IV. ENVIRONMENTAL RISKS: RESOURCE INTENSIFICATION PHASE

The mountain environment - including the resource base, its production potential, and the biophysical processes and flows regulating the stability of the environment - is exposed to serious degradation following the intensification of resource use in the mountains. This degradation process manifests the cumulative type of global environmental change visible in several parts of the developing countries (Turner et al. 1990). Its more popularly understood or projected components are deforestation, overgrazing, extension of cropping to submarginal areas (i.e., steep and fragile slopes), landslides and mudslides, periodic flash floods, soil erosion, disappearance of vital biophysical resources, reduced resource productivity, etc. Some of these have been documented as emerging indicators of unsustainability (Jodha 1990a, 1990b).

We discuss these changes in terms of biophysical processes and flows and relate them to interaction between driving forces behind resource intensification and imperatives of mountain specificities. The forces or factors behind resource use intensification are rapid population growth, market-induced demand, and resource extractive public policies. The mechanisms (or immediate causes) include the creation of infrastructural facilities particularly to reduce the degree of inaccessibility, to support extraction of mountain 'niche' and to introduce new technologies, macro-economic policies, etc, designed to develop mountain areas and closely integrate them into mainstream economies, reduce regional imbalances, and eradicate poverty. However, whatever their explicit or implicit goals or the nature of mechanisms to implement them, most of the public policies in mountain areas are insensitive to the imperatives of mountain specificities.

Table 3 summarises some of these issues and their implications in terms of circumstances associated with environmental stability or risk in mountain regions. Accordingly, irrespective of the factors behind resource-use intensification, the invariable consequence is disruption of circumstances conducive to biophysical processes and flows (indicated by initial capital letters under Table 3), central to the stability and sustainability of mountain environments. Detailed discussion of these factors will follow shortly. At this stage it would suffice to indicate the consequences of the aforesaid factors vis a vis implications of mountain specificities resulting in over-extraction of resources, reduced diversification, etc and their final impacts in terms of distortions of biophysical processes and flows indicated by Table 3.

The literature on changing resource use patterns, productivity, and environmental deterioration and their possible causes in the Hindu Kush-Himalayas and other mountain systems in the developing countries would bear with the situation indicated above (Ives and Messerli 1989, Eckholm 1975, Rieger 1981, and Price 1981). Most of these changes can be analysed and interpreted both as manifestations of circumstances leading to disruption of bio-physical processes and, in some cases, consequences of such disruptions. Table 4 illustrates these changes.

Table 3: Interaction between Resource Intensification Factors and Mountain Specificities Affecting Environmental Stability/Risk in the Mountains[a)]

Factors causing resource use intensification (Human interventions)	Mountain specificities and implications				
	Inaccessibility (closedness, limited external linkages)	Fragility & Marginality (Incompatibility with intensive use)	Diversity (High potential for diversification)	'Niche' (Products, activities with comparative advantage)	Adaptations (Activities, practices tuned to mt. conditions)
Population growth, per capita increased activities, increased animal numbers	Excess pressure on local resources with limited outlet (R,F,N)	Resource use intensity beyond use capacity (R,F,S)	Pressure of food needs, reduced range of land-based activities (R, F, S, N)	Pressure of food needs, disregard or misuse of potential (R,S,F)	Disregard of resource extensive, diversified practices (R, F, N, S)
Market forces, trade links, pressure of external demand	Integration with mainstream market situation despite low physical accessibility (R,F)	Distant demand - induced over use, backlash of cash cropping (R, S)	Narrow specialisation, reduced diversification (R,F,S,N)	External demand induced over-exploitation, marginalisation (R,F)	Decline of environment sensitive local concerns, and practices (R,S,F)
Public Interventions: a) Infrastructure for accessibility, integration, harnessing of 'niche', etc.	Reduced isolation, increased integration and level of activities (R,N)	Direct and side effects on fragile/marginal resources, increased use level (R,S, N)	Increased use level, access-determined narrow specialisation (R, F, S)	Over-exploitation of high potential areas, products, disregard of side effects (R,N, F)	External contacts, loosening of traditional values, and measures (R, S,F,)
b) Technology with narrow focus on market signals, short-term needs, sectoral orientation, external origin/orientation	Application for improved mobility, integration (F,N)	Product maximisation, indifference to resource limitations, inappropriateness (R,F, S)	Narrow specialisation, focus on limited product attributes (R, F, S)	Commercial-extraction orientation, disregard of side effects (R, F, S)	Disregard of traditional wisdom, know-how (F, R, S,)
c) Macro-economic policies - price, tax, trade, investment, extraction, development strategies	Disproportionate focus on accessibility, integration, disregarding side effects (F, N, R)	Focus on current production, disregard of resource limitations, long-term consequences (R, F, S)	Narrow specialisation, through incentives support systems, disregarding organic linkages (R,F,N, S)	Focus on revenue generation, external demand, extraction disregarding the side effects (R, N, S)	Marginalisation of traditional systems, increased dependency, subsidisation (F,R)

a) Biophysical processes affected by intensive human interventions in the mountains are: R = Regeneration; F = Flexibility; Variability; S = Resilience; N = Nature's flows, (energy and material flows).

Table 4: Negative Changes as Indicators of Emerging Environmental Risks in Mountain Areas

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; abandoned terraces; per capita reduced availability and fragmentation of land; changed botanical composition of forest/pasture. Reduced water-flows for irrigation, domestic uses, and grinding mills.	Prolonged negative trend in yields of crop, livestock, etc; increased input need per unit of 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 agrl. products; etc.	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, subsidisation.
Changes concealed by responses to changes	Substitution of: cattle by sheep/goat; deep- rooted crops by shallow-rooted ones; shift to non-local inputs. Substitution of water flow by fossil fuel for grinding mills; manure by chem. fertilisers[b].	Increased seasonal migration; introduction 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 specialisation in monocropping; promotion of policies/programmes with successful record outside, without evaluation[b]
Development initiatives, etc. - potentially negative changes[c]	New systems without linkages to other diversified activities and regenerative processes; generating excessive dependence on outside resource (fertiliser/pesticide based technologies, subsidies), ignoring traditional adaptation experiences (new irrigation structure); programmes focussed mainly on resource extraction	Agricultural measures directed to short- term quick results; primarily production (as against resource)-centred approaches to development; service-centred activities (e.g. tourism) with negative side effects	Indifference of programme and policies to mountain specificities; focus on short term gains; high centralisation; excessive, crucial dependence on external advice ignoring traditional wisdom; generating permanent dependence on subsidies.

Source: Table adapted from Jodha 1990a

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 environmental instability/risk, 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.

The Emerging Risk Scenarios

Table 4 presents a broad picture of negative changes in mountain areas which could be interpreted as indicators of emerging environmental risk scenarios in the HKH Region. The table is based on macro-level data and observations as well as evidence from micro-level field studies in the selected hill areas of China, India, Nepal, and Pakistan (Banskota and Jodha 1990a). These changes may also be described as indicators of unsustainability of the present pattern of resource use in mountain areas.

The above negative changes may relate to: (a) resource base (e.g., land degradation), (b) production flows (e.g., persistent decline in crop yields), and (c) resource management/usage systems (e.g., increased infeasibility of annual-perennial intercropping or specific crop rotation) (Jodha 1990a). More importantly, for operational and analytical purposes, the indicators of emerging environmental risks and vulnerabilities can be grouped under the following three categories on the basis of their actual or potential visibility. (Table 4 illustrates them.)

Directly Visible Negative Changes

These can include the increased extent of landslides or mudslides, drying up of traditional irrigation channels (*kools*), increased idle periods of grinding mills or saw mills operated through natural water flows, prolonged fall in the yields of mountain crops, reduced diversity of mountain agriculture, abandonment of traditionally productive hill terraces, and increased extent of seasonal outmigration of the hill people.

Negative Changes Made Invisible

People's adjustments to negative changes often tend to hide the latter. Adoption of shallow-rooted crops as substitutes for deep-rooted crops resulting in erosion of top soil on mountain slopes, substitution of cattle by small ruminants due to permanent degradation or the reduced carrying capacity of grazing lands, introduction of a public food distribution system to alleviate increased inter-seasonal hunger gaps (local food production deficits), and small farmers leasing out their lands to concentrate on wage earning, illustrate this category of negative change.

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, say, mountain 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 mountain conditions and their imperatives for environmental stability.

To illustrate the above, any farm technology that increases mountain agriculture's crucial dependence on external inputs (e.g., fertiliser) and disrupts local regenerative practices, may eventually accentuate environmental risks. Similarly, any measure that disregards the fragility of mountain slopes and ignores linkages between diverse activities at different elevations in the same valley (e.g., farming-forestry linkages) and promotes monocropping may not prove sustainable. Likewise, any resource-extraction activity (e.g., hydropower projects) or service-centred activities (e.g., tourism) or welfare-oriented schemes (e.g., subsidies generating the permanent external dependency of mountain people) that ignore the side effects and long-term consequences may enhance the prospects of environmental risks for mountainous areas and people.

Table 4 summarises some visible or less visible negative trends relating to resource base, productivity, and management of mountain resources, largely in the context of agriculture: the dominant activity of the mountain people in the HKH Region. Evidence of resource degradation, productivity decline, and disruption of traditional resource management systems from other fields such as mining and industry (Bandyopadhyay 1989), infrastructural development (Paranjipye 1988), and tourism (Singh 1989) could be presented in the same manner. It may be reiterated that in some cases the changes listed in Table 4 are causes while in others they are consequences of disruptions of the biophysical processes and flows. Furthermore, in the ultimate analysis, circumstances underlying the above changes that act as causes of disruptions of biophysical processes and flows are associated with the resource use intensification in the mountains as discussed below.