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MOUNTAIN PERSPECTIVE AND SUSTAINABILITY: A FRAMEWORK FOR DEVELOPMENT STRATEGIES

N.S. Jodha

N.S. Jodha is the Head of the Mountain Farming Systems Division, International Centre for Integrated Mountain Development (ICIMOD), G.P.O. Box 3226, Kathmandu, Nepal

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INTRODUCTION

The dominant scenario characterizing most of the mountain regions in developing countries, particularly in the Hindu Kush Himalayan region, is the widening gap between development efforts (indicated by investment and public interventions) and corresponding achievements in terms of measurable economic gains as well as qualitative changes such as the health and production potential of the natural resource base and environmental consequences.

Even in a short period, over the last 40 to 50 years, several alarming trends have emerged. There are, in this region, clearly visible, persistent negative changes relating to crop yields, availability of mountain products, the economic well-being of mountain people, and the overall condition of environmental and natural resources (Rieger 1981). For instance, compared to the situation 50 years ago, at present the extent and severity of landslides is higher, water flows in traditional community irrigation systems are lower, yield of major crops in the mountains (except in highly patronized pockets) are lower, diversity of mountain agriculture is reduced, regenerative processes based on organic linkages between different land-based activities are weakened, the inter-seasonal hunger gap (food deficit period) is longer, time spent by villagers for collection of fodder and fuel from neighbouring uncultivated areas or common property lands is longer, the botanical composition of species in forests and pastures has undergone negative changes, and, finally, poverty, unemployment, and out-migration of people are higher in the hills. Ives and Messerli (1989), Sanwal (1989), Blaikie (1985), ERL (1989) refer to some of these in the Himalayan context. As a part of the studies on sustainable mountain agriculture, under the farming systems' programme at ICIMOD, field-level information on some of these changes has been collected from selected mountain areas of Nepal, India, Pakistan, and China. These persistent negative changes, to be discussed later, are considered to be indicators of unsustainability. The almost parallel emergence of unsustainability indicators, along with the acceleration in development efforts in mountain areas, is a matter of serious concern and it calls for a fresh look at the conventional approaches to mountain development.

A rethinking on development strategies for mountain areas, in general, and mountain agriculture, in particular, may start with the development of an operational framework that incorporates the sustainability concerns. The latter can facilitate proper assessment of constraints and potentialities of mountain areas, as well as conception and design of policy and programme options suited to the specific situation of these areas. The central focus of such a framework will be on the mountain perspective, the understanding and incorporation of which alone can determine the relevance and effectiveness of any development intervention in mountain areas (Rhoades 1988). The 'mountain perspective', described simply, means explicit or implicit consideration of specific mountain conditions or characteristics and their implications while designing and implementing activities in mountain habitats. In fact, the preliminary enquiries into factors and processes contributing to the above-mentioned negative changes indicated that the latter are largely a consequence of disregard of specific mountain characteristics and their operational implications by public and private interventions in these areas.

In the following pages, we first discuss the mountain perspective by elaborating on specific mountain characteristics and their implications. The development imperatives

of mountain specificities are discussed next. Consideration of development imperatives of specific mountain characteristics provides a completely different perspective on the development approach and strategies for mountain areas. The relevant dimensions of this approach and the conventional development approach, in mountain areas, are compared to illustrate the point.

This is followed by a discussion on the sustainability issues in the mountain context. The role of mountain specificities in designing sustainable development approaches is discussed. The paper draws on the ideas, issues, and evidence discussed by the author elsewhere (Jodha 1989a, 1989b, and 1990a).

THE MOUNTAIN PERSPECTIVE

As stated earlier, the mountain perspective implies explicit or implicit consideration of specific mountain circumstances and their implications while conceiving and implementing private or public activities in mountain areas at different levels of decision-making. We may elaborate on these specificities of mountain habitats and resources.

Mountain Specificities

The important conditions characterizing mountain areas which, for operational purposes, separate mountain habitats from other areas are called here 'mountain specificities'. The six important mountain specificities (some of which might be shared by other areas such as deserts in the plains) are considered here. The first four, namely, inaccessibility, fragility, marginality, and diversity or heterogeneity, may be called first order specificities. Natural suitability or 'niche' (including man-made ones) for some activities or products in which mountains have comparative advantages over the plains and 'human adaptation mechanisms' in mountain habitats are second order specificities. The latter are different from the former in the sense that they are responses or adaptations to first order specificities. Nevertheless, they are specific to mountains (Jodha 1989a). Before describing the major mountain 'specificities', it should be noted that these characteristics are not only interrelated in several ways but within the mountains they show considerable variability. For instance, all locations in mountain areas are not equally inaccessible, fragile, or marginal. Neither do human adaptation mechanisms have uniform patterns in all mountain habitats. With full recognition of such realities we may briefly introduce the mountain specificities.

Inaccessibility

Due to slope, altitude, overall terrain conditions, and periodical seasonal hazards (e.g., landslides, snow, storms) inaccessibility is the most known feature of mountain areas (Price 1981, Allan 1986, and Hewitt 1988). Its concrete manifestations are isolation, distance, poor communication, and limited mobility. Besides the dominant physical dimension, it has sociocultural and economic dimensions (Jodha 1989a).

Fragility

Mountain areas, due to altitude and steep slopes in association with geologic, edaphic, and biotic factors that limit the former's capacity to withstand even a small degree of dis-

turbance, are known for their fragility (DESFIL 1988). Their vulnerability to irreversible damages, due to overuse or rapid changes, extends to physical land surface, vegetative resources, and even the delicate economic life-support systems of mountain communities. Consequently, when mountain resources and environment start deteriorating due to any disturbance, it happens at a fast rate. In most cases, the damage is irreversible or reversible only over a long period (Eckholm 1975 and Hewitt 1988).

Marginality

A 'marginal' entity (in any context) is the one that counts the least in the 'mainstream' situation. This may apply to physical and biological resources or conditions as well as to people and their sustenance systems. The basic factors contributing to such a status of any area or community are remoteness and physical isolation, fragile and low-productivity resources, and several man-made handicaps which prevent participation in the 'mainstream' patterns of activities (Blaikie and Brookfield 1987, Chambers 1987 and Lipton 1983). The mountain regions, being marginal areas in most cases as against prime areas, share the above attributes of marginal entities and suffer the consequences of such status in different ways (Jodha 1989a and 1989b). Several entities acquire marginal status when they are linked to dominant entities on unequal terms. In several cases mountain areas too pass through this process.

Diversity or Heterogeneity

In mountain areas, one finds immense variations among and within ecozones, even within short distances. This extreme degree of heterogeneity, in the mountains, is a function of interactions of different factors such as elevation, altitude, geologic and edaphic conditions, steepness and orientation of slopes, wind and precipitation, mountain mass, and relief of terrain (Troll 1988). The biological adaptations and socioeconomic responses to the above diversities also acquire a measure of heterogeneity of their own (Price 1981 and Jochim 1981). The diversity or 'heterogeneity' phenomenon applies to all mountain characteristics discussed here. Diversity acts as a positive attribute for the interlinked activity patterns and should serve as the true basis for assessing mountain areas' carrying capacity.

'Niche' or Comparative Advantage

Owing to their specific environmental and resource-related features, mountains provide a 'niche' for specific activities or products. At the operational level, mountains may have comparative advantages over the plains in these activities. Examples may include a specific valley serving as the habitat for special medicinal plants; mountains acting as a source of unique products (e.g., some fruits, flowers); and mountains serving as the best known sources of hydropower production. In practice, however, 'niche' or comparative advantages may remain dormant unless circumstances are created to harness them. However, mountains, owing to their heterogeneity, have several, often narrow but specific 'niches' which are used by local communities in the course of their diversified activities (Whiteman 1988 and Brush 1988). Proper harnessing of 'niche' can support sustainability while their reckless exploitation can result in elimination of 'niche'.

Human Adaptation Mechanisms

Mountains, through their heterogeneity and diversity, even at micro-level, offer a complex of constraints and opportunities. Mountain communities, through trial and error over the generations, have evolved their own adaptation mechanisms to handle them (Pant 1935, Guillet 1983, and Jochim 1981). Accordingly, either mountain characteristics are modified (e.g., through terracing and irrigation) to suit their needs or activities are designed to adjust the requirements to mountain conditions (e.g., by zone-specific combinations of activities, crops). Adaptation mechanisms or experiences are reflected through formal and informal arrangements for management of resources, diversified and interlinked activities to harness the micro-'niche' of specific ecozones, and effective use of upland-lowland linkages (Allan 1986, Forman 1988, Brush 1988; and Whiteman 1988). Adaptation mechanisms helped in the sustainable use of mountain resources in the past. However, with the changes related to population, market, and State, a number of adaptation mechanisms are losing their feasibility and efficacy. It may be noted that understanding their rationale can help in the search for sustainability.

OPERATIONAL IMPLICATIONS OF MOUNTAIN SPECIFICITIES

There is a rich body of literature in which students of mountain ecology, mountain ethnosciences, and mountain geography in particular have described the above features for different mountain systems (Price 1981, Ives and Messerli 1989, and Allan et al. 1988). However, to enhance their direct usability in the search for sustainable development in mountain areas, one needs to spell out their operational implications. This is essential to influence the decision processes affecting different activities in the mountains. The operational implications can, in turn, be described as (1) objective circumstances which can be easily understood and incorporated into policy and programme designs and (2) dependent patterns of activities, including traditional practices and patterns of resource use as well as conventional development interventions.

Objective Circumstances

Objective circumstances imply a set of constraints and potentialities that influence the choice and pattern of activities in the mountains. Distance, physical isolation, high transport cost, poor mobility, difficulties of logistics and infrastructure, vulnerability to risks due to human action and natural hazards, limited input absorption capacities, limited production opportunities, and limited exposure to and limited replicability of experiences from the plains are some of the important elements of objective circumstances in mountain areas. Mountain features such as inaccessibility, fragility, and marginality contribute to them in different ways. On the positive side, the scope for diversified activities and the presence of often unique but narrow high potential areas and activities are also a part of objective circumstances in mountain areas. Understanding of the objective circumstances or the complex of constraints and opportunities created by mountain specificities and their required resource management practices may help in designing appropriate strategies for sustainable development of mountain areas. In other words, mountain specificities can serve as a useful tool for identification of options which can or cannot serve the goal of sustainability. This will be clear from the ensuing discussion.

Dependent Patterns of Activities

Dependent patterns of activities include patterns of resource use as well as types of production, consumption, and exchange activities, directly or indirectly conditioned by the above-mentioned objective circumstances in mountain areas. They include both the traditional arrangements and practices and present-day public interventions. They represent human efforts, through technological and institutional means at individual and collective levels, to adapt to mountain circumstances or to adapt the latter to human needs. Understanding of the two-way adaptation processes and their consequences can help in identification of elements for sustainable development strategies.

Annex 1 summarizes the operational implications of mountain specificities to illustrate the points mentioned above. For convenience of presentation and understanding they are put under (1) objective circumstances and (2) dependent patterns of activities (i.e., two-way adaptation under traditional systems and present-day development interventions). Annex 1 also summarizes the consequences of recent changes vis-à-vis mountain specificities and the imperatives of objective circumstances for development interventions.

MOUNTAIN DEVELOPMENT WITH THE MOUNTAIN PERSPECTIVE

The inventory of issues and aspects covered by Annex 1 can be easily expanded and supported with quantitative evidence from different mountain areas. The dependent patterns of activities may offer insights into approaches to handle mountain situations and their limitations. Objective circumstances associated with each mountain characteristic and their imperatives for development interventions can provide broad ideas on how a given mountain characteristic should and should not be handled. Space does not permit elaboration on development imperatives of each mountain characteristic. Hence, in the following discussion, we deal with relatively broader issues where major dimensions of mountain specificities (e.g., their interrelationships) are emphasized. Moreover, under the conventional development approaches, as under specific projects, imperatives of individual mountain characteristics (as constraints or opportunities) are better understood and treated than the imperatives of interrelationships between different mountain characteristics. However, for overall development strategies, consideration of the latter is more important. Hence, the development imperatives of mountain specificities as a group are discussed below. The focus of the discussion will be on (1) the conventional development paradigm and the mountain context and (2) the prospects of sustainable development for mountain agriculture—the dominant activity of mountain people.

CONVENTIONAL DEVELOPMENT PARADIGM

Admittedly, present-day development interventions are a recent phenomenon in mountain areas. Generally, these interventions are inspired and conceived exogenously. Often, they involve pace, scale, priorities, and operating mechanisms not well known to mountain areas and people. Most importantly, the development interventions are based on approaches and models which were not conceived and designed for mountain areas. Consequently, they have generally proved to be less relevant and quite ineffective to handle the problems of mountain areas. This is revealed by poor economic performance, overexploitation of

mountain resources, disregard of equity issues, and extreme environmental perturbation (Rieger 1981, Forman 1988, and Sanwal 1989). Discontinuities between conventional development approaches and mountain conditions can be demonstrated at different levels of development interventions (Sanwal 1989). This can be illustrated by comparing some essential features of the conventional development approach and the development approach based on the mountain perspective.

In conceiving a conceptual or operational framework for the development of mountain areas, the key factors to be considered are those that separate the 'mountain' from other areas, for example, slope and altitude (Forman 1988). Compared to the two-dimensional spatiality of the plains, mountain habitats are characterized by three-dimensional spatiality. The additional dimension obstructs the applicability of developmental or other experiences of the plains to the mountains. Because of slope and altitude, and associated conditions or characteristics (which in this paper we call mountain specificities), mountains, examined from the perspective of the plains, are often considered to be relatively difficult environments to live in and in which to replicate development experiences accumulated in the plains. But despite such a perception, the fact remains that mountains have historically been the habitats of flourishing civilizations, with the clear-cut markings of mountain conditions on the complexes of production, consumption, and trading activities (Keay 1977). Furthermore, both societies and economies in mountain areas have never been static. A gradual transformation, involving a two way process of adapting sustenance strategies to mountain characteristics and vice versa, has been an integral part of the 'living mountains' (Von Furer-Haimendorf 1981, Ellen 1981, and Brush 1988). A clear understanding of these phenomena is a crucial prerequisite for correcting the approach to mountain problems and for the initiation of relevant development interventions to handle them. The first step in this direction is to understand mountain characteristics and their development imperatives.

DEVELOPMENT IMPERATIVES OF MOUNTAIN SPECIFICITIES

A consideration of a complex of varying degrees of the already mentioned mountain characteristics, their multiple dimensionality, and their interrelationships (which underlie the issues and aspects illustrated by Annex 1) would give a contextual perspective to decisions and actions in mountain areas. A sensitivity to such a mountain perspective would determine the relevance and effectiveness of any development activity in mountain areas. This is elaborated below by highlighting the development imperatives of the major attributes of mountain specificities and circumstances created by them. The dimensions of mountain specificities which help highlight the gap in the conventional development approach are briefly discussed below.

Multidimensionality

As stated earlier, most of the mountain specificities have biophysical, socioeconomic, and cultural dimensions. For instance, diversity is found in the physical and biological features of mountains as well as in the socioeconomic and cultural life of mountain people. The same may apply to the characteristics of fragility and marginality. Incidentally, production and productivity-wise, marginal and fragile areas often coincide with the habitats of

marginal plants and marginal people. Inaccessibility, too, has physical and socioeconomic (as reflected by inequalities) dimensions. 'Niche' that impart comparative advantages to the mountains, primarily relate to the physical and biological resource base but in some sense may relate to the special skills, attitudes, and management approaches of mountain communities.

The complex of mountain specificities and their multiple dimensions help in presenting an array of positive and negative attributes of mountain situations. The focus of development interventions should be on protection and enhancement of positive attributes and maximization of their role in development interventions. The opposite could be said about the negative attributes. An understanding of these attributes can greatly help in determining development goals and priorities and in designing operational programmes. Table 2.1 illustrates the situation by indicating a few possible approaches for treating the positive and negative attributes of mountain conditions. For instance, while it suggests a reduction in physical fragility by conservation and stabilization support, it emphasizes the protection of botanical fragility (represented by potentially disappearing, delicate plants) as a source of biological diversity. Similarly, while it suggests the maintenance of physical and biological diversity, it calls for a reduction in economic diversities (e.g., inequalities) and encouragement of social integration with protection of diverse values. The table suggests the need for reducing marginality of all types. More examples can be seen from the table. Most of the suggestions may sound 'normative' (i.e., based on norms emerging from one's value judgements and biases). However, our purpose, instead of sermonizing, is to put together a range of possibilities that should find a place in public interventions addressed to the sustainable development of mountain areas. These possibilities highlight the need for widening the focus (objectives and approaches) of development interventions.

Interlinked Mountain Specificities

Yet another important feature of mountain specificities is that most of them are interlinked in two ways: (1) commonality of causative factors and (2) shared consequences of disturbance to each other.

Common Causes

It is well known that most mountain conditions (specificities) share common causative factors. If the relevant factors are grouped under habitat and society (Price 1981 and Whiteman 1988), and related to mountain specificities, the point becomes quite clear. The degrees of diversity, fragility, marginality, human adaptations, and inaccessibility are, in different measures, directly linked to factors such as elevation, slope angle, slope orientation, and exposure. Similarly, climatic factors, such as precipitation and micro-climate, also contribute to the degree of diversity, fragility, marginality, and human adaptations. Socioeconomic factors, such as ethnicity, type of economic activity, and resource management patterns, play a major role in determining the degree of diversity, marginality, etc of mountain communities. Owing to the above relationships, any intervention disturbing the underlying common factor will affect other related specificities.

Table 2.1. Mountain specificities and their development implications

Mountain specificities	Dimensions and major imperatives for development interventions: Physical (climatic, edaphic)	Biological	Social/ cultural	Economic
Inaccessibility	Reduce through multiple options such as roads, ropeways, waterways, telecom	Explore and develop as new available resources (e.g., unexplored, unexploited genetic resources)	Reduce through education, participation, and support systems	Reduce disparities Improve access to special programmes for target groups
Fragility	Reduce by stabilization, conservation measures Restricted use and other conservation measures	Conserve by R&D and other support systems (e.g., endangered genetic resources/species)	Protect value systems/ institutions endangered by development	Strengthen sustenance capabilities through dependable options
Marginality	Reduce and prevent by physical and biological measures	Conserve and reduce by R&D support	Reduce by institutional reforms and support systems	Reduce by special support programmes opportunities
	Regulated use intensity	Integrate with farming systems development	Prevent by controlling negative side effects of development interventions	Prevent backlash of development
Diversity	Diversified/ decentralized approach to use and development options Homogenize some resource categories by irrigation, landshaping, etc.	Harness, enhance through support systems, infrastructure, R&D	Protect and orient to integration	Reduce inequalities Strengthen diverse options/flexibilities
'Niche'/ comparative advantage	Prevent overexploitation and its negative side effects	Harness by support systems, infrastructure prevent overexploitation	Encourage traditional skills and crafts	Harness with better terms of trade
Adaptation experiences/ mechanisms	Incorporate ethnoengineering knowledge in development interventions	Incorporate folk knowledge of resource utilization/ conservation in development options	Incorporate rationale of traditional practices in development activities	Complement new interventions with traditional economic activities

Source: Author.

Shared Consequences or 'Externalities'

Partly because of the commonality of causative factors and partly because of their crucial interdependence at usage level, a number of mountain characteristics are invariably influenced by any disturbance or treatment extended to any of them. The consequent

impacts could be negative or positive. For instance, when an inaccessibility problem is handled by the construction of a road in mountain terrain, the fragility, due to steep slopes and associated vegetation, is negatively affected.

Similarly, in the marginal and fragile areas, the improved accessibility may encourage a rate of resource extraction higher than the rate of regeneration of the same resource. Improved accessibility may also shatter the traditional occupational patterns and survival strategies of certain mountain communities. Thus, marginal areas and people may be further marginalized (Bjonness 1983). However, improved accessibility could also integrate the hitherto remote and marginal areas (their people and activities) with mainstream situations and reduce their marginality. Such negative or positive impacts, going beyond the intended purpose, are termed negative or positive 'externalities' by economists.

Table 2.2 presents the possibilities of these externalities of development interventions addressed to specific mountain characteristics. The positive and negative externalities are indicated by (+) and (−) signs respectively. Accordingly, intervention directed to inaccessibility can have both negative and positive side effects on marginality, diversity, 'niche', and adaptation mechanisms. Any treatment of fragility may reduce the degree of marginality and create new 'niche'. But this intervention may have some negative side effects on the degree of diversity and specific adaptation mechanisms associated with fragility.

Table 2.2. Externalities of development interventions directed to different mountain specificities

Mountain characteristics focussed by intervention	Impacts on other mountain characteristics and related activities					
	Inaccessibility	Fragility	Marginality	Diversity	'Niche'	Adaptation mechanisms
Inaccessibility		(−)	(−) (+)	(−) (+)	(−) (+)	(−) (+)
Fragility	(+)		(+)	(−)	(−) (+)	(−)
Marginality	(+)	(+)		(+)	(+)	(−)
Diversity		(−) (+)	(−) (+)		(−)	(−)
'Niche'			(−)	(−) (+)		(−) (+)
Adaptation mechanism		(+)	(+)	(+)	(+)	

Note: (−) and (+) indicate positive and negative impacts respectively. In some cases, depending upon the circumstances, the impact could be both negative and positive. The table illustrates the point. A more detailed inventory of externalities (impacts), within their short or long-term context, can be made with reference to specific activities (see Table 2.4 for an illustration).

Source: Author.

Any efforts directed to reduce marginality of all types will generally have positive side effects on other specificities, apart from on people's adaptation mechanisms that have evolved over time to cope with marginal situations. Efforts to reduce diversity/heterogeneity may adversely affect fragile and marginal situations and specific 'niche' (Bjonness 1983). Steps to protect and maintain diversity will have effects almost oppo-

site to the above. Depending on how 'niche' are harnessed (i.e., conserved and used or simply extracted), these steps will influence other mountain characteristics positively or negatively. Finally, any effort to use people's adaptation mechanisms (i.e., their rationale if not the contents) may make development initiatives more sensitive to the rest of the mountain specificities and would ensure positive side effects on them. This is because people's adaptation mechanisms have evolved over time through close association with mountain conditions. The details presented in Table 2.2 are more for illustrative purposes. More cases with reference to specific interventions can be worked out.

Features Constraining Development Norms

Even if they ignore the finer attributes and interrelationships of mountain characteristics, development experts readily perceive the broad features of mountain situations which we have described as 'objective circumstances.' Accordingly, infrastructure, communication, and mobility are three interrelated basic facilities with which the pace of development is closely associated. But the conventional straightforward approach to planning and creation of these facilities is obstructed by the different physical, climatic, biological, and even socioeconomic (e.g., scattered settlement patterns) factors contributing to the 'inaccessibility' phenomenon.

Any attempt to overcome these constraints leads to a second set of constraints. The latter, expressed in the language of development economics, include high overhead costs, long gestation periods (i.e., timespan between initiation and completion of a project), poor pay-off to investment (due to low absorption capacity of the mountains for 'productive' investment), uncertain economies of scale (e.g., gains positively associated with scale of operations), and limited replicability of development experiences generated in the plains. Undoubtedly, other conditions such as fragility and marginality also contribute to the above constraints faced by development planners.

Finally, mountain specificities and their interrelationships throw up several basic issues which are difficult to approach through narrowly conceived development norms and yardsticks. Among them are sustained biodiversity as a part of human heritage, ecological equilibrium and environmental stability, less immediately visible, hydrological and related consequences of development interventions, a variety of upland-lowland linkages, and equity issues in sharing invisible costs and gains of mountain development. The conventional cost-benefit calculus finds it difficult to capture most of them adequately (Paranjpye 1988). Responses of development planners to them will be mentioned later.

BASIS FOR A RESOURCE-CENTRED INTEGRATED DEVELOPMENT APPROACH

The comprehension of the above attributes of mountain specificities reveals several implications and imperatives for approaches and strategies in mountain development. Although casually mentioned in the preceding discussion, they are systematically recapitulated here.

Multidimensionality of Development Goals

The multidimensionality of mountain features calls for basic changes in development

goals. This is implied by the need for appropriate treatment of positive and negative attributes of mountain characteristics for the sustainable development of mountain areas. Development goals and needs should be described and defined in broader terms with an explicit focus on issues such as equity, environmental stability, and, of course, economic betterment. In view of the inter-generational equity issues and inseparability of the long-term health of natural resources and their current use pattern, sustainability should be the explicit component of development objectives. This is in contrast to narrowly conceived goals (per capita income growth, etc.) under the conventional approach to development.

Resource-centred Strategies

Development strategies for mountain areas have to be resource-centred. The resource characteristics (fragility, heterogeneity, 'niche', etc) determine the choice and pattern of resource use, and this in turn should be directed not only to current productivity but to sustained use of the resource base.

Again, due to inseparability of sustainability of the resource base, its use pattern, and its productivity, 'the sustainability goal' itself calls for a resource-centred approach to mountain development. It may be added that by sustainability we do not mean a self-sustaining system that is independent of external links. Conservation and harnessing of mountain potentialities, directly or indirectly through equitable exchange with other regions, are among the essential ingredients of an approach to sustainability.

One may easily contrast the above with the missing resource focus of service or product-centred development interventions (e.g., tourism) or the sectoral and extractive focus of resource-centred interventions (e.g., irrigation, mining) under the conventional approaches (Singh and Kaur 1986, Bandyopadhay and Shiva 1984, Paranjpye 1988, Reppetto 1988, Mahat 1987).

Compelling Basis for Integrated Approach

Since most mountain characteristics—acting as constraints or indicators of resource base potentials—are interlinked due to their broadly common causes and externalities when used, none of them can be treated appropriately in isolation. This forms a compelling basis for an integrated approach to development interventions. Accordingly, while considering any development option, its backward and forward linkages, or side effects also need full consideration and incorporation into the policy and programme designs. This differs from the conventional approach where sectoral projects are also called 'integrated projects' due to their administrative centralization, etc. (Bhati and Swarup 1985, Sanwal 1989).

Planning from Below and Participatory Development

The earlier mentioned 'dependent patterns of activities' represent people's adaptation mechanisms to mountain habitats. They are, in a way, repositories of traditional wisdom and experiences of mountain communities in managing and harnessing mountain constraints and resources. To benefit from this, and also to make development interventions relevant to the heterogeneous conditions of mountain habitats, it is essential that planning

from below become an integral part of the development approach in the mountains. This, by implication, necessitates a greater role for people's participation and decentralization at different stages of development planning and implementation.

Required Broadening of Norms and Procedures

Owing to the already mentioned factors such as (1) the 'objective circumstances' of mountain habitats, (2) their inadequate understanding and projection (by development planners) as merely 'constraints to development', (3) the inadequacies of conventional cost-benefit norms to account for negative and positive externalities associated with development interventions, and (4) the limited replicability of plains development experiences in the mountains, the conventional development models and approaches need significant changes to become relevant to mountain areas. This becomes all the more clear if one contrasts the major features and orientations of the conventional development approaches with these approaches conceived with sufficient recognition of the mountain perspective. Table 2.3 illustrates this by referring to broad orientations and features of the conventional development approach vis-à-vis the approach based on the mountain perspective.

OPERATIONALIZATION OF THE APPROACH

The key message of the above discussion is that, to make development approaches relevant and effective in mountain areas, the latter's specific characteristics should be made a key consideration while designing development interventions. Understanding of mountain specificities and their interrelationships, and their incorporation in development designs, can form a functional and objective basis for an integrated approach to mountain development. Acceptance of this approach may lead to several basic changes in development strategies in the mountains.

Once integration based on mountain characteristics, both at the conceptual and operational level, is achieved, other requirements such as resource-centred development, multiple goals of development, and even participatory development will also be satisfied. It may be pointed out that integrated development, as per the above approach, does not necessarily mean simultaneous adoption of multiple activities. This sort of 'integration', involving simultaneous coverage of all activities, seldom proceeds beyond a computer terminal. The essence of 'integrated development', emerging from an understanding of mountain characteristics, involves the following:

- It involves a two-way adaptation process; therein (1) the specificities are adapted or modified to suit productive activities and (2) activities are chosen and designed in such a manner that they fit well with the constraints and potentialities reflected by resource specificities. Terracing on mountain slopes and the choice of shallow-rooted crops for mountain slopes with thin topsoil are two respective examples of the above.
- Development interventions, broadly speaking, are often of the above two types. Either they are focussed on harnessing the resource or they involve promotion of activities possible in that resource context. However, the two are ultimately interrelated. But the most important point (which is the essence of integrated devel-

Table 2.3. Contrasting features of the conventional development approach and the approach based on the mountain perspective

Broad features of:	
Conventional approach	Alternative approach with mountain perspective
Goals and priorities	
Narrowly focussed—production, productivity, income growth, etc; 'extraction-oriented'; decided exogenously.	Broadly focussed—economic gains, equity, and long-term issues, e.g., environmental stability, sustainability; dictated by mountain specificities.
Resource focus	
Missing: in product and service-oriented interventions; Present: in some but oriented towards extraction only; or highly sectoral.	Resource-centred and integrated as dictated by mountain specificities and inseparability of sustainability of resource base, its use pattern, and productivity.
Forms of integration	
Activity covering full area (a valley, village, watershed); administrative centralization of diverse activities without linkages; simultaneous start of several activities without discarding sectoral focus; linkages with mainstream with dependency potential.	Integration at levels of conception, goal setting, planning, and implementation, as guided by mountain specificities and their linkages, interdependence, externalities, etc.
Norms and procedures	
Investment norms, decision procedures, technologies, and institutions insensitive to externalities, long-term issues.	Sensitive to externalities and long-term sustainability issues; determined by mountain specificities and their linkages; people's participation.
Consequence	
Dominant scenario: Performance lagging behind effort; emerging indicators of unsustainability; backlash of interventions.	Arrest and reversal of unsustainability trends; strengthening of resilience to withstand crises.

Source: Author.

opment) is that while choosing a treatment (or use pattern) for a given resource characteristic, its impacts on other mountain characteristics (e.g., the impact of road construction—to resolve inaccessibility—on physical or biological fragility, on the adaptation strategies of the people, etc.) are fully spelled out. Similarly, the implications of an activity chosen with reference to one mountain specificity for the other related specificities also need clear exposition (e.g., choice of irrigation dam to harness 'niche' characteristics of the mountains and its effects on neighbouring marginal areas, vegetation, and hydrology of the mountains, etc). Another way to look at the integrated approach is to spell out the potential key attributes of a projected activity in terms of its impacts on different mountain characteristics and activities based on them. These impacts could be negative or positive. Preparation

of their detailed inventory can give an idea of trade-offs in order to facilitate a final decision on development interventions. The following Tables 2.4 and 2.5 sketch the essence of the above idea with the help of examples.

Table 2.4. Conceptual framework for dealing with physical inaccessibility through development interventions

	Reduction in inaccessibility[a] using:	
	Conventional approach (e.g., large-scale road network)	Approach with mountain perspective (e.g., multi-option integrated approach involving road, track, rope ways waterways)
1.	*Backlash for other mountain conditions*	*Better accommodation of other mountain specificities and more favourable investment implications*
	a. Damage to slope stability, vegetation (fragility, diversity)[b]	a. Multiple small-scale, widely accessible facilities, less damaging to fragility (diversity, fragility, 'niche' adaptations)[b]
	b. Heavy resource extraction possibility ('niche', marginality, adaptations)	b. Less conducive to high resource extraction ('niche', fragility)
	c. Spatially selective coverage, unequal benefits, (diversity, marginality, adaptations)	c. Reduced extent of total sum of spatial inaccessibilities (diversity)
2.	*Unfavourable investment situation*	
	d. High overhead cost (inaccessibility, diversity, fragility)	d. Lower overhead and maintenance cost, cost sharing by people (diversity, adaptation)
	e. Long gestation period (inaccessibility, diversity, marginality, adaptations)	e. Small-scale, location-specific, short gestation period (diversity)
	f. Under utilisation (adaptations, marginality, fragility, diversity)	f. Readily usable (diversity, adaptation)

[a]Another options to handling the inaccessibility problem is to live with it and concentrate on adaptable activities. Example : emphasis on products with low perishability, low weight, high-value, low seasonality, and low crucial dependence on external inputs; diversification and decentralisation of operations in the field of production, marketing, and support services so that negative impacts of inaccessibility can be minimised.

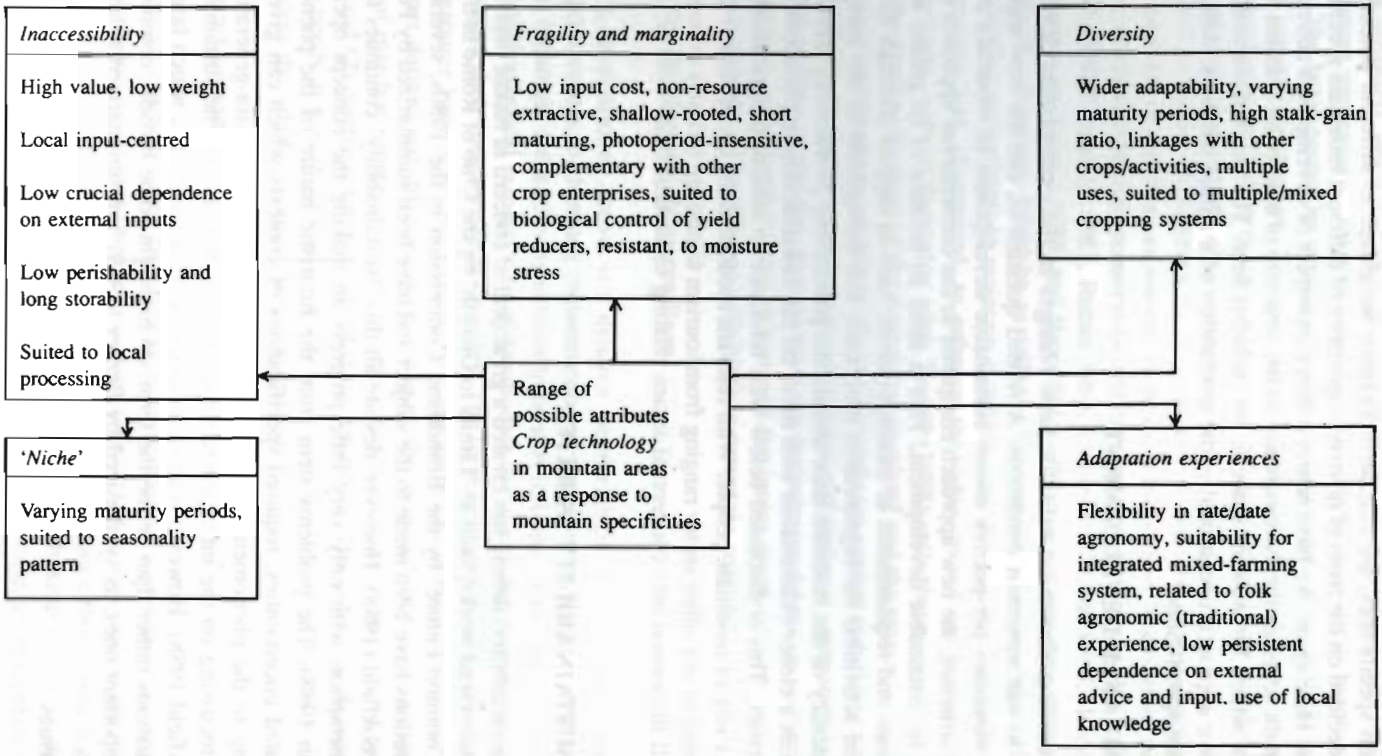
[b]The mountain charateristics to be affected by intervention are indicated in parentheses.

Source: Author.

Table 2.4 indicates the adaptation process wherein one specificity, i.e., physical inaccessibility, is chosen for illustration. We have such examples worked out for all specificities but space does not permit their inclusion. The table shows an approach to handling physical inaccessibility that is different from the conventional approach. In case inaccessibility is not treated, the table indicates the relevant attributes of dependent (adapted) activities which should be promoted by different means.

Table 2.5 illustrates the idea of an integrated approach on which a single activity is focussed. In our case, it is a prospective new crop variety for mountain agriculture. Accordingly, the concerned activity is only one, but its choice is based on an integrated

Table 2.5. Approach to identify attributes of prospective crop technology appropriate to mountain specificities



view of mountain conditions. In other words, its potential attributes, as required by mountain specificities, are indicated. Relative weightage to different potential attributes can be decided on the basis of relative importance of different mountain specificities at any location. Here again, we have nearly a dozen examples of development activities, ranging from credit schemes for the mountains to the structure of marketing systems for mountain villages, which for want of space is not included here. The key requirement for making the above approach operational is the availability of a strong database, differentiated by mountain specificities.

SUSTAINABLE DEVELOPMENT

The preceding discussion calls for basic changes in the conventional development approach to suit mountain conditions. A related question is, can the new approach based on the mountain perspective ensure sustainable development in mountain areas? By its logical structure, the new approach compared to the conventional approach is more conducive to sustainable development. This is more so because of its greater sensitivity to limitations and requirements of mountain areas, built-in support (through diversified, interlinked activities) for regenerative processes, and recognition of the inseparability of sustainability of the resource base and its use pattern and productivity. However, the issue needs a closer examination with focus on the sustainability implications of mountain specificities. This is discussed below with reference to mountain agriculture—the dominant activity of mountain people. With relevant modifications the approach used can also be applied to any other sector ranging from tourism to cottage industry in mountain areas. A small digression into conceptual issues relating to sustainability will be useful at this stage.

THE SUSTAINABILITY DEBATE

The 'sustainability' debate has created a great deal of concern in recent years. Besides the more publicized works, such as 'Limits to Growth' by the Club of Rome in the 1970s and 'Our Common Future' by the Brundtland Commission in the 1980s, several significant contributions have been made to the subject and have been summarized by Pezzey (1989) and Brookfield (1988). However, despite all this, 'sustainability' continues to be a much used metaphor, with only very little progress an making the concept operational. (O' Riordan 1988). The problems stem from the futuristic nature of the phenomenon and associated uncertainties, required specifications of contexts which can give operational meaning to the phenomenon, and the general neglect of the intra-generational aspects while focussing on the inter-generational issues as the core of the sustainability debate (Brookfield 1988). However, various definitions of sustainability, which largely describe the situations rather than define the term, do highlight some broadly common elements. The important ones, as synthesized by Pezzey (1989), are summarized below.

The Issues

Conceptually speaking, the focus of sustainability is on the issues of inter-generational equity. This implies equal (or greater) availability of options, in terms of human well-being

or production prospects, to future generations as to the present one. Theoretical possibilities of such prospects, ensurable through accumulation of capital stock and technology for use by future generations, are constrained by the capabilities of the biophysical resource base. The latter cannot be stretched or manipulated indefinitely, without initiating processes of irreversible damage. This indicates the primacy of biophysical resources in sustainable development. This is more so in the case of agriculture where the dependence on biophysical variables is more direct and crucial.

This could be further highlighted by the operational meaning of sustainability. The operational meaning of the term, as inferred from its definitions or descriptions provided by ecologists, environmentalists, economists, and other scientists (Conway 1985, Raeburn 1984, Tisdell 1988, Chambers 1987, Ruttan 1988, Lynam and Herdt 1988, 'Food-2000' 1987, Markandya and Pearce 1988, and Brookfield 1988), which becomes clearer when related to specific situations, could be as follows: Sustainability is the ability of a system (e.g., mountain agriculture) to maintain a certain well-defined level of performance (output) over time and, if required, to enhance the same, including through linkages with other systems, without damaging what Tisdell (1988) calls the essential ecological integrity of the system. Because of the time factor involved and the system's responsiveness to changing requirements, sustainability is a dynamic (as against static) phenomenon. This distinguishes sustainability from mere subsistence and makes it compatible with development. By picking up the key threads from the mainstream debate on sustainability, we attempt to give operational content to some of the issues involved with reference to agriculture (comprising all land-based activities) in mountain regions.

Primacy of the Biophysical Resource Base

Sustainability, as mentioned above, is a dynamic phenomenon, as reflected through the system's responsiveness to changing requirements. In the more concrete context of agriculture in the mountain areas, this dynamism translates into the capacities of production factors, mainly biophysical resources, to accommodate the increasing pressure of demand without damaging their long-term potentialities. The long-term productivity and health of the natural resource base is in turn affected by the pattern and intensity of its use. Thus, devoid of finer definitional differences, in essence, the sustainability/unsustainability is an outcome of match/mismatch between (1) basic characteristics of the natural resource components and (2) patterns and methods of their utilization. The latter can change (with the changing needs or perceptions of the community), but the former is normally difficult to change unless the whole resource base is transformed.

The Mountain Context

Given its inherent characteristics, the natural resource base of a system (e.g., mountain agriculture) suits only some uses (and use intensity levels). Other uses (unless the resource base itself is modified) cannot be productively maintained without either a high degree of artificial support (e.g., subsidies in chemical, biological, and physical forms) or damage to the inherent capacities of the resource base itself. In either case, inappropriate use of the resource base is a definite step towards long-term unsustainability. This problem is more specific to regions with fragile and marginal land resources such as the mountains

and the dry tropical areas. In such habitats, the unsustainability situation emerges more quickly and in a more pronounced manner. In the natural state in these areas, the range of options ensuring a proper match between resource characteristics and resource use is very narrow. However, due to human ingenuity over the generations, the range of options has been widened. Features of traditional farming systems in these regions corroborate this (Whiteman 1988, Jodha 1988, and Altieri 1987). However, these options, having evolved in the context of low demand on fragile resources, are becoming increasingly unfeasible or ineffective in the context of the new pressures generated by population growth, market forces, and public interventions (Liddle 1975, Rieger 1981, and Jodha 1986). The consequent measures, adopted to meet the situation, such as the extension of cultivation to more fragile and sub-marginal locations, the push towards monoculture induced by promotion of selected HYV crops, or the steps leading to overstocking of grazing lands and deforestation to compensate for the falling incomes, adopted to meet the situation, often fail to match well with the constraints and potentialities of the fragile resources (Liddle 1975 and Sanwal 1989). A not unexpected result is the emergence of indicators of unsustainability.

Both knowledge reviews and field studies undertaken by ICIMOD as part of the project on sustainable agriculture in the selected mountain areas of China, India, Nepal, and Pakistan alerted the researchers to the following. During a brief period of 40 to 50 years, several alarming trends have emerged in different parts of the Hindu Kush-Himalayan region. There are, in these areas, clearly visible, persistent negative changes relating to crop yields, availability of other agricultural products, the economic well-being of the people, and the overall condition of environmental and natural resources. For instance, in mountain areas at present, in comparison to the situation 50 years ago, the extent and severity of landslides is higher, water flow in traditional community irrigation systems (kools) is lower, yields of major crops in the mountains (except in highly patronized pockets) are lower, diversity of mountain agriculture is reduced, the inter-seasonal hunger gap (food deficit period) is longer, time spent by villagers for collection of fodder and fuel from neighbouring uncultivated areas or common property lands is longer, the botanical composition of species in forests and pastures has undergone negative changes; and, finally, the extent of poverty, unemployment, and out-migration of the hill people has increased. Work on an inventory of such measurable, verifiable, or objectively assessable changes and factors contributing to them forms a part of ICIMOD's current work in the selected hill areas.

Indicators of Unsustainability

The above negative changes, treated as indicators of unsustainability, may relate to (1) resource base (e.g., land degradation); (2) production flows (e.g., persistent decline in crop yields); and (3) resource management/use systems (e.g., increased unfeasibility of annual-perennial based intercropping or specific crop rotations). More importantly, for operational and analytical purposes, the indicators can be grouped under the following three categories on the basis of their actual or potential visibility (Table 2.6).

(1) *Directly visible negative changes.* These can include increased landslides or mudslides, drying of traditional irrigation channels increased idle periods of grinding mills or saw mills operated through natural water flows, prolonged fall in the yields of crops

Table 2.6. Negative changes as indicators of the unsustainability of mountain agriculture

Visibility of change	Changes Related to:[a]		
	Resource base	Production flows	Resource use/ management practices
Directly visible changes	Increased landslides and other forms of land degradation; abandonedcrop, terraces; per capita reduced availability and fragmentation of land; changed botanical compo sition of forest/pasture. Reduced waterflows for irrigation, domestic uses, and grinding mills.	Prolonged negative trend in yields of livestock, etc; increased input needed per unit production; increased time and distance involved in food, fodder, fuel gathering; reduced capacity and period of grinding/saw mills operated on water flow; lower per capita availability of agricultural products.	Reduced extent of fallowing, crop rotation, intercropping, diversified resource management practices; extension of plough to sub-marginal lands; replacement of social sanctions for resource use by legal measures; unbalanced and high intensity of input use.
Changes concealed by responses to changes	Replacement of cattle by sheep/goat and deep- rooted crops by shallow- rooted ones; shift to non-local inputs. Replacement of water flow by fossil fuel for grinding mills and manure by chemical fertilisers.[b]	Increased seasonal migration; introduc- tion of externally supported public distribution systems (food, inputs)[b]; intensive cash cropping on limited areas.[b]	Shifts in cropping pattern and composition of livestock; reduced diversity, increased specialization in monocropping; promotion of policies/ programmes with successful record outside, without evaluation.[b]
Potentially negative possibilities[c] due to de- velopment initiatives	New systems without linkages to other diversified activities; generating excessive dependence on outside resource (ferti- lizer/pesticide-based technologies) ignoring traditional adaptation experiences (new irrigation structure).	Agricultural measures directed to short-term quick results; primarily product-centred (as against resource-centred) approaches to agricultural development.	Indifference of pro- grammes and policies to mountain specificities, focus on short-term gains, high centralization, excessive, crucial dependence on external advice ignoring wisdom.

[a]Most of the changes are interrelated and they could fit into more than one block.

[b]Since a number of changes could be for reasons other than unsustainability, a fuller understanding of the underlying circumstances of a change will be necessary.

[c]Changes under this category differ from the ones under the above two categories, in the sense that they are yet to take place, and their potential emergence could be understood by examining the involved resource use practices in relation to specific mountain characteristics.

Source: Author.

in mountains, reduced diversity of mountain agriculture, abandonment of traditionally productive hill terraces, and increased extent of seasonal out-migration of hill people.

(2) *Negative changes made invisible.* People's adjustments to negative changes often tend to hide the latter. In mountain areas such changes can include substitution of shallow-

rooted crops for deep-rooted crops, following the erosion of topsoil; replacement of cattle by small ruminants due to permanent degradation or reduced carrying capacity of grazing lands, introduction of public food distribution systems, due to the increasing inter-seasonal hunger gaps (local food production deficits), small farmers leasing out their lands to concentrate on wage earning, and shift towards increased external inputs in cropping due to the decline of locally renewable resources.

(3) *Development initiatives with potentially negative consequences.* A number of measures are adopted for meeting present or perceived future shortages of products at current or increased levels of demand. Some of the measures (changes), while enhancing productivity of agriculture in the short run, might jeopardize the ability of the system to meet the increasing demands in the long run. Chances of such happenings are positively linked with the interventions' insensitivity to specific conditions of mountain areas.

These can be illustrated by any farm technology that increases mountain agriculture's crucial dependence on external inputs (e.g., fertilizer) as against the locally renewable input resource, or adds to mass production of high-weight, low-value products with a largely external market ignoring inaccessibility and related problems. Similarly, any measure that disregards the fragility of mountain slopes, ignores linkages among diverse activities at different elevations in the same valley (e.g., farming-forestry linkages), and promotes monocropping may not prove sustainable.

Under categories (2) and (3) above, there may be several changes that might bring positive results in the long run and enhance the sustainability of agriculture in the fragile areas. To separate them from negatively oriented changes, one needs a fairly detailed analysis of the components involved. This involves examination of the implications of interventions in terms of their compatibility with the relevant mountain specificities.

Approaching Sustainability through Unsustainability

The above discussion on unsustainability indicators, when related to the mainstream debate on sustainability, has two significant implications. First, judged from the complex of negative changes in many parts of the mountains, under the present patterns of resource use, the threshold limits to maintenance or enhancement of the system's performance, even by using the inter-regional linkages, seem to have been reached. Further efforts to improve output levels imply overexploitation of their biophysical resource base and initiation of the irreversible process of resource degradation. These areas represent crisis zones, where the unsustainability, usually conceived at conceptual or philosophical levels, has become an objective reality. The production prospects and output levels, on a per capita basis and in most cases on a per production-unit basis, have declined. Thus, in these habitats, one can observe the emergence of the inter-generational inequities. Accordingly, compared to past generations, the present one (unless supported externally) seems to have lower production prospects. The links between short-term intra-generational issues (poverty, inequity, etc.) and long-term inter-generational issues (emphasized by the sustainability debate) are quite apparent in these areas. This may help inject some relevance into the sustainability debate in the developing country context (Mellor 1988, Jain 1988, Jodha 1990a).

Second, since the unsustainability indicators are a product of mismatch between resource characteristics and their use pattern, the reestablishment of a match between the

two is an important step in enhancing the sustainability of mountain resources and the activities, including agriculture, based on them. At the conceptual level, the above reasoning implies a change in the perspectives on the sustainability question. Accordingly, for identifying and operationalizing the components of sustainability for a given system, one needs to examine the unsustainability phenomenon first and then proceed backwards to understand the factors and processes contributing to it. This can help in identifying practical measures to reverse the process leading to unsustainability. A practical step towards implementing the above approach is to prepare an inventory of the indicators of unsustainability in a system and then look into the 'why and how' behind them. This approach has some merits. It can help to improve the understanding of operational aspects of the issues involved in the sustainability debate. This also helps to relate more easily the involved issues to the real world situations in which the causes and consequences of unsustainability are felt. It can also help to identify concrete steps to modify the current approaches towards development and resource management. Such steps may relate to macro- and micro-level policies and programmes as well as to farm-level decisions and actions. The above approach forms the basis of the current work at ICIMOD, directed towards identifying the elements of sustainability to incorporate into strategies for agricultural development in the Hindu Kush-Himalayan region (Jodha 1989b).

THE SEARCH FOR SUSTAINABILITY

Broadly speaking, reorientation of development strategies based on a mountain perspective can help arrest or reverse the negative changes and thereby restore the sustainability of mountain agriculture. However, at the more concrete level, one has to examine the possibilities and ways in which changed resource use patterns would satisfy the conditions associated with sustainability of a system. This brings us back to mountain specificities and their operational implications discussed earlier.

The sustainability implications of mountain characteristics can be understood in terms of the degree of convergence between (1) objective circumstances (e.g., operationally relevant constraints and potentialities) created by them and (2) conditions associated with the process of sustainable development (e.g., ability of a system to sustain its performance without damaging its essential ecological integrity). To elaborate on this, we need to refer back to the operational meaning of sustainability mentioned earlier. Accordingly, sustainability (i.e., a sustained or an increased level of production performance) is conditioned by the capacities of the biophysical resource base to withstand high use intensity, to absorb high quantities of complementary inputs, to tolerate periodical shocks or disturbances without facing permanent damage, to ensure gains associated with the scale of operation and infrastructural logistics, and to gain from linkages or exchanges with other (wider) systems. Juxtaposition of the above requirements (or preconditions of sustainability) and the already discussed operational implications of mountain specificities can greatly clarify the sustainability problems of land-based activities (i.e., agriculture) in mountain areas. This is attempted through Table 2.7.

According to Table 2.7, due to features such as fragility, marginality, and inaccessibility, the system (e.g., mountain agriculture) has a very narrow production base and limited production as well as surplus generation possibilities. Because of these very factors, the scope for resource manipulations through higher input use and higher use intensity is

Table 2.7. The sustainability implications of mountain specificities

Mountain specificities (and objective circumstances)	Sustainability implications in terms of: Inherent production potential modification possibilities through:					Abilities to link with wider system	
	Resource use intensity	Input absorption capacity	Infrastructural logistics	Gains of scale	Resilience to shocks	Surplus generation & exchange	Replicability of external experience
Inaccessibility (remoteness, distance, closeness, restricted external linkages)	(−)[a]	(−)	(−)	(−)	(−)	(−)	
Fragility (vulnerability to irreversible damage, low carrying capacity, limited production options, high overhead cost of use)	(−)	(−)	(−)		(−)	(−)	(−)
Marginality (cut off from main stream, limited production option, high dependency)		(−)	(−)	(−)	(−)	(−)	(−)
Diversity (complex of constraints and opportunities, interdependence of production bases and products/activities)	(+)[a]	(+)	(+)	(−)	(+)	(+)	(−)
'Niche' (small and numerous specific activities with comparative advantage; use of some beyond local capabilities)	(+)	(+)	(+)	(−)	(+)	(+)	(−)
Adaptation mechanisms (folk agronomy, ethno-engineering, collective security, diversification, self-provisioning)	(+)	(+)	(+)	(−)	(+)		(+)

Note: (−) indicates extremely limited possibilities, while (+) indicates greater scope for sustainability through production performance, strengthened resource regenerative processes, and linkages with wider systems (e.g., upland-lowland interactions).

Source: Author.

quite limited. Vulnerability of land resources to rapid degradation (as reflected by soil erosion, landslides, etc.), even through minor disturbances, is also linked to fragility.

However, owing to the heterogeneity of habitats, agriculture in these areas is also

endowed with a complex of varied opportunities for land-based activities. Local communities skillfully harness them. But, being too diverse and narrow, and being constrained by marginality and inaccessibility, they cannot impart the benefits of large-scale operations. Benefits from the experiences of other ecological zones are also less likely, because the heterogeneities restrict the replication of external experiences to a substantial degree.

'Niche' or specific situations/products, with potential comparative advantages to mountains over other areas, are also a product of the heterogeneity characterizing these regions. Some of them are quite narrow and often harnessed to support petty trading despite poor market linkages and inaccessibility problems. Special horticultural products, such as flowers, medicinal plants, and animal products, may serve as examples. As discussed elsewhere (Jodha 1989a), mountains are also endowed with 'niche' that are too huge and complex (e.g., potential for large-scale irrigation and hydropower production), and the harnessing of them is often beyond the capacity of individual mountain communities.

Table 2.8 presents a broad view of the complex of constraints and potentialities created by the natural resource base of mountain areas. It can also serve as a framework within which the search for sustainable agriculture can be directed. The major areas that need attention for the above purpose can be presented in the form of some focussed questions.

(1) In view of the fragility, marginality, and, to some extent, inaccessibility problems, how can the use intensity of land and its (physical and economic) input absorption capacity be enhanced without resource degradation?

(2) What are the options for developing a complex of diversified activities with clear focus on (a) high productivity, despite low land use intensity and low input regimes (especially external inputs), and (b) fuller use of resource diversities and 'niche' (i.e., the options with comparative advantages), without overexploitation and degradation of resources?

(3) How to strengthen the resilience of farming systems to cope with the periodical shocks and stresses and the rapid growth of pressure on mountain resources?

(4) What should be the potential forms and patterns of linkages of mountain agriculture with other systems (i.e., agriculture and the general economy of other zones), in order to facilitate accomplishment of potential options under the above questions (1–3)?

(5) As against the supply side options, what are the institutional mechanisms to restrain and regulate pressure of demand on mountain resources?

Past Strategies

Answers to the above questions can be sought both from past experiences in handling the problems as well as from the new knowledge emerging through formal R&D and management systems relevant to mountains. The aforementioned issues, even though not formulated in the above manner, have, in the past, been addressed in various ways. Rural communities have evolved and inherited their adaptation strategies to handle the above problems. In recent decades, through development interventions, the same problems have been focussed more formally. Annex 2 summarizes the relevant components of the two, which are directed to resource management and productivity growth in agriculture as well as pressure regulation on mountain resources. The details reveal both the strengths and weaknesses of the two approaches. A synthesis of the strengths of the two may help

Table 2.8. Areas of focus for R&D for sustainable agriculture in fragile resource zones

Areas/issues of focus	Potential enhancement of sustainability through:			
	Resource use intensity	Input absorption capacity	Resilience and pro-ductivity	Inter system linkages
Resource-centred R&D				
• Physical/biological measures to manage slope, drainage, soil, moisture etc.	x	x		
• Soil binding/building plants or crops	x	x		
• Perennials (fast growing, early maturing, high productivity, high ratoonability)	x			
• Biological control of yield reducers		x	x	
• Locally renewable resource focus	x		x	
• Location specificity		x	x	
System-oriented R&D				
• Linkage of product and resource centred options			x	
• Diversified or interlinked activities: (Annual or perennial plants)	x		x	
• Extensive or intensive land uses	x		x	
R&D focussed to harness 'niches' and diversity				
• Wider adaptability of options			x[a]	x[a]
• Focus on productivity of total system			x	
• Flexibility in input use/agronomy			x	
• Recyclability/storability			x	
• Complementarity with other zones (related to input, product, value additions)				x
• Input of folk knowledge			x	x
Infrastructural/institutional and resource support[b]			x	x

[a]Gains through advantage of scale and replicability of external experience
[b]Options under this category may not directly relate to agricultural R&D.

Source: Author.

to identify the directions and possible first order options to enhance the sustainability of mountain agriculture.

By way of a comment on Annex 2, the following may be stated. As elsewhere, in mountain areas also the traditional measures and practices have been evolved by the people themselves through informal experimentation over the generations (Nogaard 1984, Chambers et al. 1989, and Altieri 1987). Hence, they are better adapted to the limitations and potentialities of mountain resources. Broadly speaking, they are location-specific and small in scale, are diversified and interlinked in their structure and operations, are often land extensive and locally renewable resource-centred, are mainly supported by folk knowledge and informal social sanctions, and generally have lower input use and lower but stable productivity. For the above reasons, they are conducive to sustainable resource use under low pressure of demand in relatively isolated or inaccessible situations. But they are becoming increasingly unfeasible and ineffective in the context of rising pressure on resources.

The measures promoted through conventional public interventions in the mountain areas, on the other hand, generally represent the extension of land-intensive production system characteristics of relatively better agricultural areas. So far, they are not well adapted to the mountain resources. The public interventions, on their current scale and level of standardization, are a recent phenomenon in these areas. Being in the early stage of evolution compared to traditional measures, probably they can be modified to suit the situation in these zones. Their major strengths are the significant input of modern science and technology, strong (public exchequer-based) resource support, and conscious decisions and efforts to relax the development constraints of mountain areas. They have significant potential for strengthening physical and market linkages among mountains and other regions. It should, however, be noted that the past efforts based on these positive attributes have not strengthened the prospects of sustainable development in mountain areas. On the contrary, several indicators of unsustainability (Table 2.6) have emerged side by side with development efforts. The primary reason for this has been the general insensitivity of public interventions to specific conditions of mountain areas. To impart this sensitivity, an effective approach would be to redesign the interventions by blending the rationale of traditional measures with the formal technological and institutional interventions.

The Intensification Question

Mountain agriculture's sustainability prospects, based on the rationale of traditional farming systems, are in a way linked to restoration and strengthening of nature's regenerative processes. Ecologically ideal and technically cheaper, such processes may prove too slow in the context of rising demands on mountain agriculture (Banskota 1989). Sustainability in such a situation calls for shortening of the regenerative processes and enhancing of inherent rates of resources renewability through scientific management (O' Riordan 1988 and Pearce et al. 1990). Viewed this way, the whole issue of sustainability of agriculture in mountain areas can be reduced to a problem of increased use intensity of land resources (for higher productivity) without permanently damaging them. The indigenous systems, though oriented to resource use with conservation, do not possess high productivity technological components to ensure high use intensity and resource conservation simultaneously. The new science and technology-based interventions have the capacity to raise use intensity and productivity of land but they are generally indifferent to conservation considerations. The above facts form the basic ground for blending the positive features of the two.

R&D Reorientation

As indicated by several examples in Annex 1 and 2, despite the presence of R&D superstructures and increased resource allocation for them, there are not many technological innovations that can significantly shorten the regenerative processes and enhance resource renewability rates for sustainability of mountain agriculture. The situation calls for significant reorientation of R&D strategies.

To facilitate this, some areas or issues are recommended as meriting the focussed attention of research and technology development (R&D) efforts. Table 2.8 summarizes

them, along with their potential impact areas, to enhance the sustainability of agriculture. Concentration on these subject areas would imply making research and technology measures more resource-centred, system-oriented, and conducive to harnessing the 'niche' and diversities of the resource base. Need for institutional and other logistic support to complement the technologies hardly needs mention. The links between specific technological measures and conditions associated with sustainability, indicated in Table 2.8, are briefly commented upon here.

Resource-centred Research and Technologies

For the enhancement of input absorption capacity and use intensity of land resources in the mountains, both mechanical and biological measures can be employed. Traditionally, people treated fragile resources by measures such as terracing, trenching, ridging, and hedges and shelterbelts, and made them usable. With a better scientific understanding of the precise interactions between resource components and specific treatment variables, new and more effective options can be evolved to handle the problems of slope, drainage, marginal soils, and excess or deficit moisture. Plants with high soil binding and soil-building capacities can also form important components of new technologies. Integrated use of early maturing, fast growing, ratoonable perennials (including trees and shrubs) and photoperiod insensitive, early maturing, high-yielding annuals can be an important step towards increased resource use intensity. Species with high productivity and high value, suited to fragile resources, can enhance their input absorption capacity in economic terms (Nair 1983). With focussed screening of the vast and diverse germplasm resources available, it should be possible to identify several species with the above-mentioned attributes.

It should be noted that a number of resource-centred technologies being developed at present implicitly focus on some of the above issues. But these initiatives, be they pasture development through reseeding or soil manipulation, or more publicized and subsidized initiatives such as integrated watershed development, are highly technique dominated, and they are still conceived of and implemented in a project mode. The institutional factors and user perspectives are almost completely neglected, and this reduces their relevance to the problems of these areas (Blaikie and Brookfield 1987).

Although, due to resource heterogeneities, the location specificity of technologies cannot be avoided, any emphasis on the wide adaptability of technological components can facilitate a wider coverage and advantage of scale to specific production activities in mountain agriculture.

Systems Approach

Suggesting a greater need for a systems approach of R&D for mountain agriculture amounts to stating the obvious. Yet, to avoid the gaps characterizing the conventional approach, a few issues need to be mentioned specifically.

Diversification and interlinkages of different land-based activities have been the major strengths of traditional farming systems. The linkages can be seen between the activities based on annuals and perennials, intensive and extensive resource uses (e.g., farming-forestry linkages), and complementary uses of common property resources and private property resources. Diversity and implied linkages are important considerations in the choice of crops and their attributes. Moreover, in such systems, the productivity and

stability of the total system, rather than that of individual components, is emphasized. Modern science and technology are endowed with several elements that can strengthen the linkages and components indicated above. On some of the individual components considerable work has been done. Research on upland crops and mountain horticulture as well as coarse grain crops and forage crops has received considerable attention at both national and international levels (York 1988). Efforts to impart a farming systems perspective to R&D have also been made (IARCs 1987). Yet, the major gap in the past R&D has been the absence of integrated focus. The latter alone can help diversified and interlinked systems of resource use and production.

Strengthening Resilience

Diversification, flexibility, and interlinkages among different production activities, input use practices, and consumption patterns imparted a degree of resilience to the traditional farming systems in the fragile areas. Resilience of the system was also strengthened by factors such as the periodic release of pressure through migration or transhumance, a variety of input and product recycling devices, collective sharing systems, and informal regulatory measures to ration the use of resources. Except for a few institutional devices, most of the above measures can be strengthened by the new technological components. To achieve the above goals, the focus of R&D will have to be on diversification, flexibility, and local resource-centred interlinked activities. Again, the availability of genetic material of diverse attributes as well as the improved knowledge and the capacity to precisely understand interactions among different biophysical variables offer significant opportunities for the development of options to satisfy the above goals (Serrano 1984, York 1988, Jodha 1986, and Ruttan 1988).

Inter-regional Linkages

Inter-regional linkages, as mentioned earlier, help in sustainability by relaxing internal constraints and facilitating the exchange of local surpluses. Under traditional systems, mountain areas had their linkages with other regions largely through the harnessing of specific 'niche' and petty trading, unequal exchanges based on large-scale extraction of their resources (e.g., timber from the hills), and periodic migration and transhumance. Such links did help in survival, but are inadequate for a sustainability that implies enhanced performance to meet the increasing demands over time (Banskota 1989).

The physical and market-based linkages between different regions are a function of the combination of several factors, some of which fall far outside the area of agricultural R&D. However, one of the basic factors promoting inter-regional exchange is the relative difference in the comparative advantages enjoyed by different regions with respect to specific activities and products. The mountains, as mentioned earlier, also have some activities and products that have comparative advantages in relation to other regions. Agricultural R&D can help mountain areas by identifying such activities and products and improving their quality and productivity. In the past, however, this sort of complementarity between the mountain regions and the other regions did not receive sufficient attention.

Institutional Dimensions

Sustainability is not merely a question of sustained physical production and its technological coefficients. The factors underlying the generation and application of technologies and the management of production factors and processes have significant institutional underpinning. However, we will briefly mention only those institutional dimensions that largely relate to the demand of the sustainability phenomenon.

Most of the preceding discussion on sustainability has concentrated on the supply aspect of the problem. It has elaborated on how mountain specificities should be understood and harnessed to maintain and enhance the production performance even by facilitating exchange with other systems. This is in keeping with the general tenor of the global sustainability debate, where the demand side of the sustainability phenomenon is not fully projected. However, there is a limit to stretching the supply side to accommodate ever increasing demands on the production systems. This is more so in the case of the mountains, where, despite technological innovations, the fragility and marginality of biophysical resources, along with other constraints, may not permit the enhancement of sustainability. The effort on the supply side, therefore, has to be complemented by restraint on the resource demands generated through rapid population growth and external markets. Space will not allow us to elaborate on these issues. Yet, it can be mentioned that pressure management on mountain areas by restricting population growth and regulating external market demands is one essential precondition for long-term sustainability. Furthermore, the demographic measures for sustainability should go far beyond controlling numbers to address issues of equity, people's involvement in sustainability-oriented decisions, etc. Similarly, market-related initiatives have to go beyond regulating resource extraction rates and address issues such as the inter-regional terms of trade and equity of exchange which are closely linked to the marginality of the mountain regions and people.

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ANNEX 1

OPERATIONAL IMPLICATIONS OF MOUNTAIN SPECIFICITIES

A. INACCESSIBILITY: IMPLICATIONS

Objective Circumstances

Physical and market-wise extent of isolation, varying degrees of remoteness; closeness of the system, high transport cost and poor mobility; high overhead cost of communication and infrastructural development; limited external linkages and replicability of external experiences; weaker regional bargaining power and neglect by the mainstream; slow pace of transformation/development and underutilization of regional potential; intra-regional imbalances; and wilderness conducive to conservation and preservation of biodiversity, etc.

Dependent Patterns of Activities and Consequences

Traditional Systems

ADAPTATIONS TO INACCESSIBILITY AND ASSOCIATED CONSTRAINTS: Local resource/locally renewable resource-centred activities; low external input agriculture, focus on low-weight, low-volume, high-value, low-perishability products; subsistence orientation of production activities; petty trading, transhumance, and seasonal migration; institutional arrangements for collective sustenance; periodical (weekly) markets; system of visiting traders; people's participation-based, decentralized, local initiatives, local storage and recycling, and processing of products/inputs.

MODIFICATIONS OF OBJECTIVE CIRCUMSTANCES (i.e., INACCESSIBILITY CONSTRAINTS): Diversified means to reduce inaccessibility through donkey tracks, waterways, ropeways, etc., using ethno-engineering measures; and collective measures for the upkeep of the indigenous transport/communication infrastructure.

Conventional Development Interventions

ADAPTATIONS TO OBJECTIVE CIRCUMSTANCES: Use of transport subsidy as a means to reduce the impact of inaccessibility; promotion of high-value (e.g., horticultural) products and local processing; State intervention to promote trade, exchange links, and market centres; high overhead cost; and detrimental development initiatives.

MODIFICATION OF OBJECTIVE CIRCUMSTANCES: Infrastructural development with a focus on the road network; modern technology for ropeways (gravity operated), and waterways; measures to promote accessibility often insensitive to other circumstances, e.g., fragility; high overhead costs prevent fuller treatment of inaccessibility problems; preponderance of piecemeal measures.

Consequences of Changes and Imperatives

Consequences of Recent Changes

CHANGES HAVING ADVERSE CONSEQUENCES IN THE CONTEXT OF INACCESSIBILITY: Population growth with limited outlets to release pressure leading to overextraction of

resources; qualitative changes in population both due to increased number and changed attitudes/approaches leading to overextraction of resources; population changes also affecting migration/transhumance patterns with implications for labour supply and resource management; improved accessibility (in some areas) encouraging market; State and rural communities for increased resource extraction, and disregard of traditional community management systems.

Imperatives for Development Interventions

Inaccessibility-related objective circumstances to be treated taking into consideration their impacts on other mountain specificities especially fragility and 'niche' exposed to overexploitation; focus on activities and processes with minimal dependence on external input resources, especially the ones involving high transport cost and longer time; local resource-centred processing and other income generating activities; focus on locally renewable resources; focus on decentralized management of resources.

B. FRAGILITY: IMPLICATIONS

Objective Circumstances

High vulnerability of natural resource base degradation and irreversible damage to the natural resource base due to natural hazards as well as high use intensity; low regenerative capacity of nature; low carrying capacity, low productivity, and limited production options; land resources suited to extensive uses; high overhead cost of resource use due to protection/conservation needs; limited physical and economic input absorption capacity of fragile resources; initial low population density; and limited replicability of external experiences and conventional development approaches.

Dependent Patterns of Activities and Consequences

Traditional Systems

ADAPTATIONS TO FRAGILITY ASSOCIATED CONSTRAINTS: Specialized production activities suited to fragile resources; institutional measures/social sanctions to regulate use and conservation of fragile resources (e.g., provision of village commons); focus on total biomass rather than grain production alone; land-extensive farming systems; transhumance, agriculture based on low cost inputs, (often) low productivity, high stability; limited surplus generation; balancing of intensive and extensive land uses by plant choice, intercropping, etc.; and focus on biological means of fertilization and land stabilization; ADAPTING (MODIFYING) FRAGILITY CONSTRAINTS TO PRODUCTION REQUIREMENT: Ethnoengineering measures such as terracing, drainage management, community irrigation systems, other forms of water management, and indigenous agroforestry.

Conventional Development Interventions

ADAPTATIONS TO FRAGILITY ASSOCIATED CONSTRAINTS: Extension of generalized high intensity agricultural practices; revenue generation through overextraction of resources (e.g., forest) from fragile areas; encouragement of annual cropping on submarginal lands through subsidies etc.; promotion to high-value cash crops under hor-

ticulture, etc.; and interventions for resource conservation with modern technologies and resource support, often insensitive to local circumstances and user perspective.
MODIFICATION OF FRAGILITY CONSTRAINTS: High productivity systems with conservation through afforestation, pasture development, etc.; intervention highly technique dominated, supported by legal and administrative measures without strong user perspectives; and large-scale resource upgrading through irrigation projects, etc., with limited concern for side effects.

Consequences of Changes and Imperatives

Consequences of Recent Changes

Resource degradation, following high use intensity due to increased demographic pressure and improved accessibility; market-induced resource extraction and side effects of other development interventions; and reduced feasibility and effectiveness of traditional mechanisms.

Imperatives for Development Interventions

Both technological and institutional measures required to blend conservation with high productivity; agricultural R&D to be focussed on issues such as intensive balancing and extensive land uses; biological measures for controlling yield reducers; and institutional measures with local control of local resources.

C. MARGINALITY: IMPLICATIONS

Objective Circumstances

Marginal areas, marginal opportunities (options) and marginal people; prevalence of fragile lands in resource base; limited access to high potential options; limited production options and capacities for investment, production, and surplus generation; neglect by the mainstream; limited, (and often) exploitative external linkages; and unequal terms of exchange.

Dependent Activity Patterns

Traditional Systems

ADAPTING TO MARGINAL CONDITIONS: Small-scale, low-cost/low-input, local resource-centred activities, with low productivity, low surplus generation and exchange; and subsistence and recycling-oriented systems with low resilience to natural and man-made shocks.
MODIFICATION OF MARGINALITY RELATED CONSTRAINTS: Resource upgrading through terracing, irrigation, and high value options (e.g., horticulture) and interlinked diversified activities for stability and surplus generation to build up economic capacity.

Conventional Development Interventions

ADAPTING TO MARGINAL CONDITIONS: Area and target-oriented anti-poverty programmes, often extension of programmes evolved in other ecosystems/habitats; State

subsidy-based development activities and welfare programmes; and generation of dependency on patronage.

MODIFYING MARGINALITY: Resource upgradation through public investment (e.g., in irrigation, communication), introduction of high pay-off options (e.g., horticulture), off-farm employment, and other support programmes; and infrastructural development and institutional interventions.

Consequences of Changes and Imperatives

Consequences of Recent Changes

Gradual erosion of traditional measures to manage marginality (through diversified and interlinked activities); most of these measures are losing ground now; development measures to handle economic marginality and marginality of biophysical resources are often ad hoc and confined to selected locations, and have negative side effects (e.g., increased resource extraction); unequal access to remedial measures, increase in socioeconomic inequity; linkages with the mainstream provided through public interventions (e.g., marketing facilities) offer unequal terms of exchange for mountain products and people; and demographic change accentuating marginality of people and resources.

Imperatives for Development Interventions

Simultaneous joint management of marginality with other mountain specificities such as fragility, inaccessibility, and diversity; technological and institutional options to upgrade marginal resources need high priority; lessons from traditional strategies.

D. DIVERSITY: IMPLICATIONS

Objective Circumstances

A complex of constraints and opportunities with varying scales and potential; bases for interdependence of multiple land-based activities; diversity as a source of resilience and flexibility of production systems; location specificities and limited replicability of external experiences.

Dependent Patterns of Activities

Traditional Systems

ADAPTATIONS TO DIVERSITY: Choice and composition of activities (e.g., mixed farming, intercropping) with varying attributes that suit specific conditions; interlinkages of diversified activities (e.g., farming forestry linkages); local resource-centred, land-based activities to match seasonal and spatial variability; strong location-specificity of activities; and folk agronomy and indigenous agroforestry measures.

STRENGTHENING (MODIFICATION) OF DIVERSITY: Attempts to harness and strengthen diversity by continuing diversified, interlinked activities and resource management practices to maintain diversity of production base.

Conventional Public Interventions

ADAPTATIONS TO DIVERSITY: Development intervention as evolved in other ecological contexts, oriented to reduce diversity (monoculture, etc.); focus on high productivity rather than diversity and flexibility; strong input of modern science and technology; emphasis on short-term considerations; sectoral orientation of production activities; State support through infrastructure and subsidies; and disregard of traditional systems.
MODIFICATION OF DIVERSITY: Application of sectorally oriented, generalized resource development programmes (irrigation, forestry, livestock, etc); strong input of science and technology; and support services (R&D, marketing etc.) also geared accordingly.

Consequences of Changes and Imperatives

Consequences of Recent Changes

Diversity of resource use and production activities on the decline; population growth restricting the scope for land extensive production systems; market demand inducing narrow specialisation; public intervention through infrastructural development, R&D, marketing support, etc.; and encouragement of monoculture and less flexible management systems.

Imperatives for Development Interventions

Focus on diversified measures compatible with the spatial/temporal diversity of mountain resources; R&D support services and sectoral programmes to be designed accordingly; location-specificity of technologies and institutional managements; and greater consideration of folk knowledge and management practices.

E. OPERATIONAL IMPLICATIONS OF 'NICHE'

Objective Circumstances

Scope for numerous, specialized activities and products with comparative advantages for mountains; potential for small-scale, high pay-off activities; potential underexploited (due to inaccessibility, marginality); harnessing of large-scale 'niche' beyond the means of local communities, extraction through external initiatives/support.

Dependent Patterns

Traditional Systems

HARNESSING OF 'NICHE': Specialized activities and products (horticulture, medicinal plants, etc) with high value as the basis for petty trading; as well as being a part of the diversified system and basis for side activities.
ENHANCING 'NICHE': Regulated use and protection through folk technologies and collective institutional measures.

Conventional Development Interventions

HARNESSING 'NICHE': Public programmes and sectoral interventions focussed on high-productivity high-value products (e.g., horticulture, potato cultivation); large-scale

extraction of specific 'niche' (forests, irrigation and hydropower production, tourism, etc.), often insensitive to negative side effects and local concerns; and small-scale, location-specific 'niche' bypassed.

ENHANCING 'NICHE': Focus on market-oriented overextraction; regeneration through modern science and technology as well as support; sectoral orientation; disregard of linkages with other mountain conditions; domination of technique and administrative-cum-legalistic framework; petty 'niche' get less attention.

Consequences of Changes and Imperatives

Consequences of Changes

Petty 'niche' marginalized due to backlash of monoculture-based specialization, reduced productivity and potential due to over-extraction; focus on market-oriented, State-supported production activities with greater uniformity and less attention to diversity, flexibility, and user perspective; large-scale 'niche' harnessed with market-induced extraction; and negative side effects (externalities) becoming a source of local concern.

Imperatives for Development Interventions

Harnessing and enhancing of 'niche' in an integrated manner; regulation of extraction rate, sensitivity to local concerns; favourable terms of exchange; and alternative norms and yardsticks to guide compensation mechanisms for exploitation of mountain 'niche'.

F. ADAPTATION MECHANISMS: IMPLICATIONS

(1) Operational implications of human adaptations (both reflected through traditional practices and development measures) should be viewed differently from other mountain specificities. In fact, they are dependent patterns (human responses to other mountain specificities).

(2) Traditional adaptations, having evolved in the context of the realities of mountain areas, are more relevant in terms of adapting activities to mountain conditions and vice versa. However, they are losing out both in terms of feasibility and effectiveness in the context of increased population and market and State-generated pressures on the resources.

(3) Present-day development interventions are also conscious efforts devoted to a two-way adaptation process. They have greater scientific, fiscal, and other resource support. But having been largely developed externally, they are less sensitive to mountain specificities.

(4) For the sustainability of mountain resources, their use pattern and productivity, the blending of rational and traditional practices and the contents and support system of present-day development efforts are essential.

ANNEX 2

MEASURES AGAINST CONSTRAINTS TO SUSTAINABLE AGRICULTURE IN MOUNTAIN AREAS UNDER INDIGENOUS SYSTEMS/DEVELOPMENT INTERVENTIONS

A. Enhancement of use intensity/input absorption capacity of land	
Measures adopted under	
Traditional farming systems	Conventional development interventions
Measures	
Resource amendments by ethno-engineering measures: terracing/trenching/ridging, moisture conservation/drainage management/ shelterbelts/agroforestry.	Selective resource upgrading through irrigation/other infrastructure, biophysical changes (e.g., new introduction; R&D activity/pilot projects for forest lands, watersheds, etc).
Attributes conducive sustainability	
Local resource-centred, community-oriented and supported, small-scale, diverse, adapted to local situation; linked to other activities.	Science and technology input, strong logistic/resource support, advantage of scale.
Limitations	
Reduced feasibility with rising pressure on land and weakening of local level arrangements, lack of new high-productivity components.	Side effects of massive interference with fragile collective resources, deforestation, landslides; inequities between transformed (e.g., irrigated) and leftover areas; insensitivity of R&D-based initiatives to local resource diversity and user perspective.
B. Usage and management of low use-capability lands	
Measures	
Folk agronomy involving activities with low land intensity and low (local and affordable) input regimes; integration of low intensity-high intensity land uses (based on annual-perennial plants, crop-fallow rotations, indigenous agroforestry, common property resources; social sanctions, resource use regulation; migration/transhumance.	Sectorally separated production programmes; high intensity uses through new technology inputs/incentives/subsidies; focussed conservation-oriented initiatives (forests/ pastures/watersheds) in largely project mode.
Attributes conducive to sustainability	
Diversified, interlinked activities with different levels of intensity, community participation, control on local demand.	New technological input, resource support and legal sanctions.
Limitations	
Reduced feasibility and effectiveness due to population growth, decline of collective arrangements, and side effects of dominant technological and institutional interventions.	General indifference to resource limitations, user perspective; technique and project mode dominated.

C. Options to harness diversity and 'niche'	
Measures	
Folk agronomy—diversified cropping, focus on multiple-use species; complementarity of cropping, livestock, forestry/horticulture; emphasis on biomass in choice of land use and cropping patterns; complementarity of spatially/temporally differentiated land-based activities; stability-oriented, location specific choices; harnessing 'niche' for tradable surplus.	Sectorally segregated programmes and their support systems (R&D, input supplies, crop marketing); focus on selected species and selected attributes (e.g., monoculture, high grain:stalk ratio); extension of generalized development experience of other habitats with high subsidy.
Attributes conducive to sustainability	
Diversity, linkages as dictated by resource characteristics; focus on locally renewable resources.	Initiatives with strong technological and logistic components, high potential for generating new options.
Limitations	
Low productivity, land-extensive measures incompatible with high man:land ratio, and changed institutional environment.	Indifferent to the totality of farming system and diverse resource potentialities; high subsidization.
D. Resilience of the system and mechanisms to handle high pressure of demand	
Measures	
Diversification and linkages of land-based activities; flexibility in scale, operations input use; locally renewableresource focus, recycling of inputs/products, self provisioning; crisis period collective sharing arrangements, common property resources, social regulations for rationed use and protection of fragile resources; release of periodic/seasonal pressure by migration, transhumance, remittance economy.	Public relief and support during crisis/ scarcities; public interventions replacing traditional self-help strategies and informal regulatory measures; highly individual focussed (not community-focussed) interventions (e.g., privatization of common property resources, crisis period cushion promoted by increased private resource productivity by HYVs occasional linking of relief measure with productivity measures.
Attributes conducive to sustainability	
Range of options to match specific constraints of the habitats; emphasis on community-centred and regulated activities; rationing of demand on fragile resource.	Resource transfer from better off areas to scarcity affected areas; possibility of linking relief initiatives with resource conservation/production programmes.
Limitations	
Unfeasibility and reduced efficacy of collective self-help measures and folk agronomic devices, due to changed demo-graphic, institutional, and technological environment.	Dependency for sustenance on external resources; encouragement for perpetual growth of pressure on fragile resources; indifference to local self-help initiatives.

E. Linkages with other systems (including wider market systems)	
Measures	
General state of relative inaccessibility and isolation from mainstream market; limited linkages agriculture/through tradable surplus from harnessing 'niche'; crisis period external dependence through transhumance, migration, and remittance economy.	Improved physical and market linkages; integration of mountain resource economy with other systems; focus on special area development programmes, transformation of limited demonstration effects.
Attributes conducive to sustainability	
A few positive side effects of isolation, local demand-centred, socially controlled extraction of fragile resources, better links between the resource users and the resources.	Improved opportunities for relaxing internal constraints through technology, resource transfer, interactions with other systems; inducement for fuller use of 'niche' through external demand; closer integration with mainstream.
Limitations	
Persistent neglect and marginal status of fragile resource areas; slow pace of transformation of agriculture; unfavourable terms of exchange for marginal areas and products.	Unless guarded against high chances of extending irrelevant external experiences (including technologies); external demand induced heavy extraction of 'niche'; unfavourable terms of exchange; distortion in local demand patterns and resource use.