Chapter 9
Mountain Agriculture in the Hindu Kush-Himalayas: Trends and Sustainability

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9.1 Introduction: The Data Base and Methodology

In the Hindu Kush-Himalayas (HKH), the majority of mountain households operate a mixed crop-livestock farming system. Food crops, horticulture and cash crops, and livestock are three integral components of mountain farming households. Over the years, changes have been taking place in terms of crop land use, land resource allocation, production, and productivity of cereal crops, horticultural crops, and livestock structure and composition. Better understanding of these changes can lead to important implications for development of sustainable mountain agriculture.

Over the years, the International Centre for Integrated Mountain Development (ICIMOD) realised the need for an empirical database on mountain agriculture to identify long-term trends and their implications. According to Jodha et al. (1992), efforts to build an empirical picture of the existing conditions in mountain agriculture, the changes over time, the various policies, and aspects contributing to its long-term sustainability have only recently begun. The lack of empirical data meant that earlier efforts to assess the state of mountain agriculture were based on a handful of micro-level case studies relating to a point of time and covering a negligible part of a vast tract of the HKH region. Concerns about the lack of an empirical database were often raised during various ICIMOD forums and the Regional Consultation on Education and Research for Sustainable Mountain Agriculture recommended that ICIMOD could be a focal point for the creation of a technical database for mountain

agriculture (Banskota and Partap 1997). Following his thorough review and analysis of the past work on mountain farming systems at ICIMOD, Rhoades (1997) found critical lacunae in empirical data on the state of mountain agriculture and recommended the creation of a systematic database on mountain agriculture.

It is on these premises that ICIMOD began to establish a systematic agricultural systems' database commencing in 1997 and focusing on biophysical and socioeconomic data. The sources of the data are national government statistics, project reports, consultants' reports, case studies, and grey literature. For this purpose, a user friendly computer framework was designed to store the information systematically and in a handy and easily retrievable programme.

This paper uses the data to analyse the general trends in mountain agriculture in terms of changes in use of crop land, changes in crop production and productivity, and changes in livestock population and composition over the past ten to fifteen years in selected provinces/states/regions of five Hindu Kush-Himalayan (HKH) countries, namely, Bhutan, China, India, Nepal, and Pakistan (Figure 9.1). The analyses provide an inter-regional perspective of farming systems in these regions.

The study involved careful review and analysis of data and information from secondary sources. The data for a 10 to 15 year period were obtained from government agricultural statistics for selected mountainous provinces/states/regions of the five HKH countries. (The government sources for time series' data are provided in Box 1). These data relate to varying time periods and different methods such as census, field survey, and estimates used by respective agencies for their collection. Also, since the data are based on administrative units, in some provinces/states, data used include some parts of the plains too. The study area, as shown in Figure 9.1, includes Balochistan and the NWFP in Pakistan; Himachal Pradesh and the UP Hills in India; Tibet, Yunnan, and Sichuan in China; the high and mid-mountain regions in Nepal, and the whole of Bhutan. Growth rates are calculated from time series' data for cereal crops and horticultural and cash crops. For livestock data and wherever time series' data are not available, a simple analysis is carried out in terms of percentage changes between two time periods.

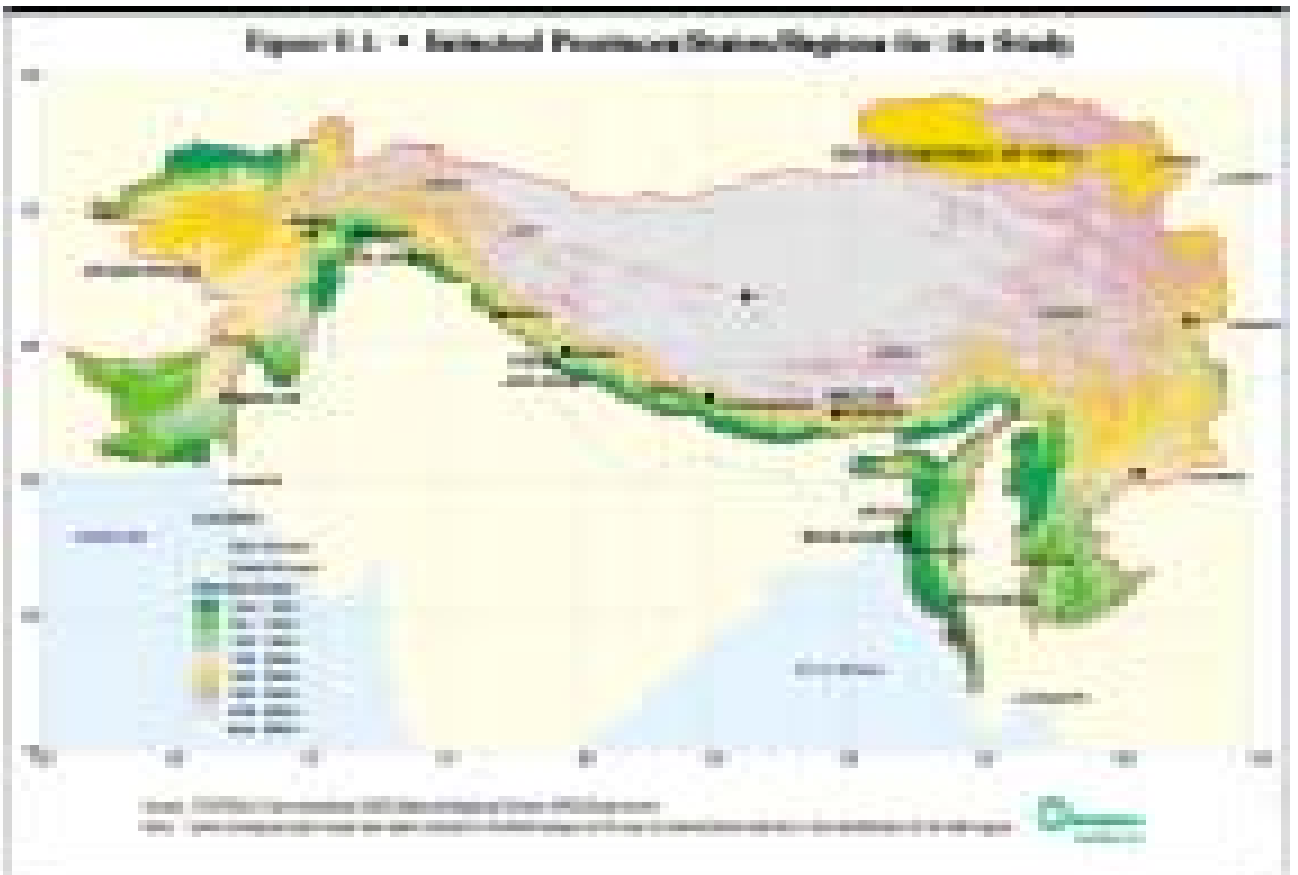
The annual growth rate is calculated by using semilog transformation:

$y = ab^t$, $b = 1+g$,

where,
y = production or area or yield, t = year, g= annual growth rate
estimating equation: In y = in a + t In b or $y\sim = a\sim + b\sim t$

where,
$y\sim$ - log y, $a\sim$ = log a, $b\sim$ = log b.

The regression yields estimates of a $a\sim$ and $b\sim$: $b\sim$ = antilog $b\sim$, $g\sim = b\sim - 1$ (Johnston 1972)



Box 1: Selected Sources of Data for the Analysis

Pakistan

- Ministry of Food, Agriculture and Livestock. Agricultural Statistics of Pakistan, 1993/94, Government of Pakistan. Islamabad
- Statistics Hand Book of Balochistan (1995), Bureau of Statistics, Govt. of Balochistan, Quetta, 1996

India

- Status of Agriculture and Future Plans for the Himalayan Region of Uttar Pradesh, Hill Development Department, Hill Agriculture Division, UP Govt, Lucknow
- Dhar T.N. and S.P. Gupta (1995). Development of Agriculture in the Himalayan States of India, SHERPA, Lucknow
- Directorate of Land Records (1992), Livestock Census, Government of Himachal Pradesh, Shimla
- Mehta, G.S. (1997). *Development Experiences and Options in a Hill Region: The Case of Uttarakhand, UP, India.* Kathmandu: ICIMOD
- T N Dhar & S P Gupta (1994). *Development of Horticulture in the Himalayan States of India*, Lucknow, India: SHERPA
- Agriculture in Himachal Pradesh, 1996. Department of Agriculture, Himachal Pradesh
- Agricultural Sector, NEC Secretariat, Shimla
- Directorate of Horticulture (1993), *Horticultural Development in HP: Facts and Figures at a Glance*. Shimla: Government of HP

Nepal

- Agricultural Statistics of Nepal (1990), His Majesty's Government Ministry of Agriculture, Department of Food and Agricultural Marketing Services, Agricultural Statistics Division, Kathmandu
- Statistical Information on Nepalese Agriculture, Ministry of Agriculture, His Majesty's Government of Nepal, Kathmandu for the Years 1995/96, 1996/97 and 1997/96

Bhutan

- Ministry of Agriculture (1995). LUPP Dzongkhag Data Sheets for Bhutan, Land Use Planning Project, Bhutan, April 1995.

China

- China Year Book of Agriculture (from 1984 to 1997), Compiled by the Editorial Board of China Agriculture Yearbook. Published and Distributed by China Agriculture Press

Discussion of the results

The section below discusses the results of the empirical analyses of the state of agriculture in selective mountainous provinces/states/regions of five HKH countries. It discusses issues in sustainable mountain agriculture, for example, what have been the changes in use of land for cereal crops vis-à-vis horticultural crops,viz.,fruit and vegetables? what are the trends in terms of productivity of cereal crops compared with horticultural crops? what are the changes taking place in livestock population and composition or which animal species are of increasing importance in the livestock economy? and what could be the implications of these trends for the sustainable development of mountain agriculture?

9.2 Trends in the Production of Cereal Crops

The results of data analysis show that the area under cereal crops has not increased, but productivity (yield per hectare) has remained relatively stable and, for some crops and in some regions, crop productivity has increased (Table 9.1). For example, an analysis of the data for a major cereal crop between 1975/76 and 1993/1994 in Balochistan shows that while the area cultivated with wheat increased significantly at an annual rate of 2.1%, the areas under paddy and maize remained almost stagnant, growing only at less than one per cent. Wheat yields also increased significantly at a rate of two per cent, but those of paddy and maize remained more or less stagnant. On the other hand, in the North-West Frontier Province (NWFP) of Pakistan, the area under maize increased at a rate of 1.4% annually, but the productivity remained stagnant. The area and productivity of wheat and paddy remained stagnant over an 18-year period between 1975/76 and 1993/94 in the NWFP.

The area under paddy has declined in Himachal Pradesh and in the UP Hills in India. Interestingly, in Himachal Pradesh (HP), although areas under wheat and maize have remained static, their yields have grown by 2.10 and 1.13% per annum respectively, although yields of paddy remained the same. In the UP Hills, the productivity of both paddy and wheat has increased considerably, although the area under cereals has declined. Analysis of area, production, and productivity of major cereal crops in the mountains and hills of Nepal between 1985/86 and 1994/95 shows that the annual growth rates in area, production, and yields of paddy are below one per cent each, indicating stagnation. However, maize production increased at an annual rate of 1.52 and 2.17% respectively in the mountains and hills. Similarly, wheat production increased by 2.62 and 1.58% respectively per annum. Although increases in maize production were mainly due to expansion in area, wheat production was due to an increase in productivity.

In the mountainous provinces of China - Sichuan and Yunnan, the area under rice either remained the same or declined slightly between 1983 and 1997. On the other hand, the yield increased significantly at rates of 1.49 and 1.93% per annum in Sichuan and Yunnan respectively during the same period. Similarly, the area under corn has remained the same, but yields have increased considerably in both provinces between

Table 9.1: Trends* in land resource allocation and productivity of cereal crops in the HKH Region

Province/ State/Region	Area under Cereal Crops			Productivity			Year
	Paddy	Wheat	Maize	Paddy	Wheat	Maize	
China							
Sichuan	-0.14	0.33	0.12	1.49	-0.04	1.52	1983-97
Tibet	0.38	0.54	1.62	-1.91	0.17	-1.30	1983-97
Yunnan	-0.58	1.36	0.04	1.93	2.37	1.81	1983-97
India							
Himachal P.	-0.38	0.17	0.19	0.53	2.10	1.32	1981-91
U P Hills	-0.13	0.01	-0.94	1.48	2.35	-0.26	1980-93
Nepal							
Hills	0.36	0.55	1.06	0.68	1.03	1.12	1985-94
Mountains	0.74	0.85	1.11	0.19	1.77	0.41	1985-94
Pakistan							
Balochistan	0.6	2.1	0.6	0.5	2.0	1.0	1975-93
NWFP	0.1	0.4	1.4	0.1	0.8	0.5	1975-93

*Annual Growth Rates (%)

1983 and 1997. In the case of wheat, both area and productivity have increased significantly in Yunnan, but these increases have been at a much slower pace in Sichuan. In the case of Tibet, the area under maize increased considerably, while the area cultivated with paddy and wheat remained the same. It is interesting to note that productivity of both rice and corn decreased significantly in Tibet between 1983 and 1997.

9.3 Trends in the Production of Horticultural Crops

An empirical analysis of the 'trend' data presents significant increases in the area cultivated with horticultural crops (Table 9.2) across the HKH region. For instance, in Balochistan, the areas under apples, citrus, and apricots grew at a significant rate per annum between 1981 and 1994, but the growth in productivity was less than one per cent. The area under vegetable crops increased by 2.96% per annum, with a small increase of 0.23% per annum in yield between 1981 and 1994. The area under tomatoes increased considerably, averaging over 3.5% per year, but the yield only increased marginally by 0.29% per annum.

In the NWFP, although the area under vegetables grew by 1.88%, productivity declined by 0.49% annually. Similarly, in the case of tomatoes, the area increased significantly by 3.2% per annum, but the yield declined by 0.29%. In Himachal Pradesh, between 1981 and 1992 the area under citrus increased at an annual rate of 3.4%. Similarly, the area under apples grew at 1.6% per annum. Nevertheless, citrus yields declined by 2.3% per annum, and the yield of apples remained virtually stagnant with a small increase of 0.4%. Although the area under vegetable crops increased by 2.5% per annum, the productivity remained more or less stagnant.

Table 9.2: Trends* in land resource allocation and productivity of fruit and vegetables in selected areas of the HKH Region

Province/ State/Region	Area under Horticultural Crops				Productivity				Period
	Apple	Citrus	Tomato	Veg.	Apple	Citrus	Tomato	Veg	
China									
Sichuan	1.40	1.25	-	-	1.17	2.46	-	-	1985-97
Tibet	1.11	-	-	-	-2.00	-	-	-	1984-97
Yunnan	4.93	4.36	-	-	-0.57	0.94	-	-	1983-97
India (Himachal Pradesh)	1.60	3.40	-	2.50	0.40	-2.30	-	-	1981-92
Nepal (Hills & Mountains)	2.83	2.39	-	-	0.45	0.31	-	-	1993-97
Pakistan									
Balochistan	4.87	4.45	3.59	2.96	0.88	2.60	0.61	0.230	1981-94
NWFP	2.37	0.76	3.23	1.88	-0.23	0.08	-0.29	0.49	1981-94

*Annual Growth Rates (%) - data not available

In Nepal, examining the trends for fruit crops in terms of land-resource allocation, production, and productivity showed that areas under apples and citrus fruit had increased significantly at rates of 2.83 and 2.39% per annum respectively between 1993 and 1997. However, the yields of these fruit crops have increased only a little.

Among the mountainous provinces of China, Yunnan tops the growth in area under cultivation of apples at 4.93% annually between 1983 and 1997. In both Sichuan and Tibet, the annual growth rate in area under apples is above one per cent.Yunnan also tops in terms of growth of area under citrus production at 4.35% annually. Orange plantation grew at 1.25% annually in Sichuan. Sichuan tops in expansion in area under pears with an annual growth of 2.56%. Among the cash crops, the area under tobacco grew considerably in both Sichuan and Yunnan with an annual growth rate of 2.26 and 5.30% respectively.

In Bhutan, analysis of data between 1986 and 1995 indicates that the area under apples increased considerably by 32.87%, while the increase in area under oranges was comparatively small. The largest gain in this period was in the area under vegetable production: a sevenfold increase. In the case of cash crops, areas under ginger and potatoes increased by more than 100%. On the other hand, areas under two other cash crops, chillies and cardamom, declined by 29.9 and 20.6% respectively between 1986 and 1995 (Ministry of Agriculture, Bhutan 1995).

9.4 Trends in Livestock Population and Composition

An analysis of livestock data shows that there is a decline in the population of cattle and sheep throughout the HKH. On the other hand, the numbers of buffaloes and

goats are increasing (Table 9.3). In Balochistan, between 1984 and 1994, the increase in the population of buffaloes was much larger than for cattle[1]. Similarly, the same was true in the NWFP between 1976 and 1986. This indicates the important role of buffaloes in the livestock economy of these provinces. Among smaller ruminants, the number of sheep has increased more rapidly than that of goats in Balochistan while populations of both have declined in the NWFP.

Table 9.3: Trends* in livestock population and composition in the HKH Region

Province/State/Region	Population				Period
	Cattle	Buffaloes	Sheep	Goats	
Bhutan	-23.0	-	21.26	108.83	1986-96
China					
Sichuan	20.62	4.40	6.97	81.02	1986-97
Tibet	2.19	-	2.28	8	1986-97
Yunnan	9.58	17.34	-25.6	13.77	1986-97
India					
Himachal Pradesh	-1.06	13.64	-8.15	5.25	1982-92
UP Hills	-5.2	15.1	-9.1	7.1	1978-88
Nepal					
Hills	3.17	0.58	-9.59	2.87	1988-96
Mountains	5.77	8.30	-2.53	9.37	1988-96
Pakistan					
Balochistan	81	133	185	87	1984-94
NWFP	9.5	68	-39	-10	1976-86

* Percentage change during the period indicated in the last column.

Analysis of livestock data between 1978 and 1988 in the Central Himalayan region (UP Hills) and between 1982 and 1992 in the Western Himalayas (Himachal Pradesh) shows that, whereas the cattle population declined, the buffalo population increased significantly. Among small ruminants, the population of sheep has declined considerably, while there has been a significant increase in the number of goats. Consequently, in terms of herd composition, the share of cattle and sheep declined and that of buffaloes and goats increased.

Analysis of livestock data in Nepal reveals that the most noticeable change in the hills is a significant increase in the population of buffaloes and goats between 1988/89 and 1996/97. The numbers of buffaloes and goats have increased, while those of cattle and sheep have declined. The most noticeable change in the mountains/hills is a considerable decline in the sheep population.

[1] The author has used the term cattle here to mean strictly cows and bulls and not all domesticated quadrupeds, or all species in the *Bos taurus* category (Tulachan & Neupane 1999)

In the mountainous provinces of China, the analysis of livestock data between 1986 and 1997 show that the goat population increased more than that of other animals such as cattle, buffalo and sheep. Although the numbers of sheep have increased slightly in Sichuan and Tibet, their numbers decreased significantly in Yunnan. Sichuan registered more increases in cattle in 1997 than in 1986 than the other two provinces, Yunnan and Tibet. However, in Yunnan the population of buffaloes increased faster than that of cattle in 1997 in comparison to 1986.

Analysis of livestock data in Bhutan between 1986 and 1996 reveals that the number of cattle has declined On the other hand, the number of goats increased considerably during the same period between 1986 and 1996.

9.5 Possible Reasons for the Emerging Trends

The most prominent observation is that although the area under cereal crops has not increased, their yields have not declined as one would think. Productivity has actually increased for some cereals leading to increased production in some mountain areas over the past ten to fifteen years. The reason for this could be a relatively favourable policy of governments towards the production of cereals in an attempt to ensure food security. For example, firstly, subsidies for fertilisers are common throughout the HKH region. Secondly, most of the fertile, valley lands with irrigation produce cereals. Thirdly, development of roads could be contributing to a timely supply of modern inputs such as fertilisers, improved seeds, and pesticides.

The area under horticultural crops,viz., fruit and vegetables, has expanded significantly over several years, indicating the increasing importance of horticultural crops in the farming systems and household economies of the HKH. The main reason for the rapid expansion in area under horticultural crops seems to be the cash income that accrues from such land use for mountain households. Because of increasing accessibility through an improved road and transport network, farmers have easy access to major consuming centres in both mountain towns/cities and lowland towns/ cities. Secondly, as a result of increasing urban incomes there has been an increasing demand for fruit and vegetables because the demand for these commodities is income elastic.

Notwithstanding their value as income-generating crops, the productivity of horticultural crops has either remained static or declined. The reason for this decline in yields could be because of the use of marginal lands and other factors such as poor orchard management. For example, in Himachal Pradesh, more than 80% of the fruit farming is on marginal and sloping lands (Verma and Partap 1992). Furthermore, production of low-yielding heterogeneous varieties, poor fruit setting, and fruit drops are common in apple growing areas of the HKH region. In some production pockets, biennial/irregular bearing, poor pollination, heavy rains when fruit are mature, and moisture stress during summer are common problems that result in low, erratic, and poor quality fruit production (JMA 1995, Jindal 1996).

In terms of livestock, there is a general decline in cattle population in the Indian Himalayas, in the hills/mountains of Nepal, and in Bhutan. This could be because of decreasing feed resources and a decline in areas for open grazing. On the other hand, there is an increase in stall-fed buffaloes in the Himalayan sub-tropics of India, Nepal, and Pakistan because of their multiple uses; mainly for milk and meat. On the whole the sheep population has been in decline (except in Balochistan) and the goat population has been on the increase throughout the HKH. Decline in the sheep population could be due to limited open grazing lands and restrictions imposed by communities on open grazing. For example, in the mountainous areas of China, one case study discovered that the grassland available per sheep unit decreased from approximately 0.6 hectare/sheep unit in 1976 to approximately 0.4 hectare/sheep unit in 1986 (Yanhua et al. 1992). Goats can be stall-fed and do not need grazing, especially in the high-pressure Himalayan sub-tropics where mixed crop-livestock farming systems prevail. Furthermore, in the Himalayan sub-tropics, goats have been an important source of cash income. The overall implication of these trends is that the role of buffaloes and goats in the livestock economy has increased, and they are playing an important role in generating household cash income.

9.6 Conclusion: Major Trends, Constraints, Strategies and Implications

Empirical analysis shows that, with little or no increase in cropped area, production of cereal crops in the HKH has not declined as much as is often perceived. Also, in some cases, increase in production has mainly been contributed by increased productivity. With a favourable government policy to support the development and improvement of road infrastructure in mountain areas, there is a prospect for increasing cereal production. Increases in production can come mainly through increased access to modern inputs, such as quality seeds, fertiliser, and irrigation, resulting from favourable government policies. Nonetheless, there seems little prospect for expansion of area under cereal production and the per capita food availability may decline due to increases in population. The main findings in mountain agricultural trends in the HKH are summarised in Box 2.

The results of data analysis also suggest that there has been an increase in crop diversification into horticultural and cash crops. Therefore, better prospects do exist for the development of niche-based horticultural crops in the HKH. As mountains have the potential for small-scale, specialised farming activities with high payoffs, proper harnessing of niche-based farming can help food security through direct use of products or trade in high-value products (Jodha 1992 and 1995). The present trends of rapid expansion of horticultural crops will have positive implications for the future development of mountain agriculture in terms of harnessing the comparative advantages of mountain areas; advantages that have positive ecological and economic effects. This could also lead to a possibility of cultivating/putting more fertile lands with irrigation (lands that are presently under cereal production) under high-value

cash (HVC) crops such as fruit, vegetables, and medicinal plants, all of which, indeed, depend more on economic profitability and market demand.

Case studies on the agricultural transformation of some mountain areas have shown how farming of HVC crops has increased food security and employment, thus improving the living conditions of mountain people (Partap 1995; Sharma 1996; Sharma 1997; Sharma and Sharma 1997; Tulachan 1997; and Badhani 1998). They also show that accessibility and the wider market network and strong R&D institutions are critical to the commercialisation of subsistence agriculture in the mountains through intensification of HVC crops. In view of future prospects, Nepal's twenty-year Agricultural Perspective Plan (APP) emphasised the development of high-value agriculture in the mountains of Nepal in order to improve the incomes of mountain people.

Development of HVC crops and further diversification in the mountains will also increase the trade between uplands (mountains) and lowlands (plain areas) in terms of mountain people specialising in HVC crops such as fruit, vegetables, flowers, and medicinal plants and lowland farmers specialising in cereal crops. Thus, by developing an effective exchange mechanism, possible improvements in terms of trade in favour of the hills and mountains can occur.

There is a great prospect of increasing the cash incomes of farmers in the HKH. Growing high-value crops such as fruit and vegetables and raising livestock for smallholder dairies and micro-livestock for meat have great potential for increasing cash incomes and eventually the standards of living of farmers. Likewise,the increasing involvement of women in research and extension programmes and introducing programmes to improve the food security of marginalised mountain households would

Box 2: Main Findings in Mountain Agricultural Trends in the HKH

- Very similar trends in mountain agriculture throughout the HKH in terms of land-use changes and livestock population
- Stagnation in growth in area under cereal crops, but an increase in crop productivity in several areas leading to increased total cereal production
- Increasing trend of crop diversification into profitable horticultural and cash crops leading to greater linkages between uplands (mountains) and lowlands (plains)
- Decline in the productivity of HVC crops— This raises concerns about the long-term sustainability of these crops.
- Increasing use of chemical fertilisers and pesticides in commercial production areas leading to environmental pollution
- Increase in smallholder dairies and micro-livestock activities with increased use of external inputs such as purchased feed

prove beneficial. The problems associated with these prospects and, also, the strategies and options related to them have been summarised in Table 9.4.

However, there has been a decline in the productivity of HVC crops. This raises concerns about the long-term sustainability of these crops. In this context, Jodha (1991 and 1995) points out that reckless exploitation of mountain niches can result in their elimination. A study of niche-based farming of horticultural crops in the mountains of Nepal shows both spatial and temporal dimensions in terms of sustainability. High economic benefits induce a spatial dimension so that a particular crop spreads quickly over time. Nevertheless, the temporal dimension of niche-based farming is manifested by soil nutrient losses and diseases over time (Tulachan et al. 1998). Furthermore, it has been reported that there has been an increasing use of pesticides on horticultural crops. Due to small farm sizes, there has been an increase in land intensification and multiple cropping with excessive use of chemical fertilisers and pesticides in commercial production areas.This has raised concerns about environmental pollution, e.g., groundwater pollution and health hazards, and about equity – who benefits the most — and gender issues. Thus, along 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 before HKH policy-makers, planners, researchers, and field workers is how to address these emerging environmental and socioeconomic issues in order to sustain the production of HVC crops on a long-term basis.

The trends in livestock raising indicate that in future there is a possibility of increased development of smallholder dairies with improved buffaloes in the high pressure Himalayan sub-tropics where mixed crop-livestock farming systems prevail. The number of stall-fed buffaloes and goats is rising with increased use of external inputs-purchased feed. This will thus put less pressure on Common Property Resources such as forests and community lands, leading to positive impacts on the environment. Also, farming of buffaloes and goats will contribute positively to the food security and nutrition of mountain households.

Table 9.4: Future prospects, problems and strategies/options for agricultural development in the HKH

Future Prospects	Problems	Strategies/Options
Increasing prospects for high-value crops such as apples, citrus fruit, and vegetables	♦ Second generation problems ♦ Diseases and pests ♦ Lack of quality planting material ♦ Inadequate access to inputs ♦ Inadequate links to markets and processing facilities	♦ R&D support to develop diverse, locally adapted variety options/ plant materials well adapted to local environment ♦ R&D support for control of diseases and pests-use of integrated pest management ♦ Market development and expansion, processing facilities, and better access to inputs ♦ Support for value-adding techniques
Increasing prospect for high-value livestock such as smallholder dairy and micro-livestock activities	♦ Shortage of quality livestock feed and fodder ♦ Shortage of quality animals ♦ Inadequate animal health services ♦ Inadequate market/credit support micro-livestock enterprises	♦ Participatory action for managing CPRs that include grazing land, forest, and pastures ♦ R&D support for optimising output from feed resources available on farmers' lands—promotion of agroforesty/feed mix technologies ♦ Institutional support for better delivery of veterinary health services ♦ Institutional support for better market linkages for livestock products ♦ Value addition and diversification of livestock products
Increasing involvement of women in the production and marketing of high-value livestock products	♦ Insensitivity of planners and local institutions for local gender needs and concerns ♦ Lack of trained women researchers and extension workers ♦ Lack of participatory approach ♦ Inadequate market/credit support for women's micro-enterprises	♦ Better understanding of gender issues in the context of changing socioeconomic conditions ♦ Sensitise planners, policy-makers, and local institutions on gender issues/needs and concerns ♦ Involve women staff/knowledgeable women farmers in programme activity formulation
Increasing food security of marginalised mountain households	Because of ♦ small farm size ♦ marginal land ♦ limited opportunity to earn cash income	♦ Increasing food security through cash security ♦ Emphasising high-value cash crops ♦ Emphasising smallholder dairy and micro-livestock. activities ♦ Carry out appropriate R & D measures for HV agriculture ♦ Emphasise marketing and processing and value-adding techniques

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Chapter 10
Agricultural Development, Growth and Poverty in India's Mountain Region

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10.1 Introduction

India can be classified into five primary or major natural regions on the basis of topographical factors These are: i) the Himalayas and Associated Hills; ii) the Northern Plains; iii) the Peninsular Plateaus and Hills; iv) the East Coast Plains, and v) the West Coast Plains (Alagh 1990). Out of these five regions, the hill areas of the country constitute 21% of the total geographical area and 9% of the total population of the country. The hill areas offer a basic life support system and natural resources. Besides those living in this region, a large part of the population in the plains is dependent on hill resources, especially those of the Himalayan region, and on their management. Most of the perennial rivers of the country originate and have their watersheds in the Himalayas. These rivers are a lifeline of agriculture in the plains, and any adverse change in the Himalayan ecology directly affects flows in these rivers For instance, deforestation in the Himalayas results in reduction in water discharge from the watersheds and increase in soil erosion, leading to siltation of rivers which raises river beds, causes frequent floods in the plains, and reduces the lifespans of multipurpose reservoirs The indirect effects are innumerable.

The hill and mountainous areas of the Himalayan region are ecologically fragile and generally underdeveloped. Development of these regions cannot be ignored because underdevelopment and poverty are serious causes of ecological degradation in the hills. Furthermore, ecological problems experienced in the hills and mountains have