linkages). This is largely because modern R&D is often designed to suit experimental and administrative convenience so it undermines the resource base. A lack of total system consideration means that the elements that help sustain the mountain resources and its productivity are ignored. Further, while modern R&D focuses on quick growth (e.g. by using chemical fertilizers and pesticides) the traditional measures involving natural resource regeneration, recycling, harnessing of diversities etc are much slow but sustainable.

Diversity and diversification:

The poverty alleviation efforts in hills and mountain areas have not worked well for several reasons. Without investment in the resource base of the people with expanding populations the expectations can only be progressive extension of poverty and degradation on which they depend for a large part of their sustenance. In agriculture, inappropriate research has been blamed for not taking into account indigenous knowledge and the opportunities and constraints, which apply to the site-specific characteristics of hills and mountains under diverse agro ecological regimes. For those living in hills and mountain areas the critical importance of income in poverty alleviation needs to dictate the research focus on; food and non-food products; opportunities and constraints to off-farm sources of earnings and productivity from non farm land resources.

Recommendations for reshaping agricultural research efforts to meet the needs of hill/ mountain agriculture are;

- → emphasis on sharpening strategic focus on poverty alleviation, particularly in setting priorities for research related to sloping lands.
- → establishing new forms of partnership in order to effectively address their role in a broader poverty alleviation strategy related to those who live in mountains.
- → poverty reduction requires focusing on an array of sources of income that goes beyond agriculture.
- → including participatory research, gender analysis for technology development and institutional innovations for on- farm and off farm employment.

→ Research on the extent and magnitude of the impacts of marginal land agriculture on the degradation of natural resources, production, and food security
→ the linkages between poverty and resource degradation.
→ Studies to enhance understanding of the intricate process of poverty and marginal lands degradation.
→ targeted research on marginal uplands at the eco-regional level

Need for new thinking towards mountain/ hill agriculture

The sustainability prospects for mountain agriculture remain bleak unless the main stream perceptions about the problems are not changed. While the former perceptions view marginal mountain lands as a constraint, but thinking from the mountain perspective, physical marginality is an inherent feature of the mountains. The civilizations living here for centuries searched for niches and harnessed these to adapt to the local environment. Fruit farming on marginal farmland in Himachal Pradesh, cardamom plantations in the forests as well as conversion of sloping farmlands into forests for planting cardamom, and afforestation of support land with seabuckthorn in China, in all the three cases the technological options reflect understanding and incorporation of niche perspective. In these examples, marginal land was adopted as a given condition and agricultural development options were searched accordingly. Common elements of the success stories were protection and productive use of marginal farmlands and support land, soil and water management and harnessing of location specific niches--- the comparative advantage.

The three examples convey a message that marginal lands are not constraints to food and economic security of hill farmers if appropriate technological choices are made, and these lands have specific niches (comparative advantages). A proper understanding of the niches can provide clue to the potentials of marginal lands under given agroecological environment. The three success stories, narrated earlier, use perennial plantations of different types with equal advantage- be it apples or cardamom or wild shrub- seabuckthorn. All three experiences are an example of combining economic sustainability with ecological stability of the landscape and local environment.

The technical approaches reveal promising scopes for diversification of mountain agriculture to perennial plants based production systems. While making use of marginal sloping lands fruit farming enhances farmers access to more farmland. Cardamom farming highlights two points, one is that local biodiversity can be a good source of niche based crops for marginal lands. The perspective behind the marginal crops is that these are the plant resources adapted to prevailing edaphic and climatic conditions of marginal lands. These may not be the crops coming from experimental stations of research institutions but local plants whose economic potentials have been determined by the market or industry. Seabuckthorn story provides insights to technological scopes for combining soil and water conservation efforts on marginal and fragile land with food security and poverty alleviation. Seabuckthorn case is a unique example which explains that forestry systems can be designed in such a way that while serving the purpose of good forests they can also provide benefits of horticulture plantation to local people. Seabuckthorn initiative also explains how forests can be made to serve as fruit trees farming in terms of offering livelihood opportunities.

The experiences described above add a new dimension to the thinking process about linking marginal mountain land management to improving livelihoods. The trends unfolded by these case examples, define a role for the biodiversity /agrobiodiversity in

enhancing use value of marginal land for sustainable mountain development strategies. Albiet in other contexts, scholars have indicated the need for adopting this alternative land use perspective (Scherr et. al., 1995; Jodha, 1992, 1997; Rhoades, 1997; Critchley and Reij, 1996; Partap 1997).

The Himalayan region state seem to be half way through to develop potentials of the agricultural niches of their respective states. New roles are envisaged for Governments and NGOs for designing and implementing strategies.

Institutions and agencies interested in investing in the food security and poverty alleviation of the farming communities inhabiting hills and mountains may find that UNCED Agenda 21, has indicated that any further hopes for improving food security, specially among the marginal societies of the world, lie in improving the productivity of marginal lands,(slope land and highlands included), using approaches that ensure sustainability of production systems. Diverting efforts to find productive and sustainable use of marginal lands under different agricultural systems is thus a major challenge before research and development institutions working in mountain areas.

For upland poverty reduction, contextual specificity in technology generation is actually the key to targeting agricultural technology research. Focusing the research on technological innovations would be an effective way of achieving the goals. Finally, if we believe that there has been an initial under investment in technological research for improving hill agriculture, then there exists an opportunity for developing the uncaptured potentials of hill agriculture.

- The evidence indicating (Partap, 1998; 1999) that there are mountain areas that may in fact have a significant potential for research-driven productivity increases, and that the returns on investment in these areas may even surpass favoured areas. Targeting of resources on these uplands should consequently help the allocation of resources in terms of productivity gains (Ladakh and Lahul and Spiti highland are such potential areas).

- While deciding research investments for hill mountain agriculture, the comparative advantage of the sub regions and landscapes need to be carefully established. Evidence gathered so far points at the potential of agro-forestry, and of the production of cash crops. These options help harness the niches with comparative advantage. In their efforts to reduce poverty in uplands/ hills/ mountains/ highlands, the international research and development agencies need to consider extending their current programmes to include activities with high potential for poverty reduction among the hill farmers.
- Increased attention to hill agriculture research in relation to water, infrastructure development and markets. So, it is important to address water—land---poverty linkages, which goes beyond soil conservation projects. Water insecurity appears to be a main poverty feature in uplands, where sloping lands dominate. It will be important to have area wise better understanding of the supply and demand of water, how to tide over water scarcity through managing excess availability. Water excess is as much a cause factor of degradation, as its scarcity.
- Extensive research on how to use mountain land resources productively and in sustainable ways, requires new knowledge about technological possibilities. The production niches and biodiversity have potentials to convert marginal uplands into productive productions systems.

Practical needs of the hill farmers for survival and strategic national interests in environmental conservation should ultimately attract institutional initiatives, local political commitment and national support to evolve approaches on ecologically sound and economically desirable hill agriculture.

- New roles are envisaged for Governments and NGOs for designing and implementing new strategies. Governments may need to formulate policies favouring use of marginal uplands for certain types of agricultural production systems that can support livelihoods of local people. More secure land rights may be one of the necessary preconditions to stimulate investments among farmers. Investments will also be required in research technology and development to create a basket of choices of suitable production systems capturing every niche of diverse

- Consideration of a mountain perspective that is essential for formulating mountain responsive development strategies, giving due consideration to the nature of marginality, fragility, diversity and niches of each area. It will not only help ameliorate the impact of marginalisation of mountain communities but also in achieving social equity by building on the comparative advantages of key land resources, specially sloping lands.
- It is important to recognize that development issues in the hills, such as sustainable livelihoods, hill agriculture, poverty, marginal and fragile environments, gender and inaccessibility are intertwined and call for an integrated development approach.
- Synergy between national interest and local needs with hierarchies of interventions to achieve consistency in implementation of NRM and development programmes needs to be created. It calls for recognizing roles of different stakeholders.
- An enabling policy environment is essential in order to recognize and strengthen potentials developed at the grass root's level and to encourage people-based initiatives in different areas.
- Policy support is also needed in order to promote research and development into niche based products, market opportunities, harnessing indigenous knowledge systems, and ensuring intellectual property rights to tribal and ethnic communities.
- Farming alone is unable to meet the food and livelihood needs of the families inhabiting hills/ mountains; therefore they employ multiple livelihood strategies through diversification of household activities. However, these options are also giving diminishing returns and hill farmers are looking for new alternatives.
- It has been increasingly recognized that marginal lands will have to play an important role in ensuring the food security of hill farmers. This will require decentralized and innovative approaches for diversifying crop production.
- It is evident that subsistence agriculture is undergoing transformation in several areas in the uplands, more and more people are benefiting from crop diversification, horticulture farming and other high value cash crop. However, diversification is not feasible without addressing the issues of food security in terms of availability of food, purchasing power, and efficient distribution system.
- There is potential for skill-based enterprises. However, these need to have an upland orientation with emphasis on value addition of niche based products.
- The significant trend witnessed by the Asian uplands in recent times is the change in demographic patterns (growing younger population and increased male out migration in search of cash income opportunities in the cities, both within the countries of the region and beyond. This has led to a shortage of men in the labour force and increasing farming related work load for women.
- While intensification of agriculture is continuing with expansion of cropped lands, marginalized farmers have limited access to agricultural technologies and inputs and this in turn is contributing to the decreasing productivity of hill farms.
- Breakdown of isolation and opening up of hills/ mountains to the wider market economy have both positive and negative impacts on the NRM and livelihoods of small hill/ mountain farmers. However, because of the strong highland-lowland linkages, these areas cannot be

looked at in isolation. Important challenge is to identify the different linkages and develop the comparative advantages that these areas offer.

- In the absence of appropriate NRM strategies on the part of the governments, conflicts of interest regarding use of natural resources are growing between the state and ethnic minorities, which are largely dependent on these resources for their survival.
- Although commercialization of forest products can help mountain communities achieve sustainable livelihoods but for maintaining sustainable use of these bio resources, institutional steps are needed to maintain the balance.
- Problem is not only of degradation of natural resources but also of continuation of improper management. Equally important is the need for transparent and well- articulated policy framework for the use of hill resources so as to ensure increased investment with proven strategies for regeneration of resources.
- Undesirable land use changes and natural resource degradation in many hill / mountain/ areas are a result of long political turmoil in these areas. Peace and political stability appears a precondition for rational and equitable use of the resources.
- Unclear land rights and inappropriate land use policies have often led to land use patterns that have endangered biodiversity and damaged environment.
- There is a growing recognition that development efforts should ensure gender equity through mainstreaming gender needs and concerns.
- It is being recognized that diversification of hill/ mountain agriculture can provide better choices and quality options for sustaining livelihoods of hill farmers dependent on sloping lands. But what is necessary in this process is to develop a clear understanding of the ecologically and economically sustainable farming options. There have been instances of successful infusion of environmental and development goals, as shown by the success stories and similar approaches need to be promoted.
- Even though hill/ mountain production systems are becoming increasingly unsustainable both economically and ecologically, yet the national policy makers have not been sufficiently sensitive to the specific upland conditions and constraints faced by up landers in coming out of the poverty trap.
- At national level there has been a general lack of recognition of the niches that hilly and mountain areas offer to increase income generation opportunities without any serious damage to environment. Therefore, there has been lack of appropriate policies to promote such activities.
- National, provincial and local governments should evolve specific strategies, policies and programmes to foster faster growth by facilitating diversification of hill/ mountain farming from subsistence food crop centered production patterns to production for the market based on comparative advantages.
- Changes are needed in law where it denies access to and use of sloping land resources that are basic to the livelihoods of local people. Shifting cultivators and agro-pastoral communities need that attention more than any one else.
- SWNM strategies largely focusing on soil aspect need to reorient focus to give more attention to managing access and scarcity of water for hill farming. Investments in low cost farmer friendly technologies for rainwater harvesting will be most welcome step.
- R&D support is required for identifying the existing and potential niches of hill / mountain farming under different agro-ecological zones and microclimates.
- Initiatives focusing on inter country transfer of knowledge and information about successful technological and institutional innovations is needed.
- Research and development efforts are required to develop products and technologies in which hills/ mountains have comparative advantage.
- It is necessary that appropriate combination of use and regeneration of natural resources is permitted in the hills rather than imposing a ban on use of natural resources.

- High priority needs to be given to efforts to develop human resources appropriate to use of opportunities offered by improvement in access and greater penetration of markets into hilly areas in the process of globalisation.

- **Most important of all To have a better understanding of the present scenario of unsustainability of mountain / hill agriculture, probably there is much need to undertake a nation wide fresh study, on all dimensions of unsustainability of hill and mountain agriculture and livelihoods and how hill, mountain and highland farmers are coping with the situation to make a living.**

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