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**STRATEGIES FOR THE SUSTAINABLE  
DEVELOPMENT OF  
MOUNTAIN AGRICULTURE: AN OVERVIEW**

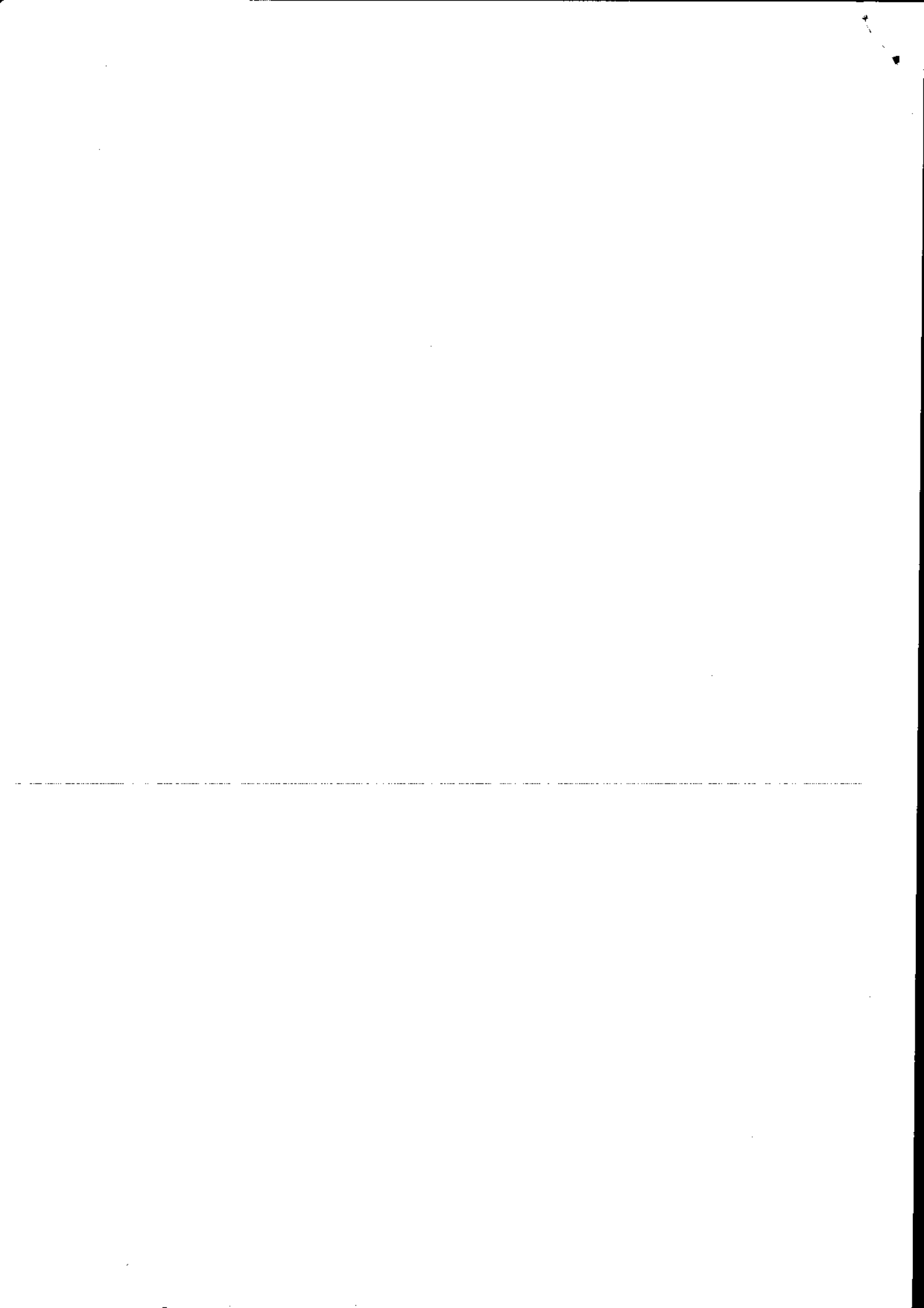
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## INTRODUCTION

### Background

Mountain areas of the developing countries face rapid increases in population pressure as well as degradation of the environment and production resource base. There are unmistakable symptoms of the emerging unsustainability of current patterns of resource use and production practices. Ironically, in most areas, such negative trends have emerged despite increased conscious efforts towards the development of mountain areas. The overall situation is both a cause of concern and a reason for reappraisal of conventional development approaches to mountain areas, in general, and mountain agriculture in particular. The latter, which includes all land-based activities such as cropping, animal husbandry, horticulture, and forestry, is a predominant activity of mountain people and serves as a focal point for sustainability interventions in mountain areas.

The present book divided into two volumes is intended to stimulate fresh thinking on development goals and strategies in mountain regions. It is largely based on work conducted by ICIMOD in collaboration with national agencies and experts from the Hindu Kush-Himalaya (HKH) region from 1988 to 1990. An important terminal activity of the work on this topic was the organization of an International Symposium on Strategies for Sustainable Mountain Agriculture in September 1990. Contributions to this symposium came from other agencies and other mountain systems (e.g., the Andes) on the relevant themes. Most of the papers presented at the above symposium are included in the two volumes. A small selection of discussion papers, not presented at the symposium, are also included to cover important topics. The inferences based on the deliberations and discussions held are synthesized in this introductory chapter, which discusses the overall focus of the book and describes thematic coverage of different papers. This is followed by a synthesis of the major findings and, finally, after a brief comment on the identification of sustainability factors, the chapter summarizes the principal issues and directives for the future based upon the work already completed.

### The Focus of the Book

In keeping with the overall objective of the research activity that provides the background for this book, its focus is on the understanding and identification of factors and processes contributing to the sustainability/unsustainability of mountain agriculture and related activities; it also suggests approaches to the integration of sustainability options in operational policies and programmes. The integrative approach to understanding, evaluating, and operationalizing the involved issues, herein referred to, is in the form of a 'mountain perspective-sustainability framework' developed by ICIMOD (Jodha, Chapter 2). The mountain perspective refers to the explicit or implicit consideration of specific mountain conditions and characteristics and their operational implications while conceiving, designing, implementing, and assessing interventions in mountain areas. These characteristics are called 'mountain specificities' and include inaccessibility, fragility, marginality, diversity or heterogeneity, 'niche', and human adaptation mechanisms. Jodha (Chapter 2) elaborates on mountain specificities and their imperatives for development interventions. Most of the papers in the two volumes try to analyse the issues and examine the evidence

with reference to different mountain specificities. Both inferences from the conceptual work and evidence from empirical work suggest that this mountain perspective framework can be used to advantage in assessing the sustainability implications of development interventions.

From the overall geographical context of the papers, the focus of this book is on the HKH region, to which ICIMOD's research activities were confined. Papers relating to the Andes, although small in number, make a significant contribution to understanding the similarities and differences of the two mountain regions.

## **THEMATIC COVERAGE**

The papers included in the book cover several interrelated themes and are hence inter-linked as well. However, on the basis of their key focusses, they have been placed in the following thematic groups.

### **Perspectives on Agricultural Development in the Mountains**

Chapter 2 (Jodha) in the book deals with the mountain perspective sustainability framework (Jodha). Different aspects of development strategies for mountain agriculture, with reference to components of the above framework, are discussed next (Banskota and Jodha, Chapter 3, Tapia, Chapter 4). This is followed by papers on the resource management systems and farm practices of mountain farmers, based on the ICIMOD-sponsored site-specific case studies, with reference to mountain specificities (Sharma and Jodha, Chapter 5, Yadav, Chapter 6). The underlying theme of these papers is an examination of the degree of sensitivity of public interventions and farmers' strategies to mountain specificities.

## **BASIC ISSUES AFFECTING THE LONG-TERM SUSTAINABILITY OF MOUNTAIN AGRICULTURE**

This theme deals with basic issues affecting the long-term sustainability of mountain agriculture. Agriculture as a biophysical or economic activity is a direct outcome of farmers' decisions and actions. The latter are strongly influenced not only by public interventions directly focussed on agricultural activities but by several other factors that constitute the overall socioeconomic and biophysical environment of agriculture. Some of the important issues covered under this heading are population dynamics (Sharma and Banskota, Chapter 7), macro-economic policies, particularly those relating to investment and resource transfer dynamics (Banskota and Jodha, Chapter 8), infrastructural development (B. Bajracharya, Chapter 10), and institutional imperatives for mountain resource management (D. Bajracharya, Chapter 9). Science and technology and the biological diversity of mountain resources are other areas examined from the perspective of their vast potential to generate sustainability options for mountain agriculture. Rhoades (Chapter 11) and Partap (Chapter 12) cover some of the relevant issues arising from this perspective.

## Mountain Farmers' Strategies and Their Implications

The focal point of the third theme is the mountain farmer or mountain farming systems. Some specific dimensions of farming systems covered by the case studies in selected hill areas of China, India, Nepal, and Pakistan, and conducted by national institutions in collaboration with ICIMOD, are presented by Yanhua et al. (Chapter 18), Bhati et al. (Chapter 21), Shrestha and Katwal (Chapter 19), and Mulk (Chapter 20) respectively. Based on secondary data and close observations, selected dimensions of farming systems in Bhutan (Gupta and Ura, Chapter 23) and Andean farming systems (Camino, Chapter 22) are also discussed. The farmers' approach to natural resources, i.e., irrigation management (Velde, Chapter 24), their innovativeness in evolving indigenous technologies (Gupta, Chapter 16), and adjustments to changing resource situations, such as the emerging labour shortages (Zimmerer, Chapter 17), are other dimensions of mountain farming systems which may have significant policy implications for development interventions. Through a variety of approaches, this group of papers highlights the sustainability—promoting features of traditional farming systems and the changing status of these features following rapid demographic, technological, and institutional changes. The papers emphasize the role of farm-level circumstances in the differential impacts of development activities.

## Innovations in Different Sectors

Despite the general insensitivity of development interventions to mountain specificities, widespread degradation of the resource base, and stagnation of agriculture, there are several success stories based on innovative approaches to development and resource management in the mountains. The experiences provided by them may prove useful for replication elsewhere. The fourth theme covers cases (development projects/approaches) of this nature. The subjects covered include technology development and diffusion in mountain agriculture (Chand and Thapa, Chapter 31, Keatinge and Khan, Chapter 32, and Pound et al., Chapter 30), institutional approaches to resource mobilization and management (Husain, Chapter 29, and Sharma, Chapter 28), designing of interventions that are area-based (Verma and Partap, Chapter 26), product-based (Zhaoguan and Ning, Chapter 27), or focussed on specific aspects (Hongbin and Xingqing, Chapter 25), of mountain 'niche' and support systems. The related issue of the potential use of new technologies and management systems e.g. through agroforestry, to increase and stabilize biomass supplies in the context of depleting forest resources in the mountains, is also covered under this theme (Denholm and Jodha, Chapter 33).

## Resource Characterization and Zonation

In order to understand the area specificity or location specificity of certain problems and their solutions, assess the limits of generalized development approaches and experiences, and facilitate use of replicable experiences as a component of future development strategies, resource characterization and zonations are an important planning tool. Theme five covers the different dimensions of zonation in the mountains (Carson, Chapter 13, Lundberg, Chapter 14, and Partap et al., Chapter 15).

## **SYNTHESIS OF MAJOR FINDINGS**

The issues, arguments, and evidence covered by both the papers and the symposium deliberations are synthesized by drawing upon the material and inferences from (1) the studies on which a number of the papers were based, (2) the number of thematic reviews commissioned by ICIMOD, and (3) other work referred to by the symposium participants. Hence, the following discussion, rather than being a summary of the papers included in this volumes, represents a broader assessment of issues arising from the papers presented, other ICIMOD material circulated during the symposium and the symposium deliberations. We have approached our assessment by focussing upon specific issues, irrespective of the thematic grouping under which the issues are covered.

Since the concentration of ICIMOD studies and the International Symposium was upon the mountain areas of the HKH Region, the following synthesis of issues predominantly refers to this region. Nevertheless, it should be kept in mind that contributions based on the situation in the Andes, besides highlighting Andean perspectives, also indicate the commonalities of situations prevailing in the mountain areas of the developing countries. Wherever necessary, we have referred to the Andean situation also.

### **The State of Knowledge on Sustainable Mountain Agriculture**

There are two basic dimensions to the knowledge on sustainable mountain agriculture. The first dimension relates to the perspectives, i.e., the understanding and incorporation of sustainability as a policy and programme goal. The second dimension relates to actual decisions or actions in the agricultural sector and their implications for the long-term sustainability of mountain agriculture.

Regarding the sustainable development perspective, the following may be noted. As in the rest of the world, the formal concern for sustainability is a recent phenomenon in mountain areas. Notwithstanding the sectoral programmes directed at soil conservation, reforestation, and agricultural production, sustainable development, implying explicit concern for the long-term consequences of present-day development interventions, has not received sufficient attention. Consequently, development programmes and policies in several parts of the HKH region have continued on an ad hoc basis and have been short-term in their focus, resource extractive in nature, sectoral in orientation, and replicative of external development designs and experiences that are often untested and unsuited to the mountain situation. However, within this overall scenario there have been some exceptions where programmes and policies, consciously or unconsciously, have been in keeping with specific mountain circumstances. The result, in such cases, has been development either without degradation of mountain resources or with arrest of resource degradation processes. Some of the success stories that have been based on innovative approaches will bear this out.

An associated aspect of the above situation relates to the empirical database on mountain agriculture to identify long-term trends and their sustainability implications. Although the situation has varied from country to country, efforts to build an empirical picture of the existing condition of mountain agriculture, its changes over time, the impact of various policies, and aspects contributing to its long-term sustainability have only recently been initiated. Thus, in each country the general problems of population pressure on agri-

culture, soil erosion, energy shortages, deforestation, overgrazing, and increasing natural hazards were extensively highlighted but empirical evidence of their effects on mountain agriculture was lacking. The bulk of research focussed on commercial crops and activities and overlooked the farmer's knowledge and adaptation strategies. The impact of various agricultural development policies and programmes was also relatively neglected. An important development was, however, a strong felt need, in all the countries concerned, for ameliorating this situation by building a stronger empirical base for decision-making and by encouraging different agencies associated with mountain agriculture to work together to achieve this goal.

Finally, even in the absence of systematic and quantified evidence, a number of inferences are possible, through the juxtaposition of development interventions and the imperatives of specific mountain conditions (called mountain specificities). By and large, development interventions in mountain areas have been undertaken without sufficient consideration of mountain conditions and their imperatives. In most cases, development strategies for mountain agriculture are simply extensions of generalized approaches that have been designed for non-mountain areas. This is so whether one looks at resource allocation and investment priorities, choice of technological and institutional measures, or intersectoral linkages and marketing (Jodha 1990b). Thus, development efforts in mountain areas usually lack the mountain perspective. Examples of this gap include large-scale infrastructural projects that have not made allowances for the fragility of steep slopes and other environmental factors, trends towards monoculture and narrow specialization in agriculture that disregard the diversity of the mountain resource base, and market integration and resource extraction levels that ignore the regeneration rate and the potential of mountain resources (i.e., 'niche'). The consequences that can be expected from such approaches are visible in the form of several negative trends which are here described as indicators of unsustainability (Jodha, Chapter 2). A few exceptions to this situation, based on small-scale initiatives, further prove that conscious sensitivity to mountain specificities can enhance the sustainability prospects. The performance of the rural development approach of the Aga Khan Rural Support Programme (AKRSP) in Pakistan (Husain, Chapter 29), the Lumle and Pakhribas Centres approach to agricultural technology development in Nepal (Chand and Thapa, Chapter 31, and Pound et al., Chapter 30), agricultural transformation through horticulture as a lead sector in Himachal Pradesh in India (Verma and Partap, Chapter 26), and modern agro-based cottage industries in West Sichuan in China (Zhaoguan and Ning, Chapter 27) may be cited in this context.

## **Macro-Dimensions: Pressure on Mountain Resources**

### *The Population Factor*

One of the key factors to consider in the context of the sustainability prospects in mountain areas (including the agricultural sector) is the scale of demand on resources. Demand has increased rapidly because of the unprecedented growth in mountain populations and this is a threat to all efforts to render mountain agriculture sustainable. If the current growth rates continue, most mountain areas in the Hindu Kush-Himalaya will easily have doubled their population in another 15 to 20 years. This will further increase the pressure on natural resources and is unlikely to improve the prospects of sustainable



mountain agriculture (Sharma and Banskota, Chapter 7, Mulk, Chapter 20 and Hongbin and Xingqing 1990).

During recent decades, population growth in some areas of the HKH region has been unbearably high. Despite problems that are related to inaccessibility, marginality, and the inadequacy of facilities in the mountains, the 'health revolution' has contributed to this growth. On the other hand, traditional pressure management mechanisms, such as migration and the upgrading of resources, through terracing, irrigation, and crop technologies, have failed to keep pace with the growth in population. This has both current and future economic/environmental consequences. Against a background of stagnant production systems, inadequate infrastructural development, and absence of higher skills and alternative employment opportunities, people's sustenance strategies, in the context of mountain characteristics, such as inaccessibility, fragility, marginality, and diversity, place a high premium on the over-supply of labour, and this makes population increases in the mountains inevitable. Hence, there is a need for measures that can reduce the high dependence on unskilled labour. Human resource development, as a crucial component of economic transformation, needs to be emphasized, along with other measures such as the inflow of capital resources and relevant technologies. Higher skill levels can also play an important role in the transfer of population from the mountains to the urban areas. Sharma and Banskota, (Chapter 7) emphasize the role of education and improved awareness in restraining population growth. The qualitative changes in the population characteristics (i.e. reflected by increased individualism, factionalism, and commercial attitudes due to market forces and survival pressure) also have had negative side-effects in terms of eroding the traditional institutional mechanisms (e.g., provision of common property resources, collective environmental security) in mountain areas. The blending of (functional) cultural values with individualistic human resource development is a big challenge.

### *Livestock*

The increase in livestock has also contributed to the increasing demands on natural resources. In most mountain areas, the livestock population is equal to, if not greater than, the human population. The increase in livestock has been an important response mechanism of mountain farmers to deteriorating economic and environmental conditions, but it is clear that current growth rates are unsustainable in the context of widespread deforestation and overgrazing. (Keatinge and Khan, Chapter 32, Pound et al., Chapter 30, Shrestha and Katwal, Chapter 19 and Dafu et al. 1990).

### *Market Forces*

The pressure on resources through rapid human and animal population growth is further accentuated by market-induced demands. Governed initially by local revenue requirements and the desire to harness mountain 'niche', resource extraction ultimately becomes a function of distant demands and market signals. The latter, being insensitive to local circumstances and indifferent to its side-effects, accelerates the process of overextraction. Evidence concerning deforestation for commercial use, mining activities, and the environmental insensitivity of hydropower and irrigation schemes from various areas in the HKH region corroborate this (Banskota and Jodha, Chapters 3 and 8 and Sharma and Banskota, Chapter 7).

The rapid resource use intensification in face of the massive growth in demand emerges as the immediate cause of several indicators of unsustainability (Jodha, Chapter 2). The possible solutions lie in restraining and regulating the pressure of demand (or rather its underlying driving forces such as population growth) or in ensuring a higher use intensity of resources without degradation. The latter calls for high productivity technologies with a potential for rapid resource regeneration and conservation which are suited to mountain conditions. This, in turn, would necessitate imparting the mountain perspective into R&D policies (Gupta, Chapter 16, Rhoades, Chapter 11, and Jodha 1990c).

### **Macro-dimensions: Issues of Macro-economic Policies**

Macro-economic policies are not only an important instrument in influencing the pace and pattern of development but also in conditioning the micro-level activities that have sustainability implications. In the HKH region, most of the negative trends, including the stagnation or decline of mountain agriculture in several areas, can be partly attributed to macro-level economic policies. The missing mountain perspective is an important gap in these policies, because most of the macro-level policies are not designed for the mountain context but according to the conventional practices or experiences in non-mountain areas (Banskota and Jodha, Chapters 3 and 8). This is so whether one looks at investment prioritization and resource allocation, factor/product pricing and other fiscal measures, infrastructural development and agricultural R&D, or choice of scale and technologies for various activities (Banskota et al. 1990, Jodha 1990a). Some dimensions of macro-level policies that seem to have hindered sustainable development in the mountains, for which data are available from different locations within the HKH region, are briefly presented below.

#### *Resource Extraction Policies*

Notwithstanding the recent focus on the welfare of mountain people and on the need for reducing inter-regional inequities, historically speaking, the goal of macro-economic policies in the mountain areas has been directed towards the extraction of mountain resources, largely for use in the non-mountain hinterland (plains) or in urban areas within the mountains. The additional short-term consideration has been revenue maximization. The regeneration and sustainable use of resources have seldom been major considerations (Banskota and Jodha, Chapter 8). Both the mechanisms and procedures for resource extraction (e.g., classification of forests, system of contractors, and auction arrangements for timber, irrigation, and power potential development without referring to local community concerns) are decided within this context. Similarly, product pricing and compensation mechanisms are guided by conventional yardsticks, rather than on the basis of the intrinsic worth of products and the sustainability implications of the pace and pattern of resource extraction. The phenomenal growth in demand for mountain resources, induced by distant market signals with complete disregard for the resource use intensification question in fragile mountain ecosystems, can be attributed to the above policies (Banskota and Jodha, Chapter 8).

*Allocative Efficiency of Public Sector Investment*

In keeping with the resource extraction focus of development policies, the investment or resource allocation patterns in mountain areas acquire certain specific features. Accordingly, most of the public sector investment is on infrastructural development (e.g., roads) or on projects designed to harness mountain potentials (e.g., irrigation and hydropower). Unfortunately, in most cases, their gains in terms of mountain agriculture are limited (ICIMOD-MFS 1990a, 1990b, 1990c, 1990d, and Banskota and Jodha, Chapter 8). Because of their scale and investment requirements, they leave little resources for ancillary activities that facilitate fuller use of the infrastructure. The diversification and interlinkages of activities are preconditions determined by the very characteristics of the mountains. However, these are usually overlooked in investment allocations.

The basic argument underlying allocative efficiency is quite straightforward. Scarce resources, whether they are public sector or private sector investments, must be used in those areas that are likely to provide the optimum results. There are important trade-offs between short-term and long-term objectives and goals, and these need to be made explicit in order to procure desirable impacts from investment decisions. Even a superficial appraisal of the successes and failures of investment decisions in the HKH region (ICIMOD-MFS 1990a, 1990b, 1990c, 1990d, and Banskota and Jodha, Chapter 8) suggests the need for substantial public investment programmes for the development of basic infrastructure, such as roads and power, as well as for strong support in the areas of technology improvements, marketing, and price incentives. However, the experience of investment failures also indicates that, in the absence of growing demand, due to the inadequate growth of ancillary activities, even investments in basic infrastructure are unlikely to bring about major improvements in highland agriculture. The experience also emphasizes the importance of proper technical support if the comparative advantages of mountain agriculture are to be harnessed (D. Bajracharya, Chapter 9, and Banskota and Jodha, Chapter 8).

A comparative review of public sector investments in mountain areas further indicated that large-scale investments in mountain areas (particularly in infrastructure) are more easily justifiable when these areas have access to larger markets in the urban areas and in the plains. Where this external demand stimulus is lacking, the transformation of mountain areas is slow and limited to certain pockets only. A comparison of the situations prevailing in Nepal and Himachal Pradesh or West Sichuan amply illustrates this. One important question in the above context is, will it not be more efficient and desirable to use resources in diversified and less capital-intensive activities? In order to avoid misallocation of scarce resources, a more careful evaluation of investment alternatives is necessary. The extent to which subsidies have a desirable impact on agricultural transformation needs more careful evaluation. Experiences from HKH countries indicate that these do not have an altogether desirable impact. However, subsidies of different types continue to be used extensively and this strategy is rarely questioned.

In view of the fact that comparative advantages in mountain areas are not uniform, in terms of either the activity or its scale of operations, the relevance of mountain specificities in evaluating investment alternatives is quite obvious. Conventional investment strategies to harness mountain potential are often focussed on large-scale activities (e.g., major irrigation and power production projects). Many relatively small-scale potentials, based on the diversity of mountain resources (e.g., fruit, flower-based activities) are ignored. The

experience of Himachal Pradesh clearly suggests that, if these comparative advantages are promoted through the activities that enjoy favourable demand in the urban and plains areas, and mountain areas have ready access to reliable food supplies at affordable prices, investments in activities (e.g., horticulture) with comparative advantages could have high pay-offs.

#### *Investment Level*

Besides the structure of investment, the level of resource allocation is another factor which often determines the pace and process of transformation in mountain areas. A comparison of Nepal and Himachal Pradesh, or the latter and the U.P. hill areas within India, clearly demonstrates this. Owing to constraints imposed by inaccessibility, fragility, diversity, and so on the costs of development and service activities in the mountains, on per unit or per capita basis, are much higher than in the plains. Besides, the overhead costs of operations are too high in the mountains. This often calls for a much larger scale of investment than that considered by conventional investment norms (Banskota and Jodha, Chapter 8, and Jodha 1990b). The implications of this factor are more serious for mountain areas that do not have a rich non-mountain hinterland for resource mobilization, as in the case of Nepal. Hence, persistent under-investment seems to be one of the important factors behind the stagnation and decline of mountain agriculture in several areas.

A related aspect of public sector investment is what may be called the 'development culture' associated with public interventions in the mountains. Accordingly, the important features of public policies in mountain areas are: centralization in decision making, perpetual subsidization of development activities, and replacement of traditional self-help and resource protection devices by formal State interventions. Although initiated as a part of the extension of generalized public interventions in rural areas (in the mountains and elsewhere), they have had several negative side-effects in terms of people's alienation from resources, lesser participation of the people, and ever increasing costs and subsidization of development activities. In the case of some of the success stories already mentioned, reduced emphasis on the above features of public policies has yielded positive results in terms of sustainable production, resource management, and participatory development.

#### *Equity Issues*

Owing to their crucial role in socioeconomic and political processes, as well as production and exchange relations, inter-regional and intra-regional equities or inequities also influence the prospects of sustainable development. The important investment issues in the context of equitable distribution and the sustainability of mountain agriculture are as follows. The relatively low development priority accorded to mountain areas vis-à-vis urban and plains areas was a common feature in all the four countries reviewed. This position had changed only recently, as the overview by Banskota and Jodha indicated (Chapter 3). This in-built bias is reflected through the low levels of investment allocation to mountain areas. More recently, while there have been some changes in this approach, with greater priority being accorded to the development of mountain agriculture, other types of development-related inequalities have emerged. The most obvious one is the spatial inequality arising out of public investments focussed on supporting agricultural development in the lowlands and accessible areas. Some exceptions, such as those evident

in horticultural development in Himachal Pradesh, may be highlighted, but even here the distribution of benefits to different groups is not equitable (Bhati 1990).

As long as certain groups and areas remain neglected and are not integrated with more dynamic pockets which are experiencing rapid development in crop farming, horticulture, and livestock, the pressures on available natural resources will continue to increase. Given the strong nature of environmental linkages between the highlands and the lowlands, continued deterioration in highland resources will ultimately affect the lowland areas as well. It is, therefore, important that public investments provide greater attention to the issues of upland-lowland linkages and their equity and sustainability implications.

Another issue that cuts across the equity argument, as well as several other arguments used in relation to structure and levels of investment in the mountains and factor and product pricing in harnessing mountain 'niche' (e.g., forests, water, energy, minerals), relates to the real worth and value of resource conservation and to the development of the mountains in other economic areas. Accordingly, unless the off-site impacts (gains) of mountain development are meaningfully perceived, most investments in these areas will continue to be treated as national liabilities (as the debate on subsidy programmes indicates) and will continue to be neglected.

The final issue under distribution relates to intra- or inter-household equity. Although all households have diversified activities in the mountains, the degree of diversification (owing to resource differences) is not uniform. The development interventions too are not equally diversified as they emphasize some activities more than others. The combined impact of the above is reflected in inequities associated with development processes. In this context, the marginalization of women through various development processes needs specific emphasis. More recently, the issues of gender inequality in mountain development have become a very significant aspect of sustainable development. Women in the mountain areas play a predominant role in the use of natural resources and could therefore play an important role in reducing the pressure on them and in enhancing resource productivity. Numerous researches related to women's issues have identified the failure to incorporate the productive resources of women's present development activities, and more specifically in natural resources management and agroforestry production, into development planning (Bajracharya et al. 1990).

In the overall context of sustainable development, the need for lowering population growth has been well recognized, but measures to mobilize women adequately in this field through education and related programmes have been weak. Similarly, the potential for enhancing the productivity of natural resources through better management by women has been completely overlooked, although women make up 50 per cent of the rural labour force and determine the use of forest resources at the household level. Lack of understanding of the gender perspective by development interventions, leading to further marginalization of women, does not contribute to the sustainable development of mountain areas.

### **Comparative Review of Macro-strategies for Agriculture**

Irrespective of their long-term consequences, significant socioeconomic and environmental changes are currently taking place throughout the entire mountain area of the Hindu Kush-Himalaya, as well as throughout other mountain systems, and are reaching even

the remotest mountain areas. These changes have come about because of a number of different factors, for example, the penetration of market forces, innovations by mountain people, and development programmes launched by local, national, and international agencies. In the following pages, we present the key features of development strategies launched by four countries of the HKH region for the development of mountain agriculture. The countries are China, India, Nepal, and Pakistan.

#### *Brief Overview of Experiences in Four Countries*

In China, the experiences in the mountain areas of West Sichuan and Xizang (ICIMOD-MFS 1990b) clearly suggest that efforts to develop mountain agriculture have been very limited. In addition to the physical difficulties already encountered by mountain farmers, various national policies adversely affected mountain areas. Prior to 1978 there prevailed a general insensitivity of development strategies to the needs and limitations of mountain people and mountain environments (Wenpu and Qinfa 1988). In spite of major achievements in capital construction, improvement in rural services, and enhanced equity following the revolution, the collectivization of farms reduced the incentives for farmers to manage agricultural resources and the environment. Moreover, restriction on 'subsidiary activities' (i.e., non-crop farm activities) and insistence on local-level food self-sufficiency reduced the scope for harnessing unique and diversified opportunities offered by mountain areas. The reforms in 1977 introduced the 'household responsibility system' that restored many of the incentives for farmers to increase agricultural output and productivity. Focus on 'regionalization' encouraged production activities more suited to diverse mountain conditions. However, in some areas the focus on private incentives has also encouraged degradation of natural resources in mountain areas. The immediate causes are: (1) reduced concern for collective management of assets such as local irrigation systems or pasture and (2) the over-enthusiasm of farmers for increasing their incomes which also tends to increase resource extraction without corresponding conservation measures (Dafu 1988). This experience has led to a more comprehensive reappraisal of development policies for mountain areas. It is now emphasized that mountain areas need a policy focus that is different from overall national policies. Both the opportunities and the constraints offered by mountain specificities need to be carefully examined. The capacity of mountain areas to produce large-scale surplus has always been small. Due to inaccessibility, markets to channel such surpluses have varied enormously from place to place. The opportunities for reinvestment in the mountains (unless diversification is encouraged) are not as apparent as in the plains. These factors significantly influence the capacity of mountain farmers to take advantage of incentives provided by national policies. Increasing attention is now being given to formulating integrated area development plans that emphasize mountain specificities in the context of sustainable resource management, poverty alleviation, and restructuring of rural institutions (Hongbin and Xingqing, Chapter 25).

Although the post-reform development strategies in China are more conducive to development of mountain areas, they have some potentially negative elements as well. As reported by Dafu (1988) they relate to emerging indifference and overextraction of collective assets (e.g., pastures), rapid intensification of resource use without sufficient concern for its use capabilities, and the erosion of the remarkable gains that China had achieved in terms of inter-household, inter-personal equity in the past.

In India, the experiences in Himachal Pradesh are the most interesting (ICIMOD-

MFS 1990a). Before its establishment as a separate and full hill state, various agricultural development programmes were undertaken. These however had limited impact. The highest priority was given to road expansion (also supported by the border road organization of the central government). Developments in hydroelectric power and irrigation potential were the other components of infrastructural development. These initiatives helped the state to harness the vast potentials of mountain resources without being constrained by funds. The potential beneficiaries—the other state governments and the central government (i.e., users of power and irrigation)—contributed towards investment in resource development. These infrastructural developments contributed immensely to the horticultural development programmes undertaken by the State in later years. Although apple cultivation was introduced much earlier in the state by big landowners, the state government made a major effort to expand its cultivation following the expansion in roads and hydroelectricity services. Horticulture proved to be a leading sector in the economic transformation of Himachal. Extensive institutional support services were provided. A major public sector corporation, the Horticultural Produce and Marketing Corporation (HPMC), was established for processing, marketing, and price support (Rana 1990). An important factor that helped in the harnessing of the comparative advantage of horticulture in the state is the vast hinterland (plains) providing a market for fruits. The HPMC, through its concerted efforts, helped to harness the market potential. Over time, other horticultural and vegetable crops have been introduced. Horticulture-based development has introduced a new type of diversification in agriculture which not only uses the diversity of the production environment but fits well into modern, market-oriented agriculture (Sikka and Singh 1988). Thus, empty spaces in orchards are used for planting hybrid grasses, and this in turn has promoted the stall-feeding of cattle, leading to the development of modern dairy farming based on cross-bred cows. The rearing of rabbits and the promotion of apiculture (mainly to facilitate pollination in horticultural crops) are other profitable components of new, diversified farming systems in the progressive areas of Himachal.

However there are certain limitations to Himachal Pradesh's achievements. The experience in cereal grain development in areas less suited for horticulture has been less encouraging. In such areas, traditional subsistence farming continues and most of the households now supplement their meagre incomes from seasonal migration to other more prosperous areas. Partly to address these problems, proper zonation of the State for agricultural development planning and a focus on target areas and target groups (e.g., tribals) are other initiatives currently emphasized. The high cost of 'servicing horticultural growth', in terms of extensive deforestation, caused by the felling of timber to construct wooden crates for apple packaging, is another problem. Efforts are currently under way to use other substitutes as well as to increase afforestation. Another important aspect of the transformation process in the State is that, in spite of these very far-reaching economic changes, pressure on natural resources is increasing. Forests are rapidly disappearing and it is maintained that there has been a substantial increase in land degradation. Increased inequities between transformed and non-transformed areas are also reported (Bhati 1990). The high cost of perpetual subsidization of horticultural development, especially of apple farming, is emerging as a major concern and as a political issue in the state.

In Pakistan, in the hill areas (e.g., the NWFP) there have been a number of major changes in recent years. Important economic changes in the mountain areas are those

of diminishing marginality and inaccessibility, increasing opportunities for trade and exchange, and reduction in the labour available for agriculture on account of increasing non-farm activities and seasonal migration (ICIMOD-MFS 1990d). Institutional changes are also noteworthy, with the arrival of new financial institutions, new development programmes (including donor-supported projects), and the evolution of local government. These changes have gradually weakened the role of local community organizations that played an important role in local resource management in the past (Hussein 1989). Furthermore, when judged from the inter-regional perspective, based on timber export and the harnessing of irrigation and hydropower, North Pakistan's mountain areas continue to be the net exporters of resources to the plains (Khan 1989).

In agriculture, especially in the accessible areas, changes have been widespread in land use, cropping systems, and livestock management. In relatively accessible areas, land is now being used less for subsistence production and more for marketable crops. In cropping systems, the switch is from labour-intensive staples to high pay-off vegetables, fruits, and other crops. The increased stall-feeding of livestock and changes in animal composition, with a preference for cattle in contrast to the pasturing of sheep and goats, are also indicators of change, although changes are more visible in focussed project areas.

In spite of these changes (which are becoming stronger on account of increasing public support and improved access) pressures on the forests and on other natural resources continue to increase. Besides the natural growth of population, the sociopolitical developments in a neighbouring country have accentuated the pressure on resources. The weakening of traditional social sanctions, which protected common property resources in the past, and the State's new fiscal measures have encouraged the overexploitation of forest resources. The spatial spread of the positive changes suggests that they are weaker as one goes higher and further away from the road. Thus, there are many areas that are currently still struggling with subsistence production activities on small, fragmented farms with poor soils that have high erosion risks. The situation of dry mountain areas, such as Baluchistan, is still worse as the biophysical constraints faced by them are much greater and stronger. Technologies for such environments are still in the process of development by national and international agencies.

In Nepal, agricultural development policies have oscillated between environmental conservation and food production (ICIMOD-MFS 1990c). The major challenge facing mountain agriculture has been the production of adequate food supplies for a rapidly growing population (Shrestha 1988). On account of widespread inaccessibility conditions, the difficulties of distributing food grains in the hills have been a major factor in concentrating on food production in hill areas. Inaccessibility has also limited the development of other non-cereal, high-value crops. Over the years, the rapid increase in the mountain population has further emphasized the importance of this food production question for the hills (Pudasaini 1988).

Despite efforts made to increase the production of cereal grains, the overall trends have been consistently negative (Bhattarai and Tamang 1988). Almost all of the 55 hill districts are now classified as food-deficit areas. While improved technology has been available for paddy, wheat, and maize, the impact of improved technology has varied from location to location. For many mountain crops, improved technologies do not exist. Traditional agricultural methods and poor agricultural performance have substantially



increased the pressure on land resources. Deforestation, soil erosion, and overgrazing are widespread throughout the country.

Some rethinking has now been initiated on this food-focus development strategy (ICIMOD-MFS 1990c). It is argued that while suitable areas should be promoted for food production, for other areas, as shown by the experience in mountain areas in China, India, and Pakistan, long-run comparative advantages might lie in other activities. Some of these changes are also evident in smaller areas in Nepal. Nepal's current constraints in replicating the horticulture-led transformation of mountain agriculture are: (1) lack of improved access, (2) a limited internal market, (3) lack of a strong institutional capability to support such an investment strategy, and (4) lack of adequate investment resources.

In a way, Nepal's performance in the agricultural and other sectors should be assessed more in relation to the above constraints. Any land-locked country with rising population pressure and no significant hinterland (i.e., the plains as a market for its products and as a supplier of investment surplus), and an accompanying high dependency on foreign aid (with donors' fluctuating perceptions and priorities), would probably not have done any better, although this should not belittle the significance of internal institutional structures such as land relations, incentive problems for enterprise, and a general disregard of the mountain people's traditional technologies and resource management systems. Despite all constraints, given the right flexibility and right understanding of the mountain perspective, the performance of development interventions can be improved. The success of the Lumle and Pakhribas technologies, the Small Farmers' Development Programmes's ability to reach the marginal areas and their inhabitants, and the impacts of community forestry initiatives can serve as examples.

#### *Some Inferences from the Country Experiences*

The country experiences summarized above represent a mixture of successes and failures. Each country has evolved its own strategies within the framework determined by geographic, political, economic, cultural, and demographic circumstances. Hence, a comparison of their achievements detached from the above framework will not be very meaningful. However, it will be worthwhile to comment on some common threads which could be used to understand and to develop future strategies.

First, irrespective of the nature of intervention and the above-mentioned country-specific circumstances, one finds a strong association between the success of development initiatives and their sensitivity to mountain specificities. This is so whether one talks of regionalization and the household responsibility system of China, the horticulture-led transformation of Himachal Pradesh, the institutional model of the AKRSP in Pakistan, or the agricultural technology developments undertaken by Lumle and Pakhribas in Nepal. What has been mentioned with reference to the four countries is corroborated by the experience of the Andean region where research and development based on mountain specificities, such as diversity, inaccessibility, and 'niche', helped in the success of the strategies (Camino, Chapter 22, and Tapia, Chapter 4). In fact, 'diversity', as a key characteristic of the mountains, has been the linchpin of development interventions in Andean agriculture. This is reflected through land use planning and cropping systems, soil conservation measures, programmes for livestock farming, and agro-based cottage industries. The policy implications of the above inference are that the mountain perspective should be integrated into the decision-making process in mountain regions.

Second, the performances of mountain agriculture and other sectors are greatly influenced by the size and type of the non-mountain hinterland the country has. The role of off-site areas as sources of benefit or burden can be detected easily once one examines certain issues, for example, the rapid increase in pressure on forests and other resources because of changes in the neighbourhood, in the case of the NWFP (Pakistan), the Indian Plains, which serve as a source of markets and investable surplus for the transformation of Himachal Pradesh (and, in contrast the absence of such facilities in Nepal), and the backlash of generalized national development strategies, on the mountain areas of China, prior to the reforms of 1977. The operational implications of this experience call for a greater focus on upland-lowland linkages, use of regional complementarities in development strategies, and recognition of the comparative advantages of the mountains.

Third, although mountain areas have generally received inadequate attention in the past the situation is gradually changing. More positively, one could say that development strategies in mountain areas have slowly evolved through trial and error. On the basis of this background, incorporation of the mountain perspective in the decision-making processes for mountain development should become a part of the evolutionary process.

### **Micro-dimensions of Mountain Agriculture: Evidence from the HKH Countries**

#### *Farming Systems and Changes*

The role and impacts of the macro-level policies and strategies at the micro-level are visible through the status and changes in the farming systems of mountain areas. The case studies conducted in China, India, Nepal, and Pakistan (Bhati et al., Chapter 21, Mulk, Chapter 20, Shrestha and Katwal, Chapter 19, and Yadav, Chapter 6, and Dafu et al. 1990) covering different farming systems also reveal this. These systems are crop-dominated, horticulture-dominated, livestock-dominated, or mixed-farming dominated. While there might not be a neat division among the different systems, especially as integration of the different components of agriculture seems to be an important adaptive strategy for farmers, the broad features and the relative importance of a particular component permit such a distinction.

There is a great deal of similarity among the four countries in terms of the geographical features underlying a particular system. Crop-dominated farming systems are almost invariably found in the foothills of a mountain area, whereas livestock-dominated systems are found in the upper mountains. Horticulture and mixed systems are found in between.

In the crop-dominated system, cereals occupy a very important place. Wheat, maize, or rice are the principal crops grown. In this system, agronomic practices include multiple cropping and intercropping. Intensive use of water to irrigate the fields is observed. Such irrigation systems are mostly farmer-managed and they form an important part of ethno-engineering devices.

Improved physical accessibility seems to have increased the access to new ideas and technologies. This has helped in transforming the systems from being purely subsistence-oriented to being market-oriented ones. Be it in Nepal or in Pakistan, access has led the farmers to cultivate more vegetables for sale in the markets. In China too, the linking of the rural areas with the wider market through road transport has led to a higher degree of commercial farming. A similar picture is more clearly visible in Himachal Pradesh

in India. In most of the areas, high-value cash crops have pushed low-value subsistence crop cultivation on to marginal land on steep slopes.

In all the four countries, there was an increase in the use of HYV (high-yielding seed variety) technology mainly in wheat and rice crops, and chemical fertilizers, particularly in the accessible areas where other support services were available. This seems to have affected the traditional practice of crop rotation to supplement plant nutrients. While land data on the extent of such a change are difficult to obtain in practice, the shift towards commercial crops has come at the cost of the diversity of the systems. The Pakistan study even reports that access to HYV technology has led to less emphasis on field terracing. This has adversely affected local resource regeneration and recycling practices. HYV technologies are, in most cases, highly subsidized in order to induce farmers to exploit technological methods in order to increase their output and income.

Another strong feature of the crop-dominated system is that livestock raising is an integral part of the system. Data from all four countries show that crop and livestock raising has important interlinkages. Cattle, buffalo, sheep, goats, and poultry are the principal livestock raised. The livestock management systems are primarily handled by individuals, and thus are determined by household resources, including labour. The keeping of diverse livestock species, along with the individual management system, indicates that the emphasis here is on the adaptation and exploitation of positive features of diversity. The interlinking of crop and livestock activities also reflects farmers' adaptations to resource fragility. The site-specific field studies have tried to quantify these linkages.

Livestock-dominated farming systems in the four countries also show some interesting similarities. Foremost among them is the feature of group-organized, livestock-rearing practices for both the grazing and management of pastures. There are strong traditions of managing grazing places and forests through an informal but effective village organization. Transhumance had been traditionally practiced in all the study areas. The studies reported rapid changes in the systems. For instance, group efforts are under strain, and, as a result, traditional herdsmen are reported to have overexploited and diminished the resource base of communities. Group management of livestock grazing, in most areas, has been weakened or discarded. Even in China, following the 1977 reforms and an increased focus on private incentives, maintenance of collective assets, including pastures, has suffered.

Other features of this type of farming system are the farmers' adaptation to their environment and response to opportunities provided by wider market linkages. First, there has been a tendency to decrease the size of herds and this is visible in several pockets in all the four countries, especially in relation to larger animals. Second, there is a replacement of animals having low or little commercial value with those having high commercial value.

Only the Nepal study reported any evidence of farmers using slash and burn cultivation practices in the livestock-dominated farming system. The livestock-dominated farming system's capacity to take advantage of new crop technologies seemed limited. This is partly because the new crop technologies have little to do with the main features of the livestock-dominated system and partly because no viable technologies relevant to the above system are available.

The horticulture-dominated system was reported to be a lead sector in the transformation of mountain agriculture in all the four areas. Farmers following this system have

shown higher levels of income and prosperity than those following other farming systems. The case studies showed that horticulture has strong links with external systems, brought about mostly by better accessibility and marketing infrastructures. In China and India, this was more evident than in other countries. However, in most cases, the system seems to emphasize narrow specializations against the diverse potential offered by the mountains. This has weakened the traditional interlinkages among different agricultural activities. The 'servicing' of this system by providing wood for fruit boxes and sticks for supporting vegetable plants also had negative side-effects in several areas. The persistent subsidization of horticultural activities despite their potential to grow without subsidies has been a frequent criticism of this system.

#### *Farmers' Adaptation Strategies to Mountain Specificities*

Farmers in study areas have exhibited a high degree of adaptability and managerial capability in facing the key constraints and opportunities generated by mountain specificities. In this adaptation process, they have not only harnessed the opportunities offered by micro-climatic and other factors, but have also exploited the opportunities offered by new changes.

To start with, farmers have resorted to various practices to address a particular form of specificity. For instance, marginality (reflected by deficiencies of land resources) has been addressed by agronomic practices, by sharing resources, by using new technologies, and by engaging in more off-farm activities. Similarly, fragility has been addressed by adaptive agronomic (and ethno-engineering) practices, by resource conservation and recycling, by undertaking joint action in resource management, and by strengthening the interlinkages among various components of the farming system. In addressing both marginality and fragility, not all adaptive practices, however, received equal importance at all locations. This was contingent upon a number of other factors, and among these the type of farming system and wider environment were important. For instance, marginality was addressed in some cases (e.g., Nepal) mainly by ethno-engineering practices, such as terracing, in others, the adaptation was accomplished by following traditional agronomic practices such as crop-fallow rotation or even abandonment of land (Pakistan).

Change in land-use practices, selection of new crops, use of locally available resources, and use of new technologies in varying degrees were used in exploiting the 'niche'. Diverse land and environmental resources were used in diversified and inter-linked activities which took into consideration local factors, traditions, and practices involving integration of crops, horticulture, and livestock. The case studies show that, in all four countries, farmers demonstrated a considerable sensitivity to the limitations of their natural environment.

Farmers' traditional strategies in managing mountain agriculture have been influenced by recent changes. For instance, a rapid increase in the population and the resultant demand for food have placed a severe strain on mountain agriculture and the farmers' resource conservation/protection strategies. The response has been the excessive exploitation of natural resources. Consequently, there is a real danger that some resources may already have been irreversibly damaged. Severe and increasing floods and landslides, as well as reduced biodiversity in several valleys and villages, could be a result of such changes. The case studies have documented a number of such negative changes. The important changes and adaptations are as follows.

First, under the impact of recent driving forces such as demographic pressure, market integration, and the side-effects of public interventions, a number of traditional sustainability-promoting practices are no longer effective or feasible. Practices involving low resource-use intensity and the support of informal social sanctions fall into this category. Second, the impact of development interventions is fairly unequal. The farming systems in the areas with better or improved access are rapidly transformed while others continue to stagnate. Areas where access, relevant technologies, and support systems were provided simultaneously responded quickly to development interventions. Third, in the rapidly transforming areas, the reduced diversity of agriculture, weakened regenerative processes, and excessive external dependence, unless checked, may prove detrimental to the long-term sustainability of transformed mountain agriculture. In the stagnant areas, there is a growing gap between the demand and supply of land resources and products.

Field evidence, collected through oral history and old records, showed the emergence of several negative trends in terms of the production potential of land resources, productivity, and resource management systems. They are described as indicators of unsustainability (Jodha 1990b). The future strategies for mountain agriculture should be focussed on the reversal of these trends.

#### *Important Inferences from the Case Studies*

The site-specific case studies of farming systems in the four countries reveal a number of features that have been observed and documented by several studies in other parts of the HKH region and other mountain systems such as the Andes (Camino, Chapter 22, and Zimmerer, Chapter 17). Some of these features have practical policy implications. First, differences in the choice of the dominant component of mixed farming systems and the linkages of the dominant enterprise with related side enterprises, visible in different agro-ecological zones, offer useful lessons for micro-level interventions. Accordingly, location specificity and diversity should be the central focus of technological and institutional programmes for agricultural development.

Second, the 'dominant activity' and the diversity of enterprises have played important roles in people's responses and in their participation in development programmes. Besides this, the other factors that have influenced the participation and impacts of development interventions are accessibility, relevant technologies, and support systems in terms of marketing and input supplies. The differences in the pace and patterns of transformation processes in different areas are also explained by the above factors.

Third, irrespective of geographical and sociopolitical differences, mountain farmers exhibit remarkable similarities in their adaptation to mountain specificities. This is more striking in countries like China, where, despite pre-reform institutional changes, directed to introduce more generalized farming systems and practices, the area-specific traditional practices survived in many forms.

The farmers know the value of their practices for resource regeneration and production stability. And yet most of the traditional practices are losing ground because they are too land-extensive to be applicable in the farmers' drive for resource-use intensification aimed at higher production to meet growing demands. Still they could provide a useful rationale for designing new technologies for high production that maintain a balanced use and conservation of mountain resources. Gupta (Chapter 16) elaborates on farmers' technological innovations and the way farmers' know-how can be harnessed

to develop relevant technologies for mountain agriculture. The experiences from Nepal and Himachal Pradesh show the use of farmers' traditional know-how in designing new technologies. However, the process is quite slow, partly due to the prevailing perceptions of R&D planners and partly due to inadequate documentation and lack of analysis of traditional technologies and their rationale (Gupta, Chapter 16, and Jodha 1990).

Fourth, an understanding of farmers' adaptation strategies could be used for micro-level planning and project formulation as the former are important manifestations of the incorporation of the mountain perspective into actual decisions and actions at village and farm levels.

At this point, it should be stated that the application of the mountain perspective framework would be qualitatively and quantitatively different at macro-level (policy and planning) and at micro-level (projects and action). The details and depths of the understanding of mountain characteristics and their imperatives will differ in both cases. This becomes clearer when one attempts to operationalize the mountain perspective framework.

Finally, the opportunities for understanding the traditional systems, the use of their rationale for designing interventions, and capture of the dynamics of continuing changes in mountain agriculture are closely linked with the flow of focussed information through regular monitoring, documentation, and information exchange. As the reviews and studies referred to in this volume revealed, the information gap is a major barrier to accomplishing the above objectives. Filling this gap needs greater and more concentrated efforts.

### **Success Stories and Replicable Experiences**

The preceding discussion on macro-level experiences and changes in farming systems in the selected areas presented a mixed picture of positive gains and negative trends. To benefit from the inter-country perspectives of positive changes, focussed enquiries were conducted on some of the success stories. Replicable lessons from such cases constitute one of the major outputs of the ICIMOD studies. In keeping with the above, and to highlight different approaches to sustainable mountain agriculture, some specific cases are examined. In the HKH region, one can count many initiatives that have performed better than the routine development interventions. Here, however, we have described five cases only.

#### *Five Successful Cases*

The cases presented here can help identify specific components as policy and programme options for agricultural development. The cases include an area-based integrated approach used in Himachal Pradesh, the technology development and diffusion model implemented by Lumle and Pakhribas Agricultural Research Centres in Nepal, institutional innovation for rural development in Pakistan by the AKRSP, agro-based cottage industries in West Sichuan (China), SFDP in Nepal and Bhutan's approach of integrating modern development and traditional cultural values and norms into resource management.

The key feature of the Himachal Pradesh case (Verma and Partap, Chapter 26) is the identification of fruit and vegetable production as a lead sector. This is followed by the marshalling of technological components from various sources, including formal R&D experiences from other regions, and farmers' traditional know-how. Provision of strong backward linkages in terms of input supplies, and forward linkages, in terms of

processing and marketing, was an essential component of the strategy. Infrastructural support in terms of roads and electricity, on the one hand, and price subsidies and price incentives, on the other, further helped the process. The growth of linked activities, such as livestock farming, further helped in the diversification and integration of land-based activities. Spade work and investment in several of the above-mentioned activities was undertaken simultaneously, and this quickened the pace of transformation.

The Lumle and Pakhribas Agricultural Centres represent unique efforts in evolving and extending agricultural technologies relevant to mountain areas (Chand and Thapa, Chapter 31, Pound et al., Chapter 30). There again, the appropriate choice of relevant lead activities (i.e., components of hill farming system) such as vegetable crops, livestock farming, and area-specific food crops was an important first step. Development, testing, and transfer of technologies involved the joint work of scientists and farmers. People's participation, institutional autonomy, and liberal fiscal support were other important components of the approach.

The AKRSP in North Pakistan represents another approach that starts with the organization of farmers' groups to strengthen their self-help capabilities (Husain, Chapter 29, Wali 1990). Besides facilitating the mobilization, collective management, and productive use of community resources, the approach also involves the appropriate choice of activities and technological and other support activities. The approach places heavy emphasis on the development of human resources and group action for the sustainable development of rural areas.

The Chinese approach to agro-based cottage industries is an effective way to generate off-farm employment and a market-oriented, high-value, product-based rural economy sustained by local resources (Zhaoguang and Ning, Chapter 27). The approach attempts to transform subsistence-oriented traditional cottage industries into viable modern enterprises. Appropriate choice of activities, use of modern scientific knowledge on plants, infrastructural facilities, processing, marketing, and subsidy-cum-incentive schemes are key factors which have contributed to the success of these ventures in various parts of West Sichuan.

The Small Farmers' Development Programme (SFDP) in Nepal (Sharma, Chapter 28) represents a fairly successful initiative in reaching remote areas and poor farming groups, despite constraints imposed by the 'inaccessibility' and 'marginality' characteristics of mountain areas. Although focussed on credit to small farmers as a key component, it has mechanisms to strengthen collective self-help.

Bhutan's effort to develop its agriculture without degrading its resource base represents an experiment in which the harmonious blending of modern science and technologies with traditional values and norms is attempted (Gupta and Ura, Chapter 23). The key focusses are on group action, selective harnessing of natural resources, and recycling of products. Market forces are allowed to play a due role but without violating traditional norms and with a non-threatening approach to nature. Although the unique cultural and demographic situations of Bhutan are conducive to this approach, the modernization process may have some negative side-effects.

### *Important Inferences*

The cases cited above have several similarities and dissimilarities. The former include appropriate choice of activities in keeping with the specific characteristics of mountain

areas; an integrated approach (although somewhat loose in some cases) to strengthening these activities; institutional and technological choices appropriate to the activities, people's participation; and practical support, including incentives, to the participants. Their differences relate to the extent of area coverage, dominant activity emphasized, relative focus on technological vis-à-vis institutional factors, and type and extent of external support.

Encouraged by the recognition of a common thread in the various success stories, it will be quite important to focus on replicable development experiences as one of the major areas to be considered for further development strategies in the mountain region. The first set of implications from the above work indicates that greater attention should be given to (1) identifying replicable experiences, (2) identifying and documenting preconditions associated with the successes, (3) identifying potential areas for replication, and (4) emphasizing the detailed zonation of mountain areas with focus on the major characteristics to serve as 'recommendation domains' for replicable experiences. To achieve the above-stated objectives, focussed information collection, documentation, and exchange are essential steps.

## **SENSITIVITY TO MOUNTAIN SPECIFICITIES**

In relation to mountain areas, the basic features of the resource base and production environment are referred to as mountain specificities. The important ones are inaccessibility, fragility, marginality, diversity, 'niche', and human adaptation mechanisms. These attributes have several operational implications in terms of objective circumstances which in turn shape the pattern of activities and their linkages. When any development intervention or resource-use practice violates the imperatives of the mountain specificities, it tends to initiate the process of resource degradation and long-term unsustainability (Jodha, Chapter 2).

As already mentioned, an important gap in development interventions in the HKH region is their inadequate consideration of mountain specificities and their implications. This is evident in the case of overall development strategies, sectoral programmes, specific projects, and farm-level initiatives. Comparison of successes and failures in the field of technology, as well as in institution-oriented projects, also revealed that successes and failures are largely associated with the consideration or disregard respectively of the mountain specificities and their imperatives while conceiving, designing, and implementing development activities.

In the light of conceptual work undertaken to develop the mountain perspective framework at ICIMOD, and the actual experience of development projects, it is realized that mountain specificities could be used as a screening device to assess the relevance and effectiveness of a given development activity and its design and implementation. Such possibilities were illustrated with reference to several activities. The important ones are discussed below.



## Specific Area/Evidence

### *Technology Options and Mountain Specificities*

Improved and relevant technologies are an important component of any strategy for sustainable development. It is now generally accepted that improved technology should not only contribute to increased productivity but should also be environmentally sustainable. The conventional R&D strategies for mountain agriculture have not given sufficient weight to mountain specificities. This is revealed by the extent of investment in research, location and spread of research facilities, and choice of activities and attributes for the technologies generated (ICIMOD-MFS 1990a, 1990b, 1990c, 1990d, and Jodha 1990d). However, the situation is slowly changing. Accordingly, in more successful initiatives, such as those of the Lumle and Pakhribas Agricultural Centres in Nepal and Himachal Pradesh in India, mountain specificities have played an important role in determining technology options. This has been realized only through experience and through the many difficulties encountered in promoting improved technologies (Chand and Thapa, Chapter 31, and Keatinge and Khan, Chapter 32). Improvements in access have favoured the adoption of improved technologies that were successful in exploiting comparative advantages through the market. The lack of improved access led to farmers' preferences for technologies that increase local food production. If fragility restricts the scope for land-intensive technology, diversity and 'niche' suggest the need for designing location-specific, improved technologies based upon an understanding of local farming systems and farmers' practices. The experiences of many research stations working for the improvement of mountain agricultural technologies have suggested that improved agricultural technologies for mountain areas can be developed only if sufficient time and resources are made available to comprehensively understand local constraints and opportunities. The lead time needed is therefore fairly long before the right combination of environmental and economic factors produce a package of improved options that meet farmer's preferences. As a part of the system developed to ensure the sustainability of improved technologies, the experience of the Lumle Centre in Nepal highlights the role of mountain specificities more clearly. It points out the need for: (1) ensuring accurate identification of problems and farmer/extensionist feedback; (2) carrying out location-specific verification of technologies; (3) multidisciplinary cooperation in assessing research results; (4) careful selection of technologies and subsequent monitoring of the impact of technologies on the environment; (5) assessment of technologies in the context of the limited resource base of hill farmers; and (6) use of indigenous resources. All these factors emphasise the role of one or more of the mountain specificities. Similar to other development activities, development of relevant technologies is also a matter of trial and error. However, the lead time can be reduced with proper understanding of relevant mountain specificities (Jodha 1990b, 1990c).

### *Investment Alternatives and Mountain Specificities*

Because of mountain specificities, the locational impacts of various investment decisions are likely to be quite different. Locational factors influence the type and scale of investment. Types of investment are influenced by all of the six mountain specificities, either singly or in combination. Roads running through fragile areas result in huge maintenance costs later on. Diversity makes it imperative that area development programmes

should have a wide base of improved technology in order to have a beneficial impact upon different groups (Tapia, Chapter 4). Agroclimatic zonation and corresponding land-use capability evaluations are therefore crucial for any long-term agricultural development programmes (Carson, Chapter 13, and Lundberg, Chapter 14). The efforts based on such understanding are only just being implemented in most mountain areas (Verma and Paratap, Chapter 26, and Hongbin and Xingqing, Chapter 25). Comparative advantages of different zones provide different types of investment opportunities. As each investment requires supporting investments, the options need to be much more carefully evaluated, especially in terms of the choice of lead sector and its ancillary activities (Banskota and Jodha, Chapter 3). At the same time, there are activities and crops that do well in several ecozones, providing opportunities for economies of scale despite the heterogeneity of mountain areas.

Many investment programmes overlook environmental fragility and marginality-related constraints (e.g., poor soil, short growing season, steep slopes) as well as farmers' preferences and adaptation strategies that have evolved over the ages as adjustment mechanisms to the constraints and opportunities of mountain specificities. Unless these are taken into account in the future, investment failures and subsidy burdens are likely to increase.

Investment in infrastructure is vital. But investments must be selective in order to make the best use of limited funds and staff. Infrastructure, such as roads, does little to help farmers when the soils are poor. In contrast, infrastructure provides decent returns in areas with good land and favourable climates. Thus, unless each investment alternative is carefully considered vis-à-vis the mountain specificities of an area, the impacts of scarce investment resources are likely to be minimal (B. Bajracharya, Chapter 10). In other words, the locational implications of investment decisions and the investment implications of locational factors (e.g., mountain specificities) need far greater emphasis in the future.

#### *Participatory Institutions and Mountain Specificities*

In today's development debate, the issue of participatory institutional mechanisms emerges as an important prerequisite for sustainable mountain agriculture. In the case of the success stories mentioned earlier, this emerged as an important component for developing appropriate technologies, more effective and equitable distribution of public support services, and improved management and maintenance of projects (Chand and Thapa, Chapter 31, Gupta, Chapter 16, Husain, Pound et al., Chapter 29, Sharma, Chapter 28, and Wali 1990). Its absence contributed to the poor impact of many projects and programmes. In the past, governments relied very heavily on implementing development programmes through official mechanisms only. Most of the decisions were made at the centre without adequate concern for their appropriateness to specific mountain areas. Over time, however, as the impact of such projects as the AKRSP in Pakistan have become more apparent, governments seem to have become more willing to adopt participatory approaches in development programmes. Non-government organizations (NGOs) that have a better understanding of the field (or local-level mountain specificities) are playing a more effective role in several small pockets. In the context of developing mechanisms that ensure the sustainability of technologies, the Lumle and Pakhribas experiences in Nepal emphasize the role of farmer participation and feedback. While discussing agricultural development experiences in the Chitral District of Pakistan, it is pointed out that, without

a decentralized and participatory approach, agricultural development policies in mountain areas will be indifferent to local realities (Mulk, Chapter 20). The experience in China also suggests that natural resource management problems in mountain areas cannot be resolved on an individual incentive and disincentive basis alone. It needs strong collective orientation, as the experience with the household responsibility system has indicated (Banskota and Jodha, Chapter 3). The failure of many of the special arrangements made to overcome particular types of bureaucratic limitations clearly suggests that institutional arrangements cannot be imposed from outside and need to have strong local participation (D. Bajracharya 1990, Chapter 9).

The success of institutional support systems in rural and agricultural development has also been facilitated by fuller understanding of mountain specificities (and their implications) such as the farmers' traditional systems and the socioeconomic measures designed to handle common property resources and the fragility and marginality of resource bases. In more concrete terms, the experience of specific projects demonstrated that the success of institutional interventions in mountain areas is closely associated with: (1) the degree of match between traditional systems and the present-day formal, legal arrangements, (2) the degree of autonomy and control ensured by the institution over local resources, (3) the equity in access to and gains from development activities, and (4) the degree of transparency and the accountability of the institutional arrangement (D. Bajracharya, Chapter 9, Husain, Chapter 29).

#### *Diversification and Interlinkages*

Most of the mountain specificities are interrelated due to their common biophysical causes (e.g., fragility and inaccessibility or diversity and 'niche' have common causes). Similarly, treatment or disturbance to one characteristic may influence others. For example, road construction to improve accessibility may adversely affect the fragile rock alignments and vegetative cover of a tract. It may improve the condition of marginal areas, but may also accentuate the rate of resource extraction beyond its regeneration rate and cause unsustainability.

The interrelationships of different mountain specificities and their implications serve as a compelling basis for an integrated approach to mountain development (Jodha 1990c). This implies a need for the clear identification and consideration of negative and positive externalities while designing and implementing development interventions. This is different from several of the conventional 'integrated' approaches to development projects where the centralized administration of activities or the simultaneous conduct of several unrelated, or even contradictory, activities at the same location is deemed to be an integrated approach. Several sectoral projects can be cited as examples of the above tendency. In contrast to the above, the approaches of the AKRSP in Pakistan, or area-based development in Himachal Pradesh (India), or antipoverty programmes in the mountains in China seem to have an integrated approach to mountain specificities.

Another important implication of the interrelationships of mountain specificities is the focus on diversified and interlinked activities. The latter has been a strong feature of traditional farming systems (e.g., farming-forestry linkages, etc) as revealed by the field studies in all the four countries. However, the conventional development strategies have often focussed on narrow specialization, reduced diversity, and interlinkages of agricultural activities (e.g., substitution of intercropping by solecropping, etc). This has negative

side effects on sustainability. However, success stories such as the Lumle/Pakhribas Agricultural Centres' initiatives, horticulture-dominated development in Himachal Pradesh, the AKRSP's success in rural transformation, and agro-based cottage industries in China show that interlinked diversification can be an effective instrument for sustainability.

The choice of lead sector/activity, with a clear understanding of the constraints and potentialities indicated by mountain specificities, can help in the identification of target groups; and can facilitate local resource mobilization and people's participation through group action. This has been the experience of successful interventions in different sectors in the four countries, as shown by enquiries into the already-mentioned initiatives with replicable experiences. The experience of the Andes in designing programmes with a focus on resource and environmental diversities (Tapia, Chapter 4) deserves special mention.

### *Focus on Micro-Level Realities*

In order to sensitise macro-level decisions to mountain specificities, the need for a greater focus on micro-level realities, through the understanding of farmers' strategies and responses, is emphasized. The more concrete role of mountain specificities in the transformation of agriculture was revealed by the already-mentioned, site-specific case studies of farming systems in different ecological zones (Sharma and Jodha, Chapter 5).

Accordingly, farm-level or village-level documentation provides better insights into the dynamics of sustainability or unsustainability and into the pace and pattern of change. Understanding and quantification of mountain specificities, and people's adaptations to them at the local level, more easily reveal the farm-level and village-level differences in the performance and impact of development interventions.

Farmers' adaptation mechanisms can offer useful clues for the design and implementation of institutional and technological interventions at the local level (Gupta, Chapter 16, and Gupta and Ura, Chapter 23). Farmers' resource management practices, through diversified interlinked activities, and the former's dependence on community or collective arrangements are fairly common across locations and even across countries. Their rationale can serve as a useful input in designing new options to suit present circumstances.

Farmers' responses to development interventions (i.e., adoption of technology or participation in general development processes) are guided by: (1) availability of a range of options rather than a specific option and (2) availability of support facilities and new opportunities in the related activities (e.g., adoption of high-value cash crops conditioned by linked activities such as input supplies and marketing facilities) (Sharma and Jodha, Chapter 5). Provision of these factors in turn could be made more realistically through an understanding of mountain specificities.

While fully realizing the importance of micro-level understanding to impart a mountain perspective into public interventions, an important condition should be understood. As stated earlier the depth and details of information on mountain characteristics, on the one hand, and their analysis and incorporation, on the other, will differ depending upon the level of their use. For macro-level policies, the mountain perspective will determine the general orientation of interventions. Their actual use at project or village level will need fine tuning and a close understanding of the location-specific complex of mountain specificities. Issues of this nature need to be clarified while operationalizing the mountain perspective framework.

### **Zonation and Resource Characterization**

An essential step in operationalizing the mountain perspective framework is full recognition, understanding, and documentation of the diversity of mountain ecosystems and resources. Although their level (e.g., region, mountain valley, watershed, or cluster of villages) may vary according to the purpose, zonation and resource characterization are essential for both demarcation of 'recommendation domains' for specific development interventions and identification of areas for replicable experiences. In this respect it helps to identify areas of homogeneity within the overall context of the extreme diversity of mountain environments which, in turn, can ensure the evolution of cost-effective ways for (intra-mountain) replicating and adapting technologies and other experiences. The prevailing approaches to zonation (e.g., ecological zones, farming system typologies) have their respective strengths and weaknesses (Carson, Chapter 13, and Lundberg, Chapter 14). In the mountain context, the complexity and variability of relevant information, because of extreme diversity, and the difficulties of information accumulation, because of inaccessibility, create additional problems. However, need-specific resource characterization or zonation (covering biophysical and socioeconomic variables) is essential to impart the mountain perspective into regional development interventions. Recent advances in information management and presentation through geographic information systems (Partap et al., Chapter 15) can be used to facilitate the task.

### **FACTORS DETERMINING SUSTAINABILITY**

The sustainability of mountain agriculture can be defined to mean the latter's ability to maintain and enhance its production performance without damaging its long-term production potential. The sustainability or unsustainability status of agriculture can be reflected through the health and productivity of the biophysical resource base, yields and returns from various production activities (e.g., crops, livestock), pace and pattern of resource regeneration, extent of dependence on biophysical, chemical, and financial subsidization to keep up the production-consumption exchange processes, degree of desperation in resource use or extraction, recourse to inferior options in the field of production, consumption, and resource management, and people's access to resources or products and its dependability. Jodha (Chapter 2) lists a number of persistent negative trends in mountain areas as indicators of emerging unsustainability.

A focussed analysis of issues covered by the discussion in this volume can help identify the factors and processes contributing to the sustainability or unsustainability prospects for agriculture and related activities in mountain areas. For example, (1) the level of and control of demand on mountain resources through human and animal population growth and market-induced resource extraction, (2) macro-level policies and their sensitivity to mountain-specific conditions, (3) the control and use pattern of mountain 'niche', (4) the level and structure of investment in the mountains, and (5) the level and manner of incorporation of the mountain perspective into development interventions, especially those relating to agricultural technology, institutional innovation, investment strategies, and the linking of micro- and macro-level perspectives.

Relating these indicators of sustainability to the above-mentioned factors can be done more easily by referring to unsustainability. Accordingly, it can be stated as follows:

- (1) A persistent deficit in products and services to meet the current and/or growing demands on a system, e.g., mountain agriculture (without external subsidization) is the key indicator of unsustainability.
- (2) Efforts to correct the gaps between demand and supply may reveal an inventory of factors that succeeded or failed in closing them.
- (3) If the situation remains unrectified, the system (e.g., mountain agriculture) may have another set of responses that are 'inferior' in terms of the available quantity and quality of products and services and measures focussing on short-term extraction with no concern for the future.
- (4) One aspect, related mainly to (2) and partly to (3), is concerned with the viability of the method and approaches to achieve (1). In the dynamic context of development (or sustainability), the viability and continued effectiveness of the (technological and institutional) measures taken are as important as the goal they are directed towards. Often development processes are unsustainable because approaches and mechanisms to achieve them are not sustainable. The collapse of development tempo or development strategies in several areas, following the withdrawal of subsidies, external support, or 'special drives', illustrate this.

It is much easier to describe the current state of mountain agriculture and its development strategies in the sustainability framework and pinpoint the role of different factors in the above four contexts. This is briefly done below.

### General Scenario

The persistent deficit of products and services (unless subsidized from outside) from mountain agriculture is quite widespread in most of the mountain areas. The contributory factors, from the demand side, are the rapid growth of both the human and the livestock population as well as distant market-induced demands, including the one created by the state's resource-extraction policies.

The general failure of efforts to bridge the demand and supply gap is also quite visible in most of the mountain areas. First, the traditional methods of pressure (demand) management (e.g., migration, reduced consumptions) are less feasible. Second, through welfare measures, health facilities (though poorer in the mountains than in the plains), and side-effects of certain development activities (e.g., animal distribution to small farmers), human and animal pressures on the land are accentuated.

Regarding the regulation of pressure due to market- and state-induced extractions, not much has been achieved in spite of frequent changes in laws and levies. The efforts to balance the deficit by resource regeneration have not succeeded in most of the areas.

The measures to augment local supplies (except in progressive agricultural areas) have not made enough headway. Wherever supplies of products and services (horticultural products, irrigation water, and hydropower) are increased, their impact on the local situation is much lower due to the unfavourable terms of trade faced by mountain areas in supplying such surpluses to the plains.

As a net situation, both in progressive areas and in stagnant areas, second order responses indicating the choice of inferior options, such as higher resource extractions, reduced quantity and quality of products and services, and outmigration, are visible. Resource degradation is a final indicator of second-order responses to persistent deficit.

Macro-economic policies, such as investment strategies, project priorities, and the harnessing of mountain 'niche', are largely geared to raising production potential and production from mountain resources. They represent step (2), namely, efforts to balance demand and supplies through promoting the latter. However, due to their insensitivity to mountain-specific conditions, the majority of them have not succeeded in spite of continued subsidization and external support.

Even the micro-level initiatives at project or village level have had the same fate as macro-level policies.

### **Specific Cases: Success Stories**

In contrast to the generalized situation described above, there are specific cases where the above-listed stages of sustainability, i.e., demand supply gaps, efforts to bridge them, choice of appropriate mechanisms, and their viability varied. The already mentioned success stories in the fields of resource management, technology development and diffusion, diversified and interlinked activities, local resource mobilization, and people's participation were able to handle the unsustainability problem successfully. Most of these activities, knowingly or unknowingly, incorporated the mountain perspective into their design and implementation.

### **LEAD ISSUES AND FUTURE DIRECTIONS**

The previous discussion on the prevailing situation in mountain areas as well as the performance and impacts of different interventions has helped to identify the issues and factors that are central to the sustainable development of mountain agriculture and mountain areas in general. This section recapitulates the major issues and focusses on their integration into holistic development policies and programmes. Most of the issues are interrelated, but we have attempted to put them into the following categories: the focus on the mountain perspective framework; the harnessing of replicable development experiences and the utility of zonation; resource allocation issues and impacts; institutional dimensions, including people's participation and the incorporation of traditional know-how in development designs; science and technology for the mountains; and managing the demand factor. Some of these issues are summarized in ICIMOD-MFS (1990e).

Within each of the above categories, even at the cost of some repetition, we refer to the reason or rationale for emphasizing particular factors and their role in sustainable development, and in addition practical steps to strengthen the factor concerned.

### **Requisite Focus on the Mountain Perspective**

The inferences from conceptual work and the evidence from field studies, as well as reviews of development interventions, strongly suggest that, in order to impart greater relevance and effectiveness to development activities in mountain areas (at policy and programme levels), greater emphasis should be placed on the mountain perspective. This implies the explicit consideration of mountain specificities and their implications while conceiving, designing, and implementing development activities. This, in turn, would mean considerable reorientation of development strategies for mountain areas. Any ef-

fort, on this front, would be useful in ensuring the long-term sustainability of mountain resources and activities based on them, including agriculture.

The important steps to implement the above recommendation include the following.

- (1) Making the mountain perspective framework an integral part of the processes used for evolving development decisions and actions in these areas.
- (2) To facilitate (1), the framework must first be made operational by simplification and practical demonstration of the concepts and issues involved. This could be attempted through various forms of action research in which past development decisions and actions and future ones are assessed with reference to mountain specificities at regional, national, district, or village (valley) levels. Using the experiences of and an understanding of action research, the procedures and methods (including data needs) can then be presented in the form of user friendly manuals and modules which help in the application of a mountain perspective framework in the context of programme contents at different decision-making and spatial levels.

It may be added that the above-mentioned procedures will vary in the use of the mountain perspective for macro-level decisions as against micro-level decisions (e.g., project formulation).

- (3) An equally important prerequisite for the effective use of a mountain perspective framework for sustainable development involves the awareness and skills of its users. The users may range from high-level policy or decision makers to project people and farmers working at the village level. The sensitization or training requirements of potential users at different levels will, however, vary.

The key requirement, as indicated by the above comments, is that, in order to make it a useful tool in the decision-making procedure, a mountain perspective framework has to be taken out of the pure research mode and put into the action research or operational mode. A small beginning has already been made by ICIMOD in terms of the preparation of users' manuals, as well as refinement, operationalization, and field testing of different components of the framework.

### **Harnessing the Potential of Replicable Experiences**

Despite the sociocultural differences and ecological heterogeneity of different areas covered by the ICIMOD studies, the situation in many parts of the HKH region showed remarkable uniformity in several respects. This is clearly revealed by the similarities of components that characterized most of the success stories in the four countries. The choice of a lead activity based on mountain 'niche', provision of interlinked ancillary activities, mobilization of local people and resources around such activities, blending of modern science and traditional know-how for technology development, and fiscal support played an important role in the success of several ventures. The commonality of the various elements outlined above suggests that there is scope for the replication of success stories in several areas. Use of replicable development experiences has a number of added advantages in terms of a potentially shorter gestation period, lower costs of trial and error, and lower overhead costs associated with new initiatives. However, in spite of the above factors, replicable development experiences have remained one of the most underused approaches to development in mountain areas. It should form one of the major components for future development strategies in the mountains. The important



steps which could facilitate the harnessing of replicable experiences for the development of mountain areas are as follows.

- (1) This approach should be recognized as a viable, low-cost, and effective approach to development. Recognition of this fact could be translated into various procedures at the project feasibility investigation stage. This recognition can induce action on several other fronts.
- (2) For effective use of replicable experiences, there are a few procedural steps. First, it is extremely useful to have an inventory of replicable experiences from comparable ecological zones. The next step includes documentation of the conditions associated with the success of specific projects. The third step includes a search for comparability of the above conditions in the areas where replication could be initiated. Finally, on-site sensitization or training of the planners and implementers of the projects in new areas, through visits and work on the successful projects, can facilitate replication.
- (3) To take fuller cognizance of the inter-regional or inter-locational differences in different circumstances, which could obstruct replications, it is useful to characterize the concerned success story in terms of ecological setting, lead time involved, technological and institutional mechanisms employed, external support, and local resource mobilization required (including people's participation).

In view of the possible lower costs and greater effectiveness, as well as well-documented procedures to conceive, design, and execute projects based on replicable experiences, this could be an area of significant interest for agencies interested in mountain development. National governments, through bilateral arrangements, could greatly benefit by using the above approach.

### **A Fresh Look at Resource Allocation and Investment Priorities**

In spite of their relative neglect in comparison to the plains in the past, the mountains have received considerable public investment during the last two to three decades. Yet the pay-offs to investment in terms of development impacts are neither uniform nor very encouraging. This is more so in the case of public sector investment, including subsidies. This is partly because of the gross inadequacy of investment in relation to the magnitude of requirement and partly because of the resource allocation patterns followed. The bulk of the public investment, even through donors, is in infrastructural development and this has longer gestation periods. Yet, the significant understanding and evidence revealed by the studies indicate that, where sufficient attention (investment) is not given to ancillary and related activities, the ability of mountain areas to benefit from infrastructural development has remained low. The comparison of cases, in which the totality of the situation was met with an integrated approach compared with those cases where partial or sectoral approaches were predominant, amply demonstrates this. Past experience suggests that some active steps can be taken to increase the impacts of public investment in mountain development.

- (1) The focus on infrastructural investment should be diluted by giving equal attention to ancillary sectors that facilitate fuller and faster use of infrastructure. Consideration of

road construction, energy development, agricultural technology diffusion, marketing, and processing as part of a package can improve the effectiveness of investment.

- (2) Even in sectoral programmes, such as road construction or agricultural technology development or diffusion, diversity should be introduced to cover wider and varied situations rather than concentrating on one or two options, as conventionally happens.
- (3) A focus on options, with a comparative advantage for mountain areas, as lead sectors, could be the first step in reorienting development programmes. Support systems and a choice of ancillary activities can be designed with reference to the lead sectors. This can act as a more effective basis for an 'integrated approach' to sustainable development in different ecozones.
- (4) Small-scale 'niche' as a basis for local lead-sectors in development programmes are a strong candidate for investment choice. Moreover, in addition to their equity implications, such options can prove more conducive to the development of private enterprises and the mobilization of local resources.
- (5) What has been stated in (1) to (4) above could be more easily designed by understanding and using the mountain perspective framework mentioned earlier. The already mentioned ICIMOD plans to operationalize the mountain perspective framework will include such cases. However, this initiative needs to be strengthened by the support and involvement of other agencies.

#### **Focus on Micro-level Realities: Important Dimensions**

Because of factors such as inaccessibility, diversity, and people's adaptation mechanisms in mountain areas, the focus on micro-level factors can improve the choice of development decisions and interventions. The successful cases covered by the ICIMOD studies clearly demonstrated this fact. The important areas where greater attention to local level factors and concerns can enhance the prospects of sustainable development are as follows.

- (1) Involvement of local people in identifying the components of local development projects and the means and mechanisms to implement them effectively. The people's better understanding of their resource base and environment, institutional strength, and self-help devices are responsible for this. Local involvement would also facilitate the people's access and command over local resources. The external input could be in terms of fiscal resources and technological support (including advice).
- (2) People's involvement or participation can be more easily mobilized around any lead activity clearly understood by the local community. The equity of gains from such activities may enhance the participation. The formation of user groups and the mobilization of collective resources have already been demonstrated as the gains of such an approach. Lower investment needs and lower operational costs emerge as by-products of activities focussed on local participation.
- (3) One of the most significant uses could be made of macro-level realities by evolving relevant technologies for mountain agriculture. The newly emerging trend of using the rationale of traditional technologies and resource management systems, through on-farm research, for technology development, is a step in this direction. This could be further strengthened to ensure resource use intensification without resource degradation. The extension and use of new technologies developed in this way would be

easier to spread. Such technologies would be sensitive to the requirements of total farming systems rather than their individual components.

- (4) Advocacy for the mountain people and the mountain cause (i.e., local concerns, resource security, equity, and the gender perspective) can be strengthened by a better understanding of micro-level perspectives.

### **Science and Technology**

As already mentioned in different contexts, science and technology issues need reiteration, because the whole question of resource use intensification is closely linked to the prospective technologies for mountain agriculture and mountain resource use in general.

The central focus of science and technology for the mountains has to be on mountain specificities as a source of constraints and opportunities which can be managed or harnessed through modern science and technology. Approaches would involve:

- (1) combining resource-centred and crop-centred technologies to achieve higher productivity without resource degradation;
- (2) blending the rationale of traditional systems (e.g., folk agronomy, ethno-engineering, indigenous agroforestry) with modern technologies;
- (3) reformulating the global issues of science and technology and their environmental and productivity consequences in the mountain context;
- (4) protecting and harnessing mountain biodiversity as a repository of elements for prospective technological options for sustainable agriculture;
- (5) focussing on the wider adaptability of technologies, without ignoring the location specificities, using the understanding and guidelines provided by zonation exercises; and
- (6) ensuring that the technology for mountain agriculture has an integrated approach covering all land-based activities, ranging from annual crops to forestry, to be relevant to the totality of mountain farming systems.

An important prerequisite for implementation of the above perspectives is the reorientation of agricultural R&D policies for the mountains. This would involve: (1) changes in research resource allocation, (2) changes in areas, products, and their attributes as focussed upon by research, and (3) a partnership between researchers and farmers. However, in light of the required skill levels of mountain people for off-farm employment, processing, and related activities to harness the micro-'niche' of mountain areas, the scope of new science and technology in the mountains need not be confined to agricultural production and conservation areas only.

### **Management of the Demand Factor**

No amount of improvement on the supply side through changed investment strategies, resource upgrading, and productivity gains will prove sustainable unless the pressure of the demand on mountain resources is controlled and regulated. Controlling population growth and the market-induced overextraction of resources are insurmountable problems in the near future. However, if the successful experience of a few initiatives in the HKH

region are any indication, the following steps may, to some extent, help reduce pressure on the land and reduce the overextraction of resources.

- (1) Emphasis on skill formation and support facilities for agro-based processing and marketing activities to increase off-farm employment and check the growth of pressure on land. Modernization of agriculture (crop, horticulture, livestock enterprises) can open up several avenues for ancillary activities.
- (2) Diversification of agriculture, through activities such as beekeeping and small-plot, intensive cultivation of special products such as flowers and medicinal plants, appears to be a viable strategy for reducing land pressure in certain areas.
- (3) Involvement of people in local resource management has proved to be cost-effective and a method of decreasing the overexploitation of forest-related resources.
- (4) Biophysical compensatory measures, besides the monetary costs for resource extraction (e.g., planting a tree for a removed tree), could be an innovative approach to balancing resource extraction and regeneration. In some parts of the HKH region, it has already been tried.

Measures similar to the above should form part of the innovative approaches by governments and donors for pressure management in mountain areas. Of course, there are no complete substitutes for controlling the human population and for the strict regulation of resource extraction in mountain areas. In this respect, it is useful to mention that greater emphasis on human resource development, through improvements in the education and economic status of women, can go a long way to changing the situation. Thus, focus on the gender perspective in mountain development deserves attention for more than one reason.

For centuries, the physical isolation of mountain areas has forced mountain people to respond to the different challenges posed by natural forces, the limitation of natural resources, and the changes in political and economic conditions. To the extent that these changes were of a limited scale, mountain people dealt with them in sustainable ways. Today the problems are on a much larger scale and so are the potentials in terms of technology, inputs, and economic diversification. These potentials, however, cannot be harnessed in a sustainable manner without the rapid development of human resources. Human resource development has lagged behind in mountain areas. Sustainable development emphasizes the need to fully develop the skills of the mountain people so that they can respond to the challenges and opportunities created by the changing economic and environmental conditions.

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