THE COMMON PROPERTY RESOURCES : THEIR CRISIS AND SUSTAINABILITY

IMPLICATIONS TO MOUNTAIN AGRICULTURE [1]

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I. INTRODUCTION

The common property resources (CPRs), in general, refer to those natural resource base which are collectively used/managed by communities or villages. These resources include forest, pastureland, grazing land, river/rivulet bank etc. In many cases, however, it becomes extremely difficult to delineate or separate them from each other especially from its utility point of view. Forest, for instance, is used for extraction of not only fuel, wood, timber but it also serve the purpose of grazing land in lower hills/mountains and pastureland in the high hills/mountains.

Ownership of the CPRs is now more complex than it used to be in the past. Though several governments or states own the most area under CPRs, village, community, and a cluster of households (10-15) within the village also command certain authority over the usage/management of the CPRs. However, the legal right of ownership of CPRs is presently more unclear.

The CPRs are the source of multiple products that are required particularly for the support of rural life, and it is more so especially in the hills and mountains which is characterised by 'closed system' because of its isolation or inaccessibility. Operationally it means the linkages with outsiders is

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minimum. Agriculture is the dominant activity in the region and its sustenance very much depends on the status of the CPRs because of the 'closed system'. The reason is that it helps to generate essential inputs required for performing various farming activities such as compost, fodder, fuelwood, timber etc within the system. In addition, the CPRs help to create non-farm activities by providing various plant materials (e.g. herbs, medicinal plants, bamboo, fibres etc.) as input materials for making basket, cloth weaving etc. Yet the contribution of CPRs was never appreciated in a meaningful manner. In fact, there is no or little attempt is made for its quantification and valued in money terms. The CPRs are always treated as 'free goods' which, therefore, never compelled concerned policy/decision makers to draw their proper attention on the resources. Even if some attempts were found to have made for proper management of CPRs that emerged out of lack of full understanding of inherent linkages among crops, livestock, forestry/pastureland or the CPRs. Therefore they never turned out be effective.

Consequently over the time the CPRs is degrading both qualitatively and quantitatively and this led to emerge the unsustainability of mountain agriculture. See Figure - 1 for schematic diagram of conceptual model of Mountain Farming System. This is reflected by the presence of negative changes which are also called "indicators of unsustainability" such as increased landslides, soil erosion, gully formation, decreased availability of input materials (e.g. compost, fodder etc.) needed for farming and thus leading to declined crop yields and livestock productivity, increased hunger gap period, reduced level of water resources, increased rate of out-migration and so on.

This paper attempts to examine the role of CPRs in mountain agriculture and draw the sustainability implications of the same in the situation when the CPRs are degrading. This examination is based on some of the case studies conducted in selected areas of the HKH Region like in India, Nepal, Pakistan, and China. Because of greater accessibility to information (with more details), however, most findings and information have been drawn from Nepal case study.

II. DATA BASE

Information presented in this paper are generated from ICIMOD sponsored various case studies conducted in the middle hills of Nepal, Garhwal hills of India, Lhasa (Tibet) and West Sichuan of China, and Chitral district of Pakistan (see Table - 1 for a brief information and also see location map). Mainly RRA method was adopted for the generation of information. Altogether 6 villages in Nepal, 8 villages in India, 3 villages each in Chitral, Pakistan and West Sichuan, China cases were studied. These are related to micro based information.

In addition, other macro based information have also been pooled or referred based on their accessibility to information.

III. COMMON PROPERTY RESOURCES : WHAT FOR?

The contribution of CPRs to rural economy is immense though it is in declining trend due to the degradation of the resources. It is, in fact, a major source of inputs that are required for farming (e.g. crops, livestock) and the sustenance of life support. People not only extract fodder, fuelwood and compost but they largely depend on CPRs for timber and woods that are required for repair/maintenance and construction of new farm tools. Table - 2 provides the contribution of CPRs in the form of various products.

In addition, the CPRs also generate major off-farm employment opportunities and income by providing various plants and plant materials that are necessary for making basket and several other household utilities, fibre for weaving and so on. Herbs and medicinal plants which are available in the forest earns hard cash income. Due to lack of information, this aspect of the CPRs, however, is not discussed here.

The CPRs, in fact, do provide employment in such a time when other employment opportunities do not much prevail. During this time, farmers collect fuelwoods and also sell in the market for hard cash, although this type of opportunity is diminishing slowly.

IV. CPRs IN CRISIS

Forest, pasture, grazing land are the three major source of CPRs that are both extensively and intensively used. But because of various reasons area under these resources is declining.

Table - 3 depicts how the CPRs in two sub-watershed areas of Nepal middle hills have been reduced by almost half over the time period of some 40 years (1954-1991). Whereas the Table - 4 presents the information about not only the area under CPRS has been declined but the reduced size of CPRs has also been qualitatively declined in various study sites of the two sub-watershed areas. In all of the study villages, the vegetative cover in the available CPRs has been reduced by one-fifth to one-third over the last 40 years or so.

One can realise both physical as well as biological degradation of CPRs in the study sites. Its economic consequences will be discussed later. In Tauthali sub-watershed the area under forest and pastureland has been reduced by more than three-fourth of its size between 1954-1991. Whereas it is above 20 percent in Singhuwa sub-watershed area over the same time period. Relatively this small proportion of reduction in the area is due to unavailability of large area (above 25 ha) under shrub/grazing land before 1954. Probably there were only good forests then which

deteoriated later and the same were converted into shrubland/or grazing land. There has also been taken place the erosion of biological diversity. For instance, people in the past (30-40 years ago) used to fetch good fodder of various (8) types and many of them used to be from leguminous species. But now one can get only 2 or 3 types of fodder trees in the forest/shrubland. Similar is the case with fuelwood and timber. People then not only used to bring a load of green cut grasses quicker within (1-2 hours) but they also used to collect various types of nutritious grasses (Table - 4). Today it takes more than 4 or 5 hours to fetch a load of fodder/compost whereas the fuelwood fetching time has increased from 4 to 8 hours and in many cases it takes more than 10 hours (See Table - 5).

V. SUSTAINABILITY IMPLICATIONS TO MOUNTAIN AGRICULTURE

The first victim of the degradation of CPRs is the agriculture and the farm community in the hills and mountains. Because it is obvious from the above discussion (section - III) which has clearly illustrated that the most and direct beneficiaries of CPRs is the farming activities (e.g. crops, livestock). Due to the declined productivity of CPRs along with its reduced size, supply of farm inputs (e.g. fodder, compost, bedding materials etc.) have been much reduced. Consequently, the sustainability of mountain agriculture has been heavily questioned. These are reflected by the increasing trend of negative changes in mountain agriculture and mountain habitat itself.

Indicators of Unsustainability in Mountain Agriculture: Outcomes of Common Property Under Stress

Altogether some 50 indicators related to the biophysical and socioeconomic aspects of the study areas have been identified, analysed, and documented for both Tauthali and Singhuwa sub-watershed areas of Nepal.

Compared to 30 or 40 years ago the sub-watershed areas seem to have undergone tremendous changes. The changes which relate to the biophysical and socioeconomic conditions of the areas can be both positive and negative However, most changes so far recorded are negative and can be considered as indicators of unsustainability. All these indicators have been grouped under three major categories. They are resource base, production flow, and utilisation and management.

These three broad categories are further classified into two sub-categories, i.e., visible and concealed. Landslides, gully formation, river-cutting, emergence of stones/rocks in cultivated land are some examples of visible changes, whereas the concealed negative changes can be understood only after analysing the situation of the areas. These indicators include increased rate of land fragmentation, increased time for fetching products and by-products of forests and pasturelands, increased hunger gap period, increased rate of out-migration, etc.

ICIMOD, MFS Discussion paper series - 32 (Shrestha, S. 1992) has been referred for such detail information on the indicators of unsustainability. In this present paper only some examples of the indicators are presented in Table - 5.

The intensity of physical degradation is increasing. Landslides, for instance, have been accentuated both in terms of spatial and temporal dimensions. The trend of physical degradation is the same whether it is in West Sichuan (China), Garhwal (India), Chitral area (Pakistan) or in the middle hills of Nepal. Only the difference is in its magnitude.

It should be noted down here that we are not trying to advocate that the whole range of negative changes should be attributed to the degradation of CPRs. What we are trying to say is that the CPRs under stress have contributed to these negative changes in mountain agriculture and its habitat.

The most noticeable visible changes in the Tauthali sub-watershed area of Nepal are the land degradation in the form of landslides and gully formations, which were either non-existent or little observed in 1954 (based on 1954 topo sheet map of Nepal), and which are now distinct and conspicious even from a far distance. The total area affected by landslides is estimated at 30 ha which constitutes 1.0 per cent of the total sub-watershed area whereas the actual study village site occupy only about half of the total area. Because of population growth and other socioeconomic factors, the net area under cultivated land is increasing rapidly at the expense of common and support land whereas land fragmentation has increased by 30 per cent and the size of parcels has decreased by about 20 per cent. Over the last 30 or 40 years, three-fourths of the total forest land has been cleared and grazing/pastureland has almost disappeared. Consequently, forests are now further away from villages which is reflected in the increased fetching time of fodder, compost, fuelwood, etc. if at all they are available. These changing circumstances have adversely affected farming; most major cereal crop yields have declined by 10 to 50 per cent, and livestock productivity, too, has decreased. Consequently, on an average, people produce enough foodgrains only for about six months now as compared to seven months in the past. Because of the degraded resource base and declining agricultural productivity, out-migration has increased tremendously. In a village like Chhipi gaon up to 20 per cent of the total households were found to have migrated permanently in search of their livelihood. Seasonal migration for off-farm employment is tremendous. At least two-thirds of the adults (particularly male) leave their home for employment in the Tauthali sub-watershed. This is the reason why there is an imbalance in the ratio of male and female population in the village in favour of the latter. This situation also affected farming due to shortage of labour. This trend is similar in other parts of HK-H Region.

The quantification of indicators is not an easy task. Therefore serious and time-consuming efforts were made in this direction. Toposheet maps and aerial photographs of Nepal were used substantially to estimate over time changes, particularly in the case of physical degradation. Various

published reports and documents were reviewed for the quantification of these indicators. However, the most conspicuous contributions were made by the local people and the farmers themselves who comprehensively and meticulously helped in this exercise.

The indicators of unsustainability ultimately manifest various forms of degradation which can be realised through reduced quality and range of options. They are discussed as follows:

Reduced Quality and Range of Options

Food Production and Consumption

On an average, the foodgrains produced by each household will suffice only for about six months now as compared to more than seven months in the past (about 20 or 30 years ago) in the Tauthali watershed area. In addition, the proportion of households producing enough foodgrains to meet a whole year's consumption needs has declined in Tauthali watershed area. This decline is estimated to be around 50 per cent. The proportion of such deficit producers has increased from 30 per cent in the past to 50 per cent at present, whereas the proportion of surplus (or adequate for their own consumption) producers is declining (e.g., from 20 to 10%).

A time series of per capita food production per year has been estimated for Sindhupalchowk district based on DFAMS (1990), Economic Analysis and Planning Division (1972), DFAMS (1977), DFAMS (1984), CBS (1984), CBS (1990), and CBS (1991). This estimation shows that the per capita food production has decreased from 163 kg in 1967/68 to 138 kg in 1988/89. Surprisingly, the rate of decline, based on the official data and the local people's own estimation coincided exactly, i.e., 15 per cent. Quality-wise also, foodgrains available for consumption appear to have declined. Local people remembered a time when people used to reject foodgrains imported from the plains on the grounds that they were not as tasty and nutritious as foodgrains produced locally. Local wheat, rice, maize, and buckwheat are rich in amino acids and other essential minerals required for human growth. People in the Muga area of Singhuwa watershed explained in a simple manner that now there is no choice but to eat parboiled rice imported from the *terai*. On an average, each household purchases about 25 to 30 per cent of the total foodgrain required from the market.

Similarly, the hunger gap period has increased from 2 to 4 months in West Sichuan. Crop yields have increased but the import of foodgrain is increasing in Lhasa (Tibet) due to increased population growth. Unprecedently, more than 50% foodgrain are being imported in Garhwal Hills due to reduction in food grain availability (Table - 5).

Fuelwood

First of all, the consumption rate (about 484 kg per capita per year) of fuelwood is already low (only 75 per cent of the national average) in the central development region (CDR of Nepal) in which the study areas belong to. On an average, the per capita consumption rate may vary between 200 to 300 kg in both the watershed area, which is only about half of the CDR average. Gairi gaon presents a rather pathetic situation of fuelwood/firewood scarcity. The estimated figure (145 kg per capita consumption) for the site is only one-third of the CDR average figure. Not only has the quantity fuelwood used decreased but, more importantly, the quality of fuelwood is also poor.

Fuelwood derived from forests was the major source in the past and accounted for about 65 per cent and over 80 per cent of the total fuelwood in Singhuwa and Tauthali respectively. The current corresponding figures are 45 per cent and 10 per cent respectively. People nowadays use more and more twigs and fodder branches as firewood, and this has increased from about 20 per cent in the past to 70 per cent in Chhipi gaon and 80 per cent in the Tauthali village of Tauthali sub-watershed. Good quality fuelwood constitutes only 20 to 30 per cent of the total firewood/fuelwood consumption. The use of crop residues (mainly maize straw) as fuel has doubled over the last 30 or 40 years, and people have also started purchasing fuelwood for Rs. 300 to 1,200 per tree depending on the size of the tree. Such sources now constitute about one-third of the total fuelwood/firewood used.

The scarcity of fuelwood has reached in such a critical stage that people are now using *banmara* plants (*Eupatorium sp.*) as firewood. In one of the study sites of Tauthali sub-watershed it accounts for 40 per cent of the total firewood used. The use of this plant as firewood is very unusual throughout the whole country. This is a glaring example of the inferior options that people are compelled to choose.

In some villages of West Sichuan (China) most paddy straw used to be utilised in farming for mulching, composting in the past but now 90% of the straw produced are used for firewood purpose. Similarly yak dung, instead of using it as manure, is now utilised as firewood and it is a major source now in some study villages (Dafu, Yu et.al. 1992). In Lhasa (Tibet), the utilisation intensity of grass roots for firewood purpose is very high which is causing barren land (Yanhua, Liu, 1992). In Garhwal Hills of India, use of lantana plant as firewood has increased by 50% Singh, V. 1992). Also see Table - 5.

Roofing Materials

Khar (*Fragmites, Sachharum, Erianthus sp.*) is a traditional plant material used for roofing and it lasts for five years. At present, due to its non-availability, people are using wheat straw as roofing

material. In Tauthali village the roofs of 60 per cent of the total households (300) are made from straw and do not last for more than two or three years. This emerging practice has two major negative implications. Firstly, it has increased labour demand for roofing due to the increased frequency of roofing construction. Secondly, a reduced supply of wheat straw has led to an acute shortage of winter fodder for animals in the hills.

Due to the scarcity of roofing materials, people have also started using the *banmara* plant (*Eupatorium sp.*) as roofing material for cowsheds. This again is an unusual trend for the country as a whole.

Fodder/Bedding Material

Lack of fodder is the main factor affecting livestock production in Nepal(ADB 1982) and more so in the middle hills (Rajbhandari and Shah 1981; Shrestha and Yadav 1990; and HMG/MOA 1991). Jackson (1985) identifies fodder production as the most important factor for livestock development in order to achieve long-term and sustainable production in the northern Indian hills.

Data collected from field surveys suggest that there are net fodder deficits in all the watershed areas studied. Only half of the total requirement, even for normal (lower) production, is met by supply based on the present utilisation pattern for fodder. Local people argued that they did not have a real problem of fodder supply until 40 years ago. Fodder availability per animal unit is declining each year due to the reduced level of the fodder resource base.

This negative trend is not confined to feed availability. More importantly, there is a decline in the quality of fodder. Most nutrients grasses and fodder trees have disappeared from forests and pastureland. This is the reason why farmers nowadays feed their animals with the leaves of *mauwa (Madhuca latifolia)* and *sal (Shorea robusta)*, which are basically fuelwood and timber trees. Kavro (*Ficus sp.*) is considered to be a good fodder but has now completely disappeared from the forest. Similarly, *banser, ghoge champ (Michelia champaca), khashru (Quercus semecapifolia)*, and *phalant (Quercus glauca)* have also disappeared from Tauthali village and these were also being used as fodder. Traditional green cut-grasses such as *siru (Hypoxis aurea), kans (saccharum spontaneum) furke, pase, salemboj*, which were widely used in the past, are not available now. Due to lack of fodder, some farmers were also seen to feed even *banmara (Eupatorium sp)* plants to their goats; which again is quite an unusual practice even for the middle hills of Nepal. Some 25 years ago, people started using *titepati (Artemisia vulgaris)* as animal feed, mainly for goats, because of the emerging shortage of fodder. When *titepati* also became scarce people started feeding *banmara* plants to the animals. There are no scientific data available in order to compare these two inferior fodder items of quality. Farmers, however, argue that *titepati* is better than *banmara*. Now there are hardly any good fodder trees left in the forest and, hence, people have to manage with inferior sources of fodder. In Garhwal Hills people are now compelled to use

banmara (*Eupatorium sp.*) needle as bedding materials for animals which among others increased acidification of soil and thus cause declined soil fertility. This has been observed in some study villages of Henwal and Bhagirathi catchment areas of Garhwal Hills (Singh, V. 1992).

The newly afforested areas, too, are unlikely to ease the fodder situation in the near future due to predominance of pine tree plantations. It is understood that the total fodder supplies, particularly from CPRs (common property land resources), have decreased by half, both in terms of quantity and quality, over the last 30 or 40 years.

In most cases, due to unavailability, animals nowadays are not provided with bedding materials which otherwise help protect animals from damp during the rainy season and from cold during the winter. Being unable to provide bedding materials has two negative implications. Firstly, extra energy (or resources) will be required to substitute for the bedding materials to protect animals from damp and cold. This will have to come from the energy generated by animal feed, thus further reducing the amount of energy that can be used for productive purposes may drop down by a further 10 per cent. The absence of substitutes may have to switch over from large to small ruminants in order to protect their health in extreme situations. Weslie Combs (1982) has worked on this aspect. The second implication of the non-availability of bedding materials is a decrease in compost materials available for crop farming. Bedding materials, as a part of product recycling, make a substantial contribution to compost production.

Modern science has offered an option to the problem of lack of substitutes for bedding material, polythene or plastic film technology. Animals kept in a shed made from such plastic film, particularly during the cold months, can salvage up to 30 per cent of the total production; otherwise this would be lost in winter. This technology has become very popular in both crop and livestock production in China. Technically, there is no reason why it should not be successful even in Nepal, but its economic viability needs to be assessed.

Compost/Manure

Manure and compost as major sources of soil fertility maintenance are now dwindling in supply. This is the main reason for declining crop yields. Compared to the mid-hill situation, the compost/manure application rate is much smaller in the studied watershed area. The present estimated rate varies from 5 MT to 9 MT per ha of cultivated land with an average rate of 6.6 MT. Compared to the past, there is a net decline of 35 per cent in the application has declined by 40 percent, i.e., from 6.5 MT to only 3.8 MT.

The above discussion clearly suggests that the level of compost/manure application per unit of land has significantly decreased (by two-fifths) over the last 30 or 40 years.

Furthermore, the quality of raw materials used in compost-making has decreased. It is quite obvious that the trend of using inferior quality fodder or bedding materials (if bedding material is available at all), is increasing. In the past, people also used indigenous plant material for making compost, viz, *asuro (Adhtoda vasica), siris (Albizia lebbek),* and *titepati (Artemisia vulgaris),* in addition to other fodder leaves and twigs. These plants contain 4.3 per cent, and 2.9 per cent nitrogen respectively (Khadka et.al. 1987). This means these plants contain six to ten times more nitrogen compared to other normal compost plant materials. These changes suggest that not only has the amount of vital elements for maintaining soil fertility decreased but that the quality has also deteriorated.

Water Resources

No estimation of changes in water resources has been made and this is not an easy task either. Measurement of water tables, analysis of aquifers, and discharge levels of running water are some of the important aspects that need to be addressed. However, there are some indicators which suggest that some negative changes are taking place even in the water resource base. This again indicates the degradation of the resource base of mountain agriculture.

Let us take an example of a *ghatta* - the local name for water mills. Traditionally *ghatta* are used for grinding foodgrains and they save a substantial amount of labour compared to other available means of foodgrain grinding such as the *jaanto*. There is not much difference between these two traditional means of grinding foodgrains in terms of the material (i.e., stones) used and the structure (e.g. two big round plates), including the operational mechanisms (both round stone plates move so that the foodgrains passing through the plates are crushed and ground). The only difference is that *ghatta* run on water energy, whereas the *jaanto* is manually operated. In fact *ghatta* have more positive attributes than *jaanto*. First, the grinding efficiency of *ghatta* is much better, second, the labour saved from the grinding activity can be used in other activities (e.g., farm, non-farm, social, etc.); and third, the *ghatta* can contribute to minimising drudgery for the women who grind foodgrains mainly with the *jaanto*.

Due to the decreased level of water resources, the number of *ghatta* has decreased from 16 to 10 over the last 30 years in the Tauthali watershed. It has also been observed that the number of months that a *ghatta* operates in some villages has decreased from six to five months due to reduced water flow.

In Singhuwa watershed, the people have also reported that about 10 ha of *khet* have been converted into *bari* due to the unavoidability of water for irrigation over the last 40 years. Conlin and Falk (1979) have shown the positive correlationship between possession of *khet* and the level of well-being of the people.

Based on micro level studies, some parts of Garhwal Hill region manifest several negative changes (Dev, S.M. 1992). One of the notable features of change realised is drying up of the water source for drinking purpose. For instance, the water flow of Aati project in Dehradun district was 70 litres per minute (lpm) in 1978 which is now only 5lpm. In Pauri Garhwal district, in Dhumkot Project the calculated flow of 48 lpm has come down to only 5 lpm. Similarly with the Kandaduwa Project in Chamoli district the flow decreased to 12 lpm from 100 lpm. In Uttarkanshi district the flow in Khalsi Project has been reduced to 8 lpm now from 150 lpm in 1973-74. In Tehri district, water sources of as many as 11 drinking water projects constructed in the past one decade have been dried up. Besides Garhwal Hills, which include the above mentioned all districts, the situation is equally bad in Kumaon hills in the central himalaya of India.

VI. WHO ARE LOSING THE MOST FROM THE CPRS CRISIS

Above discussion has clarified that the degradation of CPRs has contributed to emerging trend of unustainability of mountain agriculture which has adversely affected the welfare of the whole mountain communities. But if we examine carefully it is the resource poor farmers who are the real victims of the consequences of the CPRs crisis. These categories refer to marginal and small farmers who own less than 0.5 ha land holding and also partially medium farmers (with 0.51 to less than 1.0 ha land). These farmers consist of more than three-fourth of the total farm households. Resource rich farmers can be considered mainly large farmers who own above one hectare of cultivated land and they also own some non-agriculture land that is allocated for fodder, pasture, fuelwood and for some timber

Table - 6 depicts that the resource poor farmers (RPF) depend more in CPRs than that resource rich farmers (RRF) for compost, fodder, fuelwood, timber and for making and repairing agricultural tools. Livestock production systems plays a major role in such small farm units than the crop production does.

In order to compensate food, income and employment (due to decreased level of outputs owing to small size of land holding). Such farmers (RPF) emphasise on livestock farming which mainly depends on the availability of CPRs rather than on private property resources (PPRs). Therefore, they keep higher number of livestock per unit of land and generate higher ratio of income (Table 7) and employment within the farm resources.

Similarly, the food production (e.g. cereals) is also very much affected in small farm units due to reduced availability of manure and compost materials. In fact, there is vicious circle in the whole mountain farming system. Lesser the fodder supply from CPRs means the smaller size of livestock keeping. This means to the reduced level of manure availability which ultimately contributes to

declined level of food and crop residues production. Crop residue is an important source of animal feed. Hence it will mean to low level of livestock production and then low crop yields and animal feed. This vicious circle and then keeps on oscillating until appropriate interventions break the circle. But again if we take a closer look then every individual farm household or community is not affected in the same manner and pattern. The RRFs are for instance, not affected adversely as much as the RPFs are. Because the former category of farmers are accessible to higher level of options. For instance, besides their own private land (for fodder, compost), they can substitute manure and compost by chemical fertiliser to some extent. And there are evidences that the RRF uses higher dose of chemical fertiliser than the RPFs do.

Consequently, the out-migration for income and employment is much higher with RPFs. They generate about 80 percent of total annual cash income from non-farm activities whereas the RRFs make only 50 percent (Table - 7). Similarly within farm income livestock is the major source (above 50 percent) of cash income for RPFs whereas it is only about 20 percent with RRFs.

If we take a look on other mountaneous parts of the HK-H Region the situation is similar. For instance, in Chitral districts of Pakistan RPFs depend more on CPRs for crops and livestocks farming which is the main occupation in the region. RPFs utilise higher proportion of compost and manure as derivatives of CPRs compared to chemical fertiliser than that by RRFs. Similarly, in case of RPFs the proportion of cash income is greater from livestock which again mainly depend on CPRs for fodder. The cash incomes in farming sector in Besti and Marthing study villages are generated from the sale of livestock and partly from sheep wool (Mulk, 1992).

In general, whether it is in West Sichuan of China, Garhwal hills of India, Chitral area of Pakistan or middle/high hills of Nepal, RPFs are the real victims of the degradation of CPRs. Because the agriculture which heavily depends on CPRs is becoming unsustainable due to increasing negative trend in farming. Consequently the outmigration has increased rapidly which is also corroborated by the present increased ratio of female and male population in rural areas and vice versa in urban areas of Garhwal hills of India[3].

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[3] Proportion of female in total population in Rural and Urban areas of Garhwal Hills (India).

District	Rural (%)	Urban (%)
Uttarkanshi	48	36
Chamoli	52	38
Tehri	53	36
Pauri	55	40

Source: Census, 1981

VII. FACTORS CAUSING DEGRADATION OF CPRs

Four major factors have been identified as contributing to the degradation of CPRs and their resultant consequences realised through the emergence of increasing negative changes in biophysical and socioeconomic aspects of mountain habitat and its people.

Population Dynamics

Nepal's population is rapidly increasing. The annual growth rate was steady in the past. It was estimated at 1.16 per cent in 1941, although it was negative, viz., - 0.13 per cent and -0.17 per cent in 1920 and 1930 respectively (ADB/Manila 1982). From 1950 onwards, the growth rates have increased, i.e., 2.2 per cent for 1952-54 (ADB/Manila 1982) and 2.1 per cent, 2.7 per cent, and 2.08 per cent for 1971, 1981, and 1991 respectively (CBS Nepal).

It is also with all the mountain areas of selected countries of HK-H Region. These areas show high population growth rates. It is interesting to note that the growth rates are higher with all the Himalayan states (8) except Himachal Pradesh compared to that all India average. The compound growth rates ranges from 2.63 percent (Jammu and Kashmir) and 2.59 per cent (Assam) to 4.45 per cent (Nagaland) as against 2.15 per cent (India) for 1951-1991. Similar is the case with NWFP of Pakistan, West Sichuan and Tibet or Lhasa district of China. Chittagong Hill Tracts of Bangladesh records highest growth rate (5.64 per cent) between 1974-81 (See Table - 8).

Time series data on population are not available for the study watershed areas. However, the local people gave quite a reasonable account of population growth for Tauthali village (Nepal). They estimate that there were about 60 households in 1907, increasing to 96 in 1942, and then to about 300 households in 1991.

This pattern of population growth definitely led to the increased pressure on land. Over the last 40 years, 85 per cent of the total common land (e.g., forest, pasture) has been converted into cultivated land in Tauthali watershed. Increased cropping intensity (about 10%) and expansion of the area under cultivation (by 1.5 times) contributed to an increase in total foodgrain production. However, increased population, accompanied by a general decline in crop yields, led to a reduced (by 15%) level of per capita foodgrain production. As mentioned earlier, per capita foodgrain production, in Sindhupalchowk district (Nepal) as a whole, decreased from 163 kg in 1967/68 to 138 kg in 1988/89. This increased demographic pressure has also adversely affected the structural dimension of the land resource base. For instance, land fragmentation has increased by 30 percent (from 5 to 8), the size of parcels of land decreased by 20 pe cent (from 0.05 to 0.04), and distances to parcels of land from the homesteads have increased by 25 per cent (Also see Table - 5).

Higher Degree of Dependency on Agriculture

Traditionally people's dependency on agriculture is very high particularly in the mountain regions. In totality 80-90 percent of total population are still engaged in farming and more than half of the total GDP still comes from this sector in the HK-H Region (See Table - 9). Agriculture sector is yet to be free from its compelling situation to absorb bulk of the increased population though the proportion of people's dependency on it and its share of GDP are slowly being reduced.

When we talk of agriculture that means we will be dealing with not only with crop production but livestock also has to be incorporated in the system. Because livestock provides certain basic inputs (e.g. manure, bullock power etc.) that are essential for crop production. Therefore, total livestock population is also increasing along with the increased area under crops and the cropping intensity which are induced by the increased human population pressure. Whereas, the situation of CPRs are degrading both quantitatively as well as qualitatively. This naturally contributed to increased livestock density per unit of CPRs and also per unit of private land including cropland (Table - 5) and it is more so with poor farmers (Table - 10). In Bestl village of Chitral (Pakistan), if poor farmers earn cash income of Rs. 1864 per year from livestock then medium and rich farmers obtain only Rs. 256 and Rs. 1500 respectively (Mulk, 1992).

Hence the pressure on CPRs will continue till other sectors or sub-sectors of the economy get developed as competent to share the increased pressure released by the increased human population growth.

Technology Dynamics

Agricultural development in most HK-H Region started in the 1960s with the introduction of HYVs without fully understanding 'mountain perspective'. The initial crop yields, accompanied by the use of chemical fertiliser, were very encouraging. But now the yields are declining in many parts of the HK-H Region although improvements have recorded in Lhasa District[4] and in a few villages of Chitral district (Pakistan) areas[5]. But the same researchers have questioned the sustainability of the increased yields if the proper combination of organic and inorganic fertiliser is not made. Not only the supply of fertiliser is erratic but this new technology has undermined the traditional crop

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[4] Yields of wheat, barley and pulses have increased with an annual rate of 3.3 percent, 2.9 percent, and 1.7 percent respectively between 1958 to 1984 (Yanhua, Liu, 1992).

[5] Eight households in Kesu village had given up cultivating marginal land because of increased crop yields due to the provision of chemical fertiliser and improved seeds (Mulk, M. 1992).

livestock management. Leguminous crops cultivation unlike in the past (20-40 years ago) receives low priority in the present cropping systems (Shrestha, S. and Yadav, Y., 1992; Dafu, Y. et.al., 1990; Mulk, M., 1992; Yanhua, Y., 1992; and Shrestha, S. 1992).

The present cropping pattern (cereal crops oriented) is not only contributing to declined soil fertility but it also undermined the traditional system of combining annual and perennial crops (e.g. fodder, fuelwood etc.). This trend will again induce the pressure in CPRs despite the fact the resources have already much deteriorated.

But at the same time it is also true that the introduction of chemical fertiliser has had helped to relieve the pressure on CPRs to some extent. Some local farmers ar convinced that the number of people migrating permanently would have been much larger in Tauthali sub-watershed (one of the study areas in Nepal), had chemical fertiliser not been available. But this strategy, in reality, has only helped to delay the occurrence of serious degradation (Shrestha, S. 1992). Because this strategy has grossly undermined the bio-mass production strategy in private land.

To sum up, inappropriate technologies intervention also indirectly contributed to the degradation of CPRs and erosion of traditional management style of CPRs. Because the introduction of chemical fertiliser brought backlash on the need of CPRs conservation and biomass production strategy on PPRs.

Institutional Dynamics

The nationalisation of Nepal's village forests by the government in 1957 converted a common property regime into state property regime (Bromley, 1986). This nationalisation of forest and pastureland produced a backlash in the context of the land resource base, both in quantitative and qualitative terms. The ratio of forests and agricultural land was 2.8:1 in 1954, it decreased to 0.5:1 in the Tauthali sub-watershed and 0.06:1 in the Singhuwa sub-watershed of Nepal in 1991. John Watt Smith (1982) estimated that 3.5 ha of forest land (2.8 ha for fodder, 0.24 to 0.48 ha for fuelwood, and 0.32 ha for timber) are required for one hectare of agricultural land to sustain current activities. If this estimation is any guide, then supportland (e.g. forest, pasture, etc.) available for carrying out sustained farming activities is far below the requirements in sub-watershed areas. The nationalisation of common land is a major contributing factor for the decline in the land resource base. Many traditional, community based initiatives for the conservation of common land have disappeared. The institutional arrangements are highly constraining (Jodha, 1992). This led to some destruction of the CPRs through the conversion of the resources into cultivated land and haphazard and unhealthy pattern of resource extraction. Because the government rules and orders could not be effective as it was in the traditional management systems. This is further corroborated by the fact that the systems are now being revitalised in particularly some "critical areas" (Shrestha, S. ; and Yadav, Y. 1992).

In Chitral area of Pakistan, the allowance of commercial logging is contributing to the destruction of the forest resource base. Still there are some good forest for their proper harvest. The desire to make "windfall gains" from forest royalties is so widespread and is such a malignant disease that it can only be checked by total banning the cutting of these forests for commercial purposes (Mulk, M. 1992). Similar instances are recorded in many parts of Himachal Pradesh, Garhwal hills of India (Dev, S.M. 1992).

VIII. STRATEGIES FOR IMPROVING CPRs AND CONTRIBUTING TO SUSTAINABILITY OF MOUNTAIN AGRICULTURE

In the present context of persisting trend of degradation of CPRs the following strategies based on both macro and micro perspectives may help promote the usage and management of CPRs in judicial manner. This will ultimately help to contribute to sustainability of mountain agriculture. More importantly, the development/conservation of CPRs will promote or improve the 'equity' aspect. The inclusion of CPR incomes in total household incomes from other sources, reduces the extent of rural income inequalities as indicated by lower value of the Gini-coefficient (Jodha, 1988).

Management of CPRs at Local Level : Community or Village Forestry

These days there are not much arguments on the conservation/management/usage of CPRs at local level is the best and most effective strategy. Attempt from concerned GOs and NGOs are already there in the field in most of the HKH Region. Introduction of community forestry, leasehold forestry in Nepal, joint forest management initiatives in India, social forestry in other country are some of the examples of responses to the proper management of forestry resource base or CPRs. The success of viable institutional options to tackle the common property regimes is guided by the innovation of rules to meet new situations and adaptable to vertically differentiated ecological conditions of mountain ecosystems (Bromley, 1986). Now the User groups of forestry can harness 100% benefit that is generated from the community forestry in Nepal. At the time of introduction of community forestry in 1977/78 it was 75%. Thus, from a programme that was based on government - Panchayat joint management, Nepal moved to a radically community - based programme with no revenue sharing (ICIMOD, 1992 edited by Campbell J. G.; and Denholm, J.). 'Crisis of Confidence' among local people, however, is still prevailing among farmers for responding wholeheartedly to these GOs initiatives. There is still fear that the government may take over forest once it is fully developed, although the degree of fear is much reduced now compared to the past situation.

Despite of this fear people have already initiated the conservation management and proper usage of CPRs at local level in the study areas particularly in the study site (for example in Muga site of

Singhuwa watershed area) where the degradation of CPRs and the status of unsustainability of agriculture is high. This is happening out of 'no option' situation. Local management committee, formed in local people's own initiatives, has already revitalised their traditional management of pastureland by enforcing rotational grazing system instead of haphazard system that caused degradation of pastureland until two years back (Shrestha, S. and Yadav, Y. 1992).

In recent years it has been recognised that there are many places in both Kavre and Sindhupalchowk District of Nepal where local initiatives have led to protection of forest and shrubland resources (e.g., firewood, fodder, leaves for animal bedding) (Fisher, 1989). It has been suggested that this has happened as a response to the shortage of resources (Gilmour, 1987; Fisher et.al. 1989).

Biomass Production Strategy

In the present context of reduced size of CPRs accompanied by increased size of livestock population, its proper management will not be sufficient to meet the demand for fodder, compost, fuelwood etc. Therefore, efforts must also be made to enhance total biomass production in private property resources (PPRs). Combination of annual and perennial crops cultivation should be the major strategy in farmers' field. There are now several local crop technologies which will not only increase grain yields but also the crop residues which is a major source of fodder particularly during winter when the feed scarcity is highest. ICIMOD has made an attempt to explore the agricultural technological options which may not only help improve mountain agriculture but it may also facilitate to reduce the pressure on CPRs and thus enhancing the productivity of the same (ICIMOD - PAC, 1993).

One of the study sites (Ghame in Singhuwa sub-watershed, Nepal) has been progressively/ transforming/from worst/to better situation of agriculture and the improved status of welfare of local community. This has occurred mainly because of farmers' increased emphasis on this very biomass production strategy on PPRs (Shrestha, S. 1992).

Off-farm Employment

Creation of off-farm employment opportunities will help to relieve the pressure on excessive dependency on agriculture. This also can take place when CPRs are improved. Because, the CPRs are the major source of input materials that are essential for basket making, rope/paper making, weaving from natural fibre. Availability of herbs and medicinal plants in forest can bring extra fat income to rural household.

IX. CONCLUSION

Over the time common property resources (CPRs) are persistently degrading both in quantitative and qualitative dimensions. Consequently, the mountain agriculture is becoming unsustainable which is reflected by the emerging trend of negative changes which are also called indicators of unsustainability. Therefore, the overall welfare of mountain communities are adversely affected because agriculture is the dominant activity in the mountain. And more specifically, it is other than the resource poor farmers' (RPFs) who have turned out to be the real victim of CPRs degradation. Because they depend more on CPRs than that resource rich farmers (RRFs) do.

High population growth, excessive dependency on agriculture, inappropriate public interventions (e.g., technological and institutional dynamics) have contributed to this degradation of CPRs and its consequences.

In this context, some pragmatic strategies based on both macro and micro perspective may help promote the usage and management/conservation of CPRs in a judicial manner. To this effect, local people can be the best manager for the management and conservation of CPRs. For this, local people should be fully convinced that the CPRs actually belong to them. They will be accountable or responsible for any positive/or negative outcomes from their management of CPRs. Secondly, the management of CPRs alone is not adequate keeping in view of much reduced size of CPRs accompanied by highly increased livestock population and the increased area under cultivation which demand for higher level of CPRs products for their smooth functioning. Biomass production strategy in private land, and therefore, should be highly promoted. There are already some evidences both in study areas and in other project areas that it will work very effectively. Thirdly, and lastly, promotion of off-farm activities will help to release some pressure on agriculture which very much depends on the status of CPRs. Proper management and conservation of CPRs will, in fact, create some sideline activities since the CPRs may again provide the input materials for basket, rope making, fibre for weaving and herbs and medicinal plants for cash income.

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Table - 1: **Location of Study Sites (where case studies were undertaken) in Selected Areas of Hindu Kush Himalayan (HKH) Region**

S.N.	Country	Province/State/ Zone	District/Country	Sub-watershed	Villages/Study Sites	Total No. of Villages Studied
1.	Nepal	Bagmati	Sindhupalchowk	Tauthali	1. Chhipi gaon 2. Gairi gaon 3. Tauthali	6
		Koshi	Dhankuta	Singhuwa	1. Ghame 2. Muga 3. Deurali	
2.	India	Uttar Pradesh	Tehri Garhwal	Hemral	1. Paturi 2. Palas 3. Jardhar gaon 4. Sawali	8
				Bhagirathi	1. Serain 2. Rajgaon 3. Palash 4. Malidev	
3.	China	Sichuan	Xichang City	-	1. Lijia 2. Bingli	3
			Wenchuan Hongyuan		1. Third Village	
4.	Pakistan	NWFP	Chitral	-	1. Kesu 2. Besti 3. Marthang	3

Note: ICIMOD had commissioned various studies in these selected areas of HK-H Region in 1990/1991.

Table - 2: **Present Extraction Rate of Fodder, Fuelwood, Compost etc. from CPRs vs Cropland in Nepal Case**

kg/Year/Household

	Sub-watershed					
	Tauthali[1]			Singhuwa[1]		
	1	2	3	1	2	3
Fodder						
o CPRs[2]	1,610	220	7,140	13,220	2,850	9,583
o PPRs[3]	8,390	8,905	3,030	22,205	9,405	16,200
o Balance : Surplus (+)/Deficit (-ve) based on demand and supply						
Fuelwood						
o CPRs	620	390	610	980	400	825
o PPRs	540	560	520	850	620	600
Compost						
o CPRs	1,000	400	1,400	4,900	760	3,600
o PPRs	2,900	1,800	500	8,300	2,535	6,100
Timber						
o CPRs	120	90	120	120	90	120
o PPRs	30	60	30	60	60	60
Agri. Tools and Others						
o CPRs	30	20	30	40	20	40
o PPRs	10	20	10	20	10	20

Source: Shrestha, S. (1993) - Dynamics of Unsustainability of Mountain Agriculture, ICIMOD Forthcoming Publishing Document, Kathmandu, Nepal.

Note: 1) No. 1,2,3 indicate the study villages in order as referred to Chhipi gaon, Gairi gaon and Tauthali respectively in Tauthali sub-watershed area where they are Ghame, Muga, and Deurali villages respectively in Singhuwa sub-watershed area.

2) CPRs = Common Property Resources

3) PPRs = Private Property Resources which include both private agricultural and non agricultural land.

Table - 3: Overtime Change in CPRs in Two Sub-watershed Areas of Nepal

		Tauthali Sub-watershed							
		1954		1978		1991		Change (%)	
		ha	%	ha	%	ha	%	(1954-78)	(1954-91)
1.	CPRs (3+4)	2,155	73	1,318	45	984	33	-39	-54
2.	Agriculture	765	27	1,632	55	1,966	67	+133	+157
3.	Shrub/Grazing/ Pastureland	861	29	585	20	265	9	-32	-69
4.	Forest	1,294	44	733	25	719	24	-43	-44
	Total	2,950	100	2,950	100	2,950	100	-	-
		Singhuwa Sub-watershed							
		1954		1978		1991		Change (%)	
		ha	%	ha	%	ha	%	(1954-78)	(1954-91)
1.	CPRs (3+4)	781	44	711	40	672	38	-9	-9
2.	Agriculture	1,011	56	1081	60	1,120	62	+7	+11
3.	Shrub/Grazing/P astureland	-	-	23	1	48	3	+100	+100
4.	Forest	781	44	688	39	624	35	-12	-20
	Total	1,792	100	1,792	100	1,792	100	-	-

Source: Shrestha, S. (1992) - Mountain Agriculture : Indicators of Unsustainability and Options for Reversal, MFS Discussion Paper 30, ICIMOD, Kathmandu.

Shrestha, S. (1993) - Dynamics of Unsustainability of Mountain Agriculture, ICIMOD, Forthcoming Publishing Document, Kathmandu.

Note:

1. Data presented here for 1954 and 1978 are based on the topo sheet maps and aerial photographs interpretation respectively whereas the data for 1991 is based on the field visit and superimpose on the above aerial photographs.

2. Emergence of shrub/grazing land in Singhuwa sub-watershed in 1978 and 1991 is due to the degradation of forest. Once the deterioration exceeds certain limit that is no more called as forest and hence it is called shrub land/or grazingland.

Table - 4 : Decreased Area Under Forest/Pastureland by Study Sites

Under	Time Frame/Year	Unit	Tauthali Sub-watershed				Singhuwa sub-watershed			
			Study Sites			Unit	Study Sites			
			1	2	3		1	2	3	Over all
1. Decreased Area Under	1954	ha	159	55	6		291	467	23	
	1991	ha	40	15	-		262	384	3	
o Forest	C	%	-75	-75	-100		-10	-20	-85	-20
o Pasture/ Grazing land	1954	ha	38	227	103		17*	6*	12*	
	1991	ha	-	-	30		12	4	10	
	C	%	-100	-100	-70	-90	-30	-33	-20	-25
o Forest/ Pasture	1954	ha	197	282	109		291	467	23	
	1991	ha	40	15	30		253	388	13	
	C	%	-80	-95	-70	-85	-15	-20	-45	-15
2. Reduced Level of Vegetative Cover of CPRs	1954	%	70	80	90		75	75	90	
	1991	%	55	50	65		55	55	70	
	C	%	-20	-35	-30	-30	-25	-25	-20	-25
3. Reduced level of Biodiversity in CPRs										
o Fodder Trees	A	No. of	8	7	6					
	B	types	3	3	2					
	C	No. of types %	-60	-60	-65	-60	-40	-50	+25	-25
o Fuelwood	A	No.of	10	8	10					
	B	types	2	-	5					
	C	No. of types %	-80	-100	-60	-65				
o Green cut grasses	A	No.of	5	5	5					
	B	types	3	3	3					
	C	No. of types %	-40	-40	-40	-40				

Source : Shrestha, S. (1992) - Mountain Agriculture : Indicators of Unsustainability and Options for Reversal, MFS Discussion Paper No. 30, ICIMOD, Kathmandu.

Footnotes:

1. Information presented here for 1954 and 1991 are based on the topo sheet map and observation with superimpose respectively.

2. Asterix (*) marks denotes the information for 1978 based on aerial photographs but not for 1991. Because the information was not made available for 1954. The smallest unit of data recording was 25 ha of land area. Therefore, even if there were small patches of pasture/grazing land that were not recorded in 1954 topo sheet map.

3. Study sites/village no. 1,2,3 indicate the same villages as referred in Table - 1.

Table - 5: Indicators of Unsustainability of Mountain Agriculture in Selected Areas of Hindu-Kush Himalaya (HKH) Region

S.N.	Indicators	China[1]		India[2]	Nepal[3]	Pakistan[4]
		West Sichuan	Lhasa (Tibet)	Garhwal Hills	Middle Hills	Chitral District
1.	Increased landslides.	No. of areas affected by landslides has increased from 3 to 8 within last 10 years.	Landslides are occurring extensively over the years.	Landslides or mass movements are increasing both in common and private land over the years	No. of areas affected has increased from 2 to 10 and the areas from 7 to 29 ha between 1954 to 1991	Increasing
2.	Increased soil erosion.	Soil erosion is increasing with the increased area under barren land.	Soil erosion particularly in grassland is extensive. Crop land is also affected because of marginal land cultivation.	Local farmers estimate that about 150 cm top soil has been washed away over the last 40 years because that much height of stone is now exposed above the soil surface.	Increased by 30% in the study areas.	Increasing due to the emergence of barren land due to excessive logging and over grazing + cult. of marginal land.
3.	Extension of cultivated land to forest, pastureland, grassland and marginal land.	Almost one-third of cultivated land increased in the expense of grassland on steep slopes. Transfer to #12.	3000 ha of grassland has been converted into cultivated land which is increased by 12%.	Encroachment to CPRs is serious. 55% of the present total cult. area is due to the encroachment.	Area under cult. land has increased by 1.5 times and CPRs decreased by 75% between 1954 and 1991.	It is occurring.
4.	Decreased per capita landholding size.	Decreased from 1.8 to 1.2 mu (15 mu = 1 ha) between 1978-1988.	Decreased from 0.25 to 0.17 ha. On an average decreased by 30-40%.	It is decreasing.	In general per capita land holding size is believed to be decreased although some report to have increased by 10 or 20% in the hills.	It is in decreasing trend.
5.	Increased livestock density.	Pressure on CPRs is increasing in a faster rate due to two reasons:increased livestock population and decreased area under CPRs due to its conversion into cult. land.	Total livestock population increased from 86,630 to 1,460,000 between 1958-84 and livestock density increased from 0.03 to 0.55 animal/ha grassland between 1958-1984.	Livestock density is 2.8 times higher than the carrying capacity now.	Livestock holding per farm has decreased by 55% but the density per unit of CPRs has drastically increased by more than 60%.	It is in increasing trend.

S.N.	Indicators	China		India	Nepal	Pakistan
		West Sichuan	Lhasa (Tibet)	Garhwal Hills	Middle Hills	Chitral District
6.	Increased ratio of small and large animals.	Total population of small animals (goat and sheep) has increased in a higher proportion than that in large animals (cattles etc.).	Increased from 1.48 to 1.55 small animal equivalent to 1.0 large animal between 1958 and 1984.	It has been observed in some areas.	The ratio has increased from 60:40 to 40:60 over the last 30 years or so.	Increasing.
7.	Declined level of crop yields.		Crop yields have increased by over 2% per annum between 1958 and 1984. But it is reported to be difficult to sustain the yields now due to CPRs degradation.	Crop yields are believed to be declined by 10-25% as per farmers observation except in valley and fertile land accompanied by the regular supply of fertiliser.	Except millet all crop yields have declined by 10-20%.	
8.	Declined level of livestock productivity.		Now on the verge of declining trend although it has already declined in some areas.	300 litres/year cow milk yield is very low - bullock power output (0.187 kw) is much reduced compared to the past and national average figure.	Distinct negative changes have taken place in all livestock production parameters. Milk yield decreased by 40%; body wt. by 20% wool by 20%.	
9.	Reduced supply and increased fetching time of forest products essential for farming/degraded biodiversity	Fodder, compost supply is reduced. In grassland unedible grass increased from 24-34% poisoning grass (1.5-4%) and decreased high quality grass (33-26% of the total)	Supply has declined both from CPRs due to reduced area and the replacement of fodder cult. by cereals in private land	Rice varieties alone decreased from 48 in 1882 to 8 in 1992. 33% of total cult. land and 56% of total village is affected by oxalis-an unwanted plant. 'Green Desert'is developing due to the increased invasion of harmful weed like parthenium, lantana etc.	Compost, manure reduced to 6.6 from 10.1 mt/ha; fodder declined by 50%. Types of fodder fuelwood trees reduced by 60% and grasses by 40%.	Not only the supply is reduced but fetching time of forest products has increased from 4 to 7 hours.

S.N.	Indicators	China		India	Nepal	Pakistan
		West Sichuan	Lhasa (Tibet)	Garhwal Hills	Middle Hills	Chitral District
10.	Increased rate of land abandonment.	Land fragmentation increased by 5-10 times, and size of parcel decreased from 3.1 to 1.3 mu (15 mu = 1.0 ha).	Has not emerged yet. But it is bound to occur in few years of time.	Farmers have started to abandon few terraces because of low fertility and lack of plant nutrients. 10% land is abandoned in Henwal catchment area.	Land abandoned by 35 ha (3% of total cult. Land in study areas) due to low fertility. This is a serious situation recorded in one of the study villages.	It is increasing mainly due to lack of water.
11.	Increased rate of land fragmentation.	It is increasing.	Started to occur.	Fragmentation is increasing and reached 35 now from 10 in the past. Size of parcel also is much reduced which is now (0.22-.053 ha).	Fragmentation from (2-50) to (3-110) and increased by 30%, and size of parcel is also reduced by the same percent.	Average no. is declining along with the size of parcel.
12.	Steep slope cultivation.	Decreased area under green manuring from 56% to 6%. It is substituted by cereal crops (90%) exchange with #3.	Grassland on steep slope is now being converted into cult. land. It has increased by about 10%.	It is increasing. Cultivation of even 30° or above slope is now emerging.	15% of total cult. Land is now above 30° slope.	Increasing trend.
13.	Increased use of inferior option e.g. fuelwood.	More than 90% paddy straw is now used for firewood purpose which was only 70% in the past. Now yak dung is a major source of fuelwood which was only 50% of total fuelwood.	Grass roots in meadows are uprooted for fuel purpose, and its intensity is increasing rather faster due to vanishing forest and lack of forest plantation.	Now lantana plant occupies almost 50% of total firewood use. Increased use of pine needles as bedding materials.	In some villages banmara (Eupatorium sp.) plants share 40% of total firewood use + increased (more than twice) use of crop residues.	Scarcity of good fuelwood is increasingly being realised.
14.	Increased Hunger Gap Period.	Increased from 2 months to 4 months in a year.	Per capita grain availability has doubled (100-200kg) in 1952-84. But at the same foodgrain import is increasing.	Increased level of foodgrain supply from outside. Now 50% foodgrain requirement is met from import.	Hunger gap increased from 4.7 to 5.6 months in a year + No. of household producing enough foodgrain decreased by 60%.	In some areas crop yields have declined therefore dependency on outside for foodgrain is increasing.
15.	Increased rate of out-migration.			Majority adult men are out of home for off-farm employment. This is depicted by the fact female constitutes 55% in rural areas and 38% in urban population.	Outmigration (seasonal) increased by many folds. Now 80% adult men go out for off-farm income. No. of months staying out has also increased.	Increasing.

Source: 1 (a) Dafu, Yu. et.al. (1992) - Farmers' Strategies and Sustainability of Mountain Agriculture in West Sichuan, China, Draft Report Institute of Mountain Disaster and Environment, Chinese

1. (b) ICIMOD (1988) - Agricultural Development Experiences in West Sichuan and Xizang, China, MFS Workshop Report No. 2, ICIMOD, Kathmandu, Nepal, October 6-10.

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Table - 6 (a): Extraction Ratio of Fodder, Fuelwood, Compost etc. from CPRs vs. PPRs

Kg/Household/Year

CPRs Products		Sub-Watershed					
		Tauthali			Singhuwa		
		Study sites			Study sites		
		1	2	3	1	2	3
Fodder							
o CPR	A	80	80	90	50	80	90
	B	16	5	70	37	25	37
o PPR	A	20	20	10	50	20	10
	B	84	95	30	63	75	63
Fuelwood							
o CPR	A	80	70	90	70	70	90
	B	53	40	40	54	54	58
o PPR	A	20	30	10	30	30	10
	B	47	60	46	46	60	42
Compost							
o CPR	A	80	80	100	50	70	100
	B	25	20	75	35	25	35
o PPR	A	20	20	-	50	30	-
	B	75	80	25	65	75	65
Timber							
o CPR	A	100	100	100	80	80	100
	B	80	60	80	66	66	66
o PPR	A	-	100	-	20	20	-
	B	20	40	20	37	37	37
Agrl. Tools and Others							
o CPR	A	100	80	100	80	80	90
	B	75	50	75	66	66	66
o PPR	A	-	20	-	20	20	10
	B	25	50	25	37	37	37

Source: Shrestha, S. (1993) - Dynamics of Unsustainability of Mountain Agriculture, Mountain Farming Systems Division, ICIMOD, Kathmandu, (Forthcoming Publishing Documents)

Note: A = Past (20 or 40 years ago)
B = Present

Table - 6 (b) : Extraction Ratio of Fodder, Fuelwood, Compost etc. from CPRs

Sub-watershed/Farm Size	CPRs Products				
	Fodder	Fuelwood	Compost	Timber	Agri. Tool and Other
A. Tauthali					
Marginal	60	80	70	100	95
Small	30	60	50	90	80
Medium	12	62	40	90	80
Large	8	12	20	60	30
B. Singhuwa					
Marginal	70	80	40	100	95
Small	66	60	40	90	90
Medium	40	45	32	80	60
Large	22	30	24	60	35

Source: Shrestha, S. (1993) - Dynamics of Unsustainability of Mountain Agriculture, Mountain Farming Systems Division, ICIMOD, Kathmandu, (Forthcoming publishing document).

Note:
Marginal farmer (farm) = Less than 0.25 ha
Small farmer (farm) = 0.25 - 0.50 ha
Medium farmer (farm) = 0.51 - 0.99 ha
Large farmer (farm) = equivalent/or above 1.0 ha.

Table - 7: Total Annual Cash Income per Household by Farm Size and Study Sites

		Farm Size				Average
		Marginal	Small	Medium	Large	
Tauthali						
o	Farm	5	20	30	40	25
	Cereals	5	40	45	65	40
	Horticulture	-	10	10	15	10
	Livestock	95	50	45	30	50
o	Off-farm	95	80	70	60	75
Singhuwa						
o	Farm	5	30	45	50	35
	Cereals	10	35	55	65	50
	Horticulture	-	10	15	15	10
	Livestock	90	55	30	20	40
o	Off-farm	95	70	55	50	65

Source : Shrestha, S. (1993): Dynamics of Unsustainability of Mountain Agriculture, Mountain Farming Systems Division, ICIMOD, Kathmandu, Forthcoming Publishing Document.

Table - 8 : Population Growth Rates in Selected Areas/Region of HKH

Country/Region	Year	Growth Rates	Country/Region	Year	Growth Rates
	1980	1.95	Nepal [3]	1952/52-61 1961-71 1971-81	1.65 2.07 2.66
Bangladesh [1] Chittagong Hill Tracts	 1951-61 1961-74 1974-81	 2.97 2.16 5.64	Bhutan [4]	1965-80 1980 +	1.6 2.0
India [2] Arunachal Pradesh	 1961-71 1971-81	 3.34 3.06	Pakistan [5] NWFP	 1951-61 1961-72 1972-81	 2.32 3.52 3.12
Manipur	1941-51 1951-61 1961-71 1971-81	3.13 2.42 2.78 2.82			
Nagaland	1941-51 1951-61 1961-71 1971-81	1.17 5.60 3.41 4.14	China [6] Xizang (Tibet) W. Sichuan	 1982-861 1950[5] 1960[5] 1970[5] 1980[5]	 1.69 0.97 2.62 2.38 1.44
Meghalaya	1951-61 1961-71 1971-81	2.42 2.78 2.82			
Sikkim	1941-51 1957-61 1961-71 1971-81	1.26 1.65 2.61 4.19			
U.P. (8 Districts)	1881-91 1961-71 1971-81	1.2 2.40 2.38			
Himachal	1941-51 1951-61 1961-71 1971-81	0.53 1.66 2.09 2.15		1973-83 1973-83 1973-83	2.1 1.3 1.6
Jammu & Kashmir	1951-61 1961-71 1971-81	0.91 2.63 2.63			

Note: Adapted from Sharma, P. (1992) - Mountain Perspective, Population and Sustainability Issues, Paper presented at IHED-ICIMOD Workshop on "Approaches to Sustainable Development of the Indian Himalayas", Manali, H.P. India, August 1-4.

Source: 1. Chittagong Hill Tracts District Statistics, 1983.
2. M.K. Premi & R.P.Tyagi, 1982. Population of India, Country Monograph # 10 ESCAP.
3. Nepal, CBS, 1987. 4) World Bank, 1984. 5) Pakistan, NWFP Statistics 1987.
6. ICIMOD, 1990a. Chen Guojie et.al. 1992.

Table - 9: Dependency on Agriculture in Selected Areas of HKH Region

Country	Year	Proportion of Total Population Engaged in Agriculture (%)	Share of Agriculture in Total Output or GDP (%)
China [1]			
o Tibet (Xizang)	1986	87	82
o West Sichuan	1986	82	58
India [2]			
o Himachal Pradesh	1987	71	40
Nepal [3]	1986	90	56
Pakistan [4]			

Source: 1). ICIMOD (1988) Agricultural Development Experiences in West Sichuan And Xizang, China, MFS Workshop Report No. 2, ICIMOD, Kathmandu, October 6-10.

2). ICIMOD (1988) Agricultural Development Experiences in Himachal Pradesh, India, MFS Workshop Report No. 1, ICIMOD, Kathmandu, April 11-13.

3). ICIMOD (1988) Agricultural Development Experiences in Nepal, MFS Workshop Report No. 3, ICIMOD, Kathmandu, November 14-16.

4). ICIMOD (1989) Agricultural Development Experiences in Pakistan, MFS Workshop Report No. 4, ICIMOD, Kathmandu, February 15-18

Table - 10: Livestock Density by Land Use Type in Chitral District of Pakistan

LSU/ha Land

Study Sites/Type of Farmer	Homestead and wool	Fodder and Other Trees	Cropland	Homestead + wool/of fodder and other Trees
A. **Kesu**				
Poor	58	106	8	37
Medium	59	176	6	176
Rich	-	-	-	-
B. **Besti**				
Poor	566	295	105	194
Medium	253	60	43	48
Rich	41	303	12	36
C. **Martheng**				
Poor	286	99	40	74
Medium	571	77	49	68
Rich	243	86	19	63

Source: Mulk, M. (1992) - Farmers' Strategies for Sustainable Mountain Agriculture, Chitral District, Pakistan, MFS Discussion Paper No. 27, ICIMOD, Kathmandu.