

VI. 'CUMULATIVE' - 'SYSTEMIC' CHANGE LINKAGES

The preceding discussion has described various facets of the cumulative type of environmental change in the Hindu Kush-Himalayan mountain region. This has also highlighted the central role of interactions between attributes of mountain resources and features of resource use systems in enhancing environmental risks. The process of resource use intensification, guided by several driving forces, has been described. With the unabated role of these forces, mountain areas and communities are in for greater environmental instability and its consequences. The level of instability and risks is already quite serious, even without the impacts of global systemic changes (e.g., global warming). The latter can further accentuate the situation.

The Impact of Systemic Changes

Details on potential systemic changes affecting the mountain areas under review are almost negligible when compared to the information on cumulative changes discussed above. However, with full recognition of the limitation of the information on systemic changes (e.g., their conjectural nature and associated uncertainties of predicted change scenarios), a few possibilities may be stated. Accordingly, the potential changes in the HKH Region resulting from global warming, as summarised for an ESCAP meeting (Topping et al. 1990), includes the following points.

- (i) Because of warming, forests (the unmanaged ecosystems) may undergo both quantitative and qualitative changes. Some of the species may disappear and others may move spatially. This may accentuate the already known current negative trends relating to forest areas. The resulting reduced biodiversity may influence both biophysical functions and flows governing the environmental stability as discussed earlier. This may make the economy and survival strategies of people more vulnerable to risks.
- (ii) The region may have higher rainfall (convective high intensity rains). This may cause increased runoff, flash floods, soil erosion, mud and land slides, and can influence overall farming systems. Impacts of such changes on the circumstances affecting basic biophysical functions and flows, on the one hand, and people's survival strategies, on the other, hardly need elaboration.
- (iii) Increased warming will lead to increased snow melting and consequent disturbance to hydrological cycles, seasonality of waterflows, and related impacts on land use, cropping intensities, etc, disturbing the already threatened diversity and sustainability of mountain resource use. The environmental risks will be further accentuated.
- (iv) To the above potential changes one may add a few more possibilities. The latter relates to likely changes in the specific mountain conditions (fragility, diversity, 'niche', etc.) and their interrelationships. This, in turn, may generate new constraints and opportunities, influencing the comparative advantages of mountains and their links with other regions and perspectives of public interventions in mountain areas. At the micro-level, the agricultural systems covering all land-based activities may undergo several changes including disturbance to well-adapted cultivars and management practices, product and income flows, as well as people's strategies to cope with risks (Jodha 1989) which, in turn, may influence the resource use pattern with implications for environmental stability.

To sum up, the combined impact of all the above changes may result in increased compulsions or incentives (opportunities) for resource use intensification, which, in turn, may accelerate the already observed cumulative changes and their impact on vital biophysical processes and flows.

Accentuation of "Cumulative" Change

A total view of the environmental risks in the mountains caused by global changes can be had by a combined perspective of 'systemic' and 'cumulative' changes. Accordingly, Table 5 presents some possibilities of current trends in resource degradation (cumulative changes) likely to be accentuated by the impacts of global warming (e.g., systemic changes). The impact of the combined role of the two types of changes on biophysical processes and nature's flows is indicated by the capital letters in Table 5.

Table 5: Potential Accentuation of ‘Cumulative’ Change-led Environmental Risks Due to Impacts of ‘Systemic’ Change

Current problem (cumulative type of change) likely to be accelerated by systemic change	Potential key manifestation of ‘systemic’ change (impacts of global warming)		
	Vegetation changes: forest size, location, composition, growth cycle; bio-diversity, interactive processes	Increased convective rains: floods, run off, soil erosion, changes in growing season, hydrological cycle	Warming-led snow melt: increased waterflows, soil erosion, changes in the hydrology of mountains and flood plains
Deforestation, vegetation degradation, reduced diversity	X (R,F,N,S) ^{b)}		X (R,N,F)
Soil erosion, land and mud sliding, floods		X (N,F,S)	X (N,F)
Changes in land use pattern, reduced diversity of farming systems, increased resource use intensity and degradation	X (R,F,N)	X (S,N)	
Increased vulnerability of people’s survival strategies to environmental instability due to resource degradation and disruptions	X (R,F)	X (R,F,S)	X (R,S)

- a) See Table 4 for details of some of the negative changes indicating emerging environmental risks.
- b) The capital letters indicate biophysical processes and flows likely to be affected: R = Regeneration; F = Flexibility, Variability; N = Resilience; S = Energy and material flows (see text).

Accordingly, potential impacts of global warming-led changes in forests and vegetation may accentuate the current problems associated with deforestation, land use intensification, overgrazing, landslides, etc. The changes in waterflows caused by warming-led snow melt or increased convective rains will also accentuate the current problems stated above. Thus the current crises reflected through 'cumulative' changes in mountain areas, in a way, manifest the degree of vulnerability of mountain habitats and the people to potential negative impacts of systemic changes.