An Overview of Changing Mountain Agriculture

Traditional agriculture in mountain areas has relied primarily on locally available natural resources and their management for meeting food, fodder, fibre, and fuel needs. In most communities, some of the natural resources are privately owned (such as arable land and livestock), whereas others, such as water, grazing, and forest areas, are community- controlled. Crops, livestock, and forestry have formed an integral part of the upland farming system (Carson 1992). In adapting to the specific needs of greatly varying slopes, aspects, climates, and soils over short distances, farming systems in mountain areas had a number of important priorities in natural resources' management.

The first was the maintenance of soil fertility. A number of different measures was employed by upland farmers to maintain soil fertility (Shah et al. 1991). The most important was the use of compost which involved using livestock manure, leaf litter from forests, and crop residues from fields. A principal focus of mountain women's daily work was, and still is, to transfer forest resources to the farm, to feed the livestock (for manure), and to provide leaf litter for compost. Other measures included the use of different crop combinations (intercropping as well as rotation), leaving fields fallow for various periods, and the practice of agroforestry. In many areas, special nitrogen-fixing legumes were also planted. Livestock-dominated systems in colder areas practised transhumance to exploit different seasonal niches. The movement of livestock also served to improve soil fertility in different places.

The second was the control of soil erosion. On sloping areas, it is almost impossible to completely halt soil erosion, at least not at affordable costs. However, in terms of the possibilities from the farmer's side, considerable efforts were made in the past to control soil erosion through different measures (Carson 1985, Shah et al. 1991, and Schreier et al. 1995). Terracing was a very significant capital formation in upland areas in the past. Depending on soil characteristics, geology, slope, and aspect, terraces changed. This reservoir of ethno-engineering knowledge has yet to be properly tapped. The use of different types of biomass - both perennials and seasonal - has also been important for regulating runoff and, thereby, controlling soil erosion (Partap and Watson 1994). Shifting cultivation was another strategy for controlling soil erosion as well as improving soil fertility (Ramakrishnan 1992). Proper drainage of fields was common and a great deal of care was taken to ensure that, as far as possible, soil loss was minimal. In the context of landslides, at least minor ones, in some instances, were deliberately triggered by farmers in order to reduce the slope or expand the agricultural area.

The third was the management of water resources. The movement of water from one place to another on sloping terrain increases the risk of soil erosion, landslides, and slope failures. However, without water there can be no agriculture. In upland areas, the main challenge for water management has been to organise safe discharge during a three-four month surplus period and frugal use of available water over a nine-month dry period. While the traditional engineering works in upland areas were relatively simple, the rich experiences in terms of mobilising a large number of farm households to undertake regular maintenance and to maintain a reasonably equitable water-sharing system have been fairly well recognised (Sowerwine et al. 1994).

The fourth was the management of forest resources. Upland farmers have always recognised the critical role of forests. Once the forests are gone, upland farmers know that farming will not bepossible for very long. Consequently, regulating and controlling mechanisms were established, many of which were well accepted by the community and therefore well enforced. Forest resources have always been a principal source of tension between the government and local people, and governments are increasingly recognising the legitimacy of the rights of local groups to certain forest areas (Chhetri 1992 and Karki et al.1994). Farmers also preserved biodiversity. Variations in altitude and microclimate provided a natural basis for plant diversity. While some were recognised for their economic value, others were integrated into different cultural and religious traditions. Specific crops were required for different types of cultural and religious festivals. Others were raised for their medicinal value as well as for warding off evil spirits (Roder 1995).

In spite of the many positive aspects of management in upland farming systems, a number of internal and external factors has made changes inevitable. It is these changes that are responsible for the breakdown in traditional linkages between farming systems and natural resources, threatening the capacity of mountain agriculture to provide for the needs of mountain farmers. A number of factors has been important among these changes.

Within the last 30 years, there has been a rapid growth in population in upland areas. It has more than doubled (Sharma 1994). This growth has put more pressure on farming systems to meet food, fodder, and fuel needs and to provide better incomes. Hill resources supported a moderate growth in population in earlier times, but the present rates of growth are exceeding the carrying capacities of many upland areas. Over time, this growth has resulted in the uneconomic fragmentation of land holdings and increasing pressure to further intensify the use of limited natural resources.

The unmanaged growth of livestock has resulted in excessive deforestation and overgrazing, affecting the productivity of livestock in many ways; and this includes the supply of manure - the main reason behind the increasing livestock numbers in upland areas. Many consider the increasing number of livestock and relatively poor management practices to be a major threat to sustainability of hill environments in the future (Jodha et al. 1992).

The penetration of market forces into the hills has brought many advantages, but it has also brought a number of disadvantages (Jodha et al. 1992). Market demands for various natural resources, particularly forests, have accelerated extraction, and the concern is now no longer for sustainable supply but for profits, resulting in the rapid depletion of limited mountain resources. In addition, market mechanisms also tend to weaken local socio-institutional sanctions, especially if the profits that result from breaking these sanctions are high. The extraction of forest products is an important example. The strong response required from the community to change these conditions has been demonstrated by the Chipko Movement in India.

The increase in support services and basic infrastructure has also played an indirect role. Along with services and infrastructure, external (i.e., non-local) contacts and linkages have become more important, for both inputs and outputs, than in traditional conditions in which internal (local) linkages are important. As the dependence on resources from local areas declined, there was also a general weakening in local resources' management systems over time. At the same time, the impact of using external inputs on natural resources was either not known or not adequately monitored.

Changes in land policies have had a significant influence on the conditions of many land-based resources in upland areas. A review of land and forest policies clearly indicates that sustainable management of available land resources has not been the objective of government policy until very recently. Land and forest policies were used for a long time in the past simply to generate more revenue for the government (Regmi 1976).

Ensuring proper land use has not been an important objective. Policies have moved from the stage of total state control over land resources to partial control. In view of the failure of past policies, participatory management is being promoted in some areas, such as forests, but its impact in reversing the overall process of deforestation is still not adequately known.

In response to different pressures over time, upland farmers have made different adjustments. As theextent of the influence of different factors varies greatly, the adjustment processes and presently prevailing conditions are also not uniform.

First let us look at areas with **poor access.** The degree of access has been an important factor in this process of change. This can be further differentiated according to low and high population density. In areas with **poor access but low population density** (where land is still fairly abundant), the influence of modern agricultural technology is limited. This condition is still found in upland pastures and in some upland tropical forests. While the present relationship between access and change may be seen to be stable, there are doubts as to how long it can be sustained (Blaikie 1976 and Banskota 1989). Even remote areas are beginning to experience increasing population and market penetration, both of which take a heavy toll on natural resources. It is only a matter of time before these areas also begin to experience further population growth and depletion of natural resources, even without any improvements in access conditions.

In areas with **poor access but high population density** substantial pressures already exist on available natural resources. Farming has become very land-intensive in contrast to the land-extensive practices earlier. However, as technology is more or less stagnant and soil fertility is not adequately maintained, productivity is declining. There is mounting pressure to extend cultivated areas, resulting in further deforestation and loss of the resources available for agriculture. In view of the difficulties of access, use of modern technology is limited to a few entrepreneurial farmers. The overall conditions appear to be extremely discouraging regarding both farm productivity and the conditions of natural resources in areas with poor access.

Second, regarding those areas with improved access, it can be seen that the improvement in access has had a far-reaching impact on natural resources and farming systems (Sharma 1995). The general effects are the introduction of market-based inputs, commercialisation of agriculture, and strengthening of the privatisation of resources wherever possible. Improved access has also facilitated the introduction of improved technologies for crops, horticulture, livestock, and even agroforestry to some extent. Production is less for farmers' own consumption and more for distant markets. Dependence on external inputs and knowledge increases rapidly.

If support services are relatively well organised to take advantage of comparative advantages and improved technology, switches from traditional crops to new market-based crops are rapid and very lucrative. Farmers also find it relatively more profitable to buy food grains and focus on the most suitable high-value crops. This type of change appears to be economically very desirable from the point of view of the farmer. There are instances of adverse environmental effects arising out of excessive use and misuse of mineral and chemical inputs. In some areas, environmental impacts have become very serious and educating farmers to manage these problems is critical (Sharma 1995).

Insofar as the changing farming system's impact on natural resources in such areas is concerned, this is mixed. The increased use of chemical fertilizers has reduced the need for a large number of unproductive animals, and, consequently, there appears to be some reduction in the pressure on forest resources (Basnyet 1990). Unfortunately, by the time chemical fertilizers arrive, there may not be any forests left. As improved varieties of crops require a reliable water supply, better management of water resources is expected. With the development of horticulture, land is placed under permanent tree crops, and this could have a favourable impact in terms of reducing soil erosion. On the whole, with increased incomes from high-value crops, farmers tend to care more for their own natural resources in order to protect their future incomes (Sharma 1995). The impact on community-managed resources is not very clear. Initially, resources tended to deteriorate, but, gradually, they have also improved in some instances.

In general, if better access improves the performance of farming systems, there are other problems. Access does not come cheaply to upland areas and maintenance costs are very high. The extent to which small farms can actively participate in the development of comparative advantages dependsa great deal on the availability of support services and the affordability of high pay-off inputs. There are also the environmental effects of the increased use of chemical fertilizers. Even more critical is the use of pesticides. The worst scenario is one in which well-off farmers pollute the environment with new chemical and mineral inputs, while poor farmers continue to overexploit limited forests, pastures, and water resources. Thus, mountain agriculture is at a critical juncture. If it is to be made sustainable in the future, the dynamics of changing mountain agriculture must be better understood and improved technologies introduced in such a manner that productivity gains are not at the cost of the environment.