

## **Constraints to the Sustainable Development of Mountain Agriculture: Implications of the Present Trends**

### **Constraints to Mountain Agriculture**

There are several physical constraints to agriculture in the mountain areas of the HKH region: remoteness and inaccessibility, marginality, and fragility in terms of moisture stress and poor soil conditions and a short growing season. Added to these are socioeconomic constraints such as small landholdings, poor productivity, poor production management, labour shortages, poor post production management, poor marketing and marketing networks (lack of market development), and lack of entrepreneurship. All these have led to under utilisation of the resource bases in the mountains and limited the generation of surpluses in the agricultural sector that could be used to invest in and support the growth of the mountain economy. Nevertheless, the 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. Harnessing these advantages and promoting investment in high-value cash crops can lead mountain areas to a prosperous and sustainable path of development.

Due to growing population, landholdings are becoming increasingly fragmented and smaller in size; unable to sustain the basic family livelihoods from farming alone. On the other hand, it has also necessitated bringing marginal and waste land under agricultural production. It has led to the encroachment of forest land, thus reducing forest areas. Because local farmers cannot sustain their livelihoods with farming alone, there is an increasing trend of outmigration in search of off-farm employment or employment in the agricultural sector of other prosperous regions. For example, each year thousands of hill/mountain people from Nepal outmigrate to Himachal Pradesh and the Punjab in India and work there as agricultural labour. This has created a unique situation in which women are heading farming households in many mountain areas of Nepal. Women are carrying out the traditional tasks of farming and child raising in these areas. Thus, in many mountain areas, e.g., in Uttarakhand, local people survive on remittances. This is true in many mountain areas of Nepal too.

On the one hand, in the areas that have better access to roads and communications and market links, e.g., Himachal Pradesh, local farmers have been able to harness the local mountain niches and diversity in terms of producing and marketing fruit and off-seasonal vegetables. This type of farming has led them to earn cash income and hence to economic prosperity. In these areas there

is increasing intensification of land use with multiple cropping patterns leading to over-extraction of soil nutrients and increase in incidents of diseases and pests.

Therefore, mountain farming has both constraints and opportunities. Apart from the physical, there are technology constraints in terms of lack of appropriate technology. Local knowledge and indigenous technologies are completely ignored. In the past, and even today, the research and development (R and D) focus is oriented towards the plains and mountains are neglected. In the majority of cases, the national R and D institutions made simple attempts to transfer high input technological packages in the mountain farming systems, and in many cases this has failed or created second generation problems. Instead of selecting appropriate, local crop varieties and animal breeds, national governments attempted to introduce exotic varieties of crops and exotic breeds of animals in the mountain environments which are harsh, fragile, and with limited land and animal feed resources. In the majority of areas, such attempts have failed.

Food grains, horticultural crops, and livestock form integral parts of mountain farming systems. Improvements in one sub-system can lead to improvements in the others, similarly constraints to one may result in constraints to another. The constraints to the sustainable development of each component may vary from place to place, however. In the following passages, each is discussed separately.

### ***Food grain crops***

Mountain farms in general are small and fragmented. Although there are some fertile valleys and river basins, the majority of mountain farming areas are marginal, rainfed upland slope areas, some steep and fragile. High mountain areas have a short growing seasons and are remote and inaccessible. The majority of these uplands are food deficit areas where incomes are low and farming practices poor. In order to increase the yield and production of food grains it will be necessary to introduce suitable technologies such as improved crop varieties, irrigation, and fertiliser, and ensure the timely availability of adequate amounts of fertiliser and quality seed materials. Lack of these is a major constraint to increasing yields. There are some regional differences in the problems farmers confront.

Although poor infrastructure and lack of timely and adequate amounts of inputs, such as fertiliser and quality seeds, inhibit improvements in productivity in the Indian Himalayan states, this is not the only problem. The majority of householders are marginalised farmers with no irrigation facilities, and they are unable to invest in improved seeds or modern farming technology. Shifting cultivation, which is common, also inhibits adoption of improved agricultural technologies such as high-yielding varieties (HYVs), chemical fertilisers, and modern implements (Kholas and Raina n.d.). The situation in the mountains of Pakistan is similar. Landholdings are very small and most farmers are very poor and cannot afford to purchase the essential farm inputs; lack of essential inputs in time and availability at reasonable prices are serious constraints (Shah and Basti 1995). Other factors also contribute to the low productivity: viz., fragmentation of the small landholdings, and poor communication and marketing facilities (Sharif 1994).

Landholdings in Nepal and Bhutan are also small and operate mostly on a system of low input-output subsistence agriculture. In Nepal little fertiliser is used for food grain crops in the mountain region as a result of inadequate institutional services, poor transport infrastructure, and farmers' low buying capacity (Pandey et al. 1995). There is a further problem associated with the relative overuse of subsidised nitrogenous fertiliser like urea, which leads to an imbalance in the soil. In Bhutan, agricultural production is generally based on a low level of purchased inputs. The maintenance of soil fertility depends primarily upon the use of farmyard manure. The intensification of production needed to increase returns to labour and land will require the use of more chemical fertiliser.

## **Horticulture**

The major constraints to improving horticultural crops are poor orchard management practices; lack of timely availability of adequate amounts of inputs such as quality plant materials, quality seeds, and fertiliser; inadequate access to agricultural extension services and advice, particularly for women who are the actual performers of many important agricultural operations; and lack of marketing information services. Across the HKH, poor post-harvesting and value-adding skills (for example, grading standardisation, packaging, storage, and transport) also aggravate the problem of achieving high-value agricultural outputs. Furthermore, development of markets and trade is limited in the majority of areas. These problems have greatly constrained the ability to harness the comparative advantages of mountain niches to their maximum advantage. Furthermore, many of these are new crops and intended for markets, thus farmers do not have the indigenous knowledge on optimal growing techniques or the awareness of market outlets and market requirements.

Cultivation of low-yielding heterogeneous varieties, poor fruit setting, and fruit drop are common in apple growing areas of the HKH. In some apple production areas, farmers are faced with problems of frost and hail during flowering and fruit development; biennial/irregular bearing; poor pollination; heavy rains at the time fruit matures; and moisture stress during summer, all of which contribute to low, erratic, and poor quality fruit production (Jindal 1996; John Mellor Associates 1995). Inappropriate training, pruning, and fertilisation of fruit trees are common.

Because of the lack of regular markets and reliable marketing, hill farmers find it too risky to switch to more lucrative high-value crops and continue with subsistence farming. Many of the high-value crops that are grown are grown for export markets, particularly vegetable seeds, ginger, and cardamom. Even these are produced in small and isolated mountain pockets with poor market links and inadequate market support in terms of information, processing, and marketing. This has resulted in high transaction costs, market risks, uncertainty, and vulnerability to price fluctuations and the external market (Tulachan et al. 1998). The specific problems vary slightly within the region.

In Pakistan, poor orchard management has been identified as one of the factors contributing to the wide variability in the productivity and quality of marketable products. Heavy intercropping has shortened the productive life of mandarin and apple trees. Various pests and diseases are seriously damaging fruit and other cash crops, e.g., codling moth in apple and viruses and minor leaf pests

which are serious threats in Gilgit and Hunza (Ahmed 1995). In the Northern Areas, apple yields are low and biennial bearing is a problem. The local apple varieties have soft flesh with a poor shelf life. In Balochistan, orchard farming has led to a rapid depletion of groundwater. (Prior to the 1970s most wells were dug manually). Availability of electricity led to the introduction of deep tube-wells, over 10,000 were in use to irrigate orchards by 1988/89. Whereas the water tables fell by about 15 cm per annum between 1900 and 1980, they are now falling in the Quetta Valley at an estimated rate of 30 to 300 cm per annum depending on the source of the data (World Bank 1996). Farmers in the Quetta Valley actually over-irrigate the orchards, using two to three times more irrigation water than required, despite its being a water scarce area.

Post-harvesting problems also pose constraints to the development of horticulture. There is a lack of adequate fruit processing and packing facilities and there are no proper arrangements for the efficient marketing of farm produce. In 1993-94, the total value of post-harvest losses of fruit and vegetables was estimated to be about Rs 5.7 billion from the Quetta market alone (Ahmed 1995). There is a need to improve post-harvesting technology at both the household and community level and to establish agro-industries that can process large quantities of low-grade fruit and vegetables. Furthermore, appropriate transport facilities are required to minimise spoilage of perishable products produced in temperate and sub-temperate regions but sent to sub-tropical or tropical regions for marketing.

The problems faced in India are similar. According to Khosla and Raina (n.d.), horticultural development in the Indian Himalayan state of Jammu and Kashmir is characterised by low productivity due to the lack of good quality planting material; unscientific management of orchards; lack of marketing facilities close to the areas of production; inadequacy of post-harvest management technology; and lack of irrigation facilities. In Himachal Pradesh, the cultivation of horticultural crops has been taken up in an unscientific manner. At present, 150 to 200 fruit trees are planted per hectare compared with the 1,000 to 1,500 fruit trees that could be planted using modern technology. Most of the orchards are too old and at least one-third of the apple orchard area needs replanting. The old orchards have low productivity and produce poor quality fruit. The poor quality produce from old orchards is one of the main factors leading to the huge quantities of culled fruit, an estimated 25% of the total production in the state.

In the mountains and hills of Nepal, production of horticultural crops is seriously constrained by post-harvest problems such as poor grading and packaging and lack of storage and processing facilities to increase value. Physical damage and losses are high as a result of inappropriate handling during harvesting, packaging, loading and unloading, and transportation. The loss in fresh vegetables can be as high as 30%. Although efforts have been made to develop cellar storage facilities at some production sites, they are grossly inadequate. The lack of adequate processing and storage facilities means that there are wide price fluctuations over short periods. Horticultural crops are mostly produced on a small scale in distant and dispersed pockets in the mountains. The lack of volume coupled with poor infrastructure increases marketing costs considerably, and farmers' risks are high. The lack of information on pricing and market windows limits farmers' ability to plan production decisions. In Mustang and Jumla, the sustainability of apple production is seriously constrained by lack of the infrastructure needed for marketing—roads, ropeways,

and storage facilities. Similarly, production of seed potatoes in the high mountain regions may not be sustainable if production cannot be linked properly with lowland areas through appropriate marketing and market infrastructures (Tulachan et al. 1998).

Bhutan suffers from similar problems to the other areas: poor orchard management practices; the impact of insects, diseases, and animals, which cause a drastic reduction in the quantity and quality of apples and lead to premature fruit drop in citrus orchards; and post-harvesting problems. The problems are compounded by the limited size of the domestic market.

### **Livestock**

Scarcity of fodder during the winter is a crucial problem for raising livestock across the HKH region. Steep slopes, difficult access, lack of water, and erosion of grasslands, force the animals to graze in denuded forests. The frequent moves from place to place in the search for food compels the animals to spend more energy. Overall the major constraints to livestock raising can be summarised as:

- shortage of animal feed and fodder during the winter;
- shortage of vaccines;
- a disorganised marketing system; and
- lack of market information services.

Again the problems differ slightly between areas.

The rangelands of Pakistan are largely in poor condition as a result of mismanagement and years of overgrazing. The Forestry Master Plan has estimated that 86 % of the rangelands in the country are in very poor condition and degraded. In Balochistan, the Arid Zone Research Institute (AZRI) estimated that 12 million ha (56%) of rangelands were in poor condition (Sharma et al. 1997). In the NWFP, overstocking and excessive grazing are causing serious environmental degradation. Of the five million ha of grazing lands, 4.3 million ha are so depleted that there are no or few signs of evergreen vegetation.

In the Indian Himalayas many grasslands produce only about one-fourth of their productive potential. The result is an acute fodder and feed shortage, estimated to be 40 to 60%. The causes of deterioration of pastures and grasslands are overstocking, continuous and overgrazing leading to a proliferation of unpalatable grasses and weeds and a decline in the proportion of leguminous forage, movement of migratory animals to highland pastures too early in the season, soil erosion, lack of manuring, and mineral deficiency (Bhargava 1990; Dhar 1997). Overgrazing and open grazing are often given as major causes of poor regeneration in degraded forest areas. This is probably because the livestock density per unit of land area in the Himalayas is much higher than in the lowlands, although farms rarely produce fodder crops. Although a significant proportion of animal feed is derived from crop residues and waste, the increasing growth of an already large livestock population has far exceeded the carrying capacity of forests and other grazing lands. In Himachal Pradesh, up to 80% of fodder requirements are met by forests. The average landholding size is small so crop residues are not sufficient as animal feed, and fodder cultivation is not popular. The intensity of grazing and browsing is very high, about five livestock



units per ha of grazing land compared with the 0.5 units that can be supported sustainably at the present level of production (Singh 1994).

Nepal faces an estimated 20-36% feed shortage overall, but the situation is much worse in the mountains as a result of the small size of landholdings, limited support land for grazing, and restriction on grazing of animals in forest areas by community forestry users' groups. Under-feeding leads to late maturity, high mortality, poor lifetime performance, and infertility of cattle and buffalo stocks. Reproductive disorders seem to be the main factor contributing to the continuous decrease in local livestock germplasm (Sherchand and Pradhan 1997).

Similarly, in Bhutan lack of animal feed during the winter months is an acute problem for almost all farmers. The shortage results from open and uncontrolled animal grazing on pasture rangeland as well as traditional animal feeding practices. In winter, animals feed on dry and matured native grass, bamboo shoots, tree bark, and millet and oat residues. It has been claimed that thousands of yaks die in the high mountain areas, where there is snow cover for three to four months a year due to lack of food. In the southern hills, maize, rice, and wheat are grown on terraced land and along river banks, and crop residues make up the bulk of the animal feed. The productivity of communal pastures is decreasing every year, despite the implementation of various fodder and pasture development projects. Thus crop residues, which are locally available, have become the most reliable animal feed during the periods of feed scarcity (Bajracharya 1992).

## **Implications of the Present Trends for the Sustainable Development of Mountain Agriculture**

The analysis shows that the production of food grains in the HKH has not declined as much as is often thought. In some cases, the production has actually increased as a result of increased productivity. With favourable government policies to support the development and improvement of the road infrastructure in mountain areas, there is a prospect that production of food grain can be increased. The increase in production would result from increased access to modern inputs such as quality seeds, fertiliser, and irrigation. There seems little prospect that the area under food grain production will increase, however, and the per capita food availability may decline as a result of increases in the population.

The analysis also suggests that there is increasing crop diversification and introduction of horticultural and cash crops. There are good prospects for the development of niche-based horticultural crops in the HKH. Mountain areas have certain comparative advantages and a potential for small-scale, specialised farming activities with high payoffs. Proper harnessing of niche-based farming can contribute towards ensuring food security, through both direct use of products and trade in high-value products (Jodha 1991 and 1995). The present trends towards rapid expansion of horticultural crops will have positive implications for the future development of mountain agriculture. It would be possible to irrigate a greater proportion of the more fertile land and use it to grow high-value cash (HVC) crops such as fruit, vegetables, and medicinal plants, instead of cereals as at present.

Case studies on agricultural transformation in some of the mountain areas have shown that farming of HVC crops has increased food security and employment, and thus improved the living conditions of mountain people (Partap 1995; Sharma 1996; Sharma 1997; Sharma and Sharma 1997; Tulachan 1997; Badhani 1998). They have also shown that accessibility, a wider market network, and strong R&D institutions are critical to the commercialisation of subsistence agriculture through greater emphasis on HVC crops. Nepal's twenty-year Agricultural Perspective Plan (APP) has emphasised the development of high-value agriculture in the mountains of Nepal as a way to improve the livelihoods of mountain people. Development of HVC crops and further diversification in mountain agriculture will increase trade between upland (mountain) and lowland (plains) areas. Mountain people can specialise more in HVC crops such as fruits, vegetables, flowers, and medicinal plants and lowland farmers in cereal crops. Development of an effective exchange mechanism can lead to improvement in the balance of trade in favour of the hills and mountains.

One possible problem is the declining trend in the productivity of HVC crops in the mountains, which raises concerns about the long-term sustainability of these crops. Jodha (1991, 1995) pointed out that reckless exploitation of mountain niches might result in their elimination. A study of niche-based farming of horticultural crops in the mountains of Nepal 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 (Tulachan et al. 1998). Furthermore, there has been a reported increase in the use of pesticides on horticultural crops. As a result of the small size of farms, there has been an increasing trend towards intensification of land use involving multiple cropping and excessive use of chemical fertilisers and pesticides.

The trend towards introduction of HVCs has raised concerns about environmental pollution, e.g., groundwater pollution and health hazards; about equity, who benefits most who loses; and about gender issues. Thus with the development of HVC crops many second generation issues are emerging. According to Rhoades (1997):

“perhaps, more importantly, the ‘second generation’ problems of ecological and social issues need to be understood prior to wholesale promotion of high-value cash crops. Impacts on equity of class, gender, and ethnicity, in particular, need to be further explored”.

Thus, the key challenge facing HKH policy-makers, planners, researchers, and field workers is how to address these emerging environmental and socioeconomic issues in order to ensure that the production of HVC crops can be sustained on a long-term basis. Also, increasingly concerns are being raised on the issue of globalisation. How might globalisation affect the processes of harnessing the mountain niches in terms of growing HVC crops that have comparative advantages agroecologically or agro-climatically. Will it promote further harnessing of mountain niches leading to enormous benefits to mountain people or provide disincentives to mountain people? This is a critical issue that needs to be studied in the near future.

