Sustainable development of the Indian Himalayan region: Linking ecological and economic concerns*

J. S. Singh

The Indian Himalayan region occupies a special place in the mountain ecosystems of the world. These geodynamically young mountains are not only important from the standpoint of climate and as a provider of life, giving water to a large part of the Indian subcontinent, but they also harbour a rich variety of flora, fauna, human communities and cultural diversity. Despite the abundance of natural resources, most of its people are marginalized and still live on subsistence level. The unscientific exploitation of natural resources is leading to increasing environmental degradation and aggravating the impact of natural hazards. There is a need to evolve new paradigm to restore balance between economic interest and ecological imperatives with due regards to socio-cultural principles.

Keywords: Ecological role, economic valuation, Indian Himalayan region, socio-cultural acceptance, sustainable development.

WITH the increasing realization that the natural resources of mountain areas are vital for both upland and downland people, the Global Agenda for sustainable development has brought mountains to sharp focus. Development needs addressing local aspirations and national compulsions have to be met if economic upliftment is to be achieved. However, development interventions also imply a demand on resources as well as modifications of existing natural systems. Development in the mountains, therefore, has to have a different approach, given the fragility and vulnerability of the Himalayan ecosystems due to the uniqueness of mountain specificities[1]. Development interventions ignoring the imperatives of mountain specificities will invariably result in resource misuse and subsequent accelerated environmental degradation, which would be disastrous not only for the local populace, but also for downstream inhabitants. Such negative impacts of unplanned development, insensitive to mountain specificities, are already becoming common, the most frequent being the regular incidences of landslides, river obstructions and flash floods in the mountain and recurrent floods in the plains.

In addition to the negative impacts of localized development activities, the effect of climate-induced changes, an outcome of unsustainable practices and waste generation, on the mountain systems is frightening. Global warming and its effects on glacier recession have far-reaching implications both in time and space. The intense vulnerability of mountain ecosystems and their elements to the human as well as climate-induced changes, therefore, is of great concern. Not surprising, therefore, that the complexity of such issues continues to receive considerable attention at the global fora like the WSSD (World Summit on Sustainable Development, Johannesburg, August 2002) and Bishkek Global Mountain Summit (October 2002). These events have arrived at a consensus that mountains would require specific approaches and resources for sustaining livelihood needs and improving the quality of life. This would require an integrated approach, which gives due consideration to closely intertwined aspects of human socio-cultural/socio-economic systems and natural ecosystem components/processes.

The Himalaya: uniqueness

Among the global mountain system, the Himalaya is the most complex and diversified, and separates the northern part of the Asian continent from South Asia. The region being a discrete geographical and ecological entity, figures prominently in major biophysical settings of the planet earth. This vast mountain range (over 2500 km in length, between 80 and 300 km wide and rising from low-lying plains to over 8000 m asl) produced a distinctive climate of its own and influences the climate of much of Asia[2]. The great

J. S. Singh is in Banaras Hindu University, Varanasi 221 005, India and the Botanical Survey of India, Allahabad 211 002, India

*Excerpts from the X Pandit Govind Ballabh Pant Memorial Lecture delivered on 10 September 2004 at G.B. Pant Institute of Himalayan Environment and Development (GBIPHED), Kosi-Katarmal, Almora. These excerpts are compiled and communicated by Uppeandra Dhar, GBIPHED. e-mail: uppdhar@rediffmail.com

variation in topographical features causes immense diversity in climate and habitat conditions within the region. Temporal and spatial variations caused by diversity in geological orogeny have resulted into a marked difference in climate and physiography and consequently in the distribution pattern of biotic elements. This spatial position and heterogeneous dispersion of biodiversity elements have led to complexity in biogeographical patterns of the region. The eastern Himalaya (including northeast India) that harbours about 8000 species of flowering plants is considered a cradle of flowering plants, whereas the western Himalaya supports over 5000 species of flowering plants[3]. The Indian Himalayan region (IHR) as a whole, supports nearly 50% of the total flowering plants in India of which 30% flora is endemic to the region. There are over 816 tree species, 675 edibles and nearly 1743 species of medicinal value found in the IHR[4]. In view of growing threat to biological diversity, conservation and rational use of biodiversity in the Himalayan region could bring enormous economic benefits to the local populations and can indeed contribute to sustainable development[5,6].

The region is known as a 'water tower of the earth'. Approximately 10–20% of the area is covered by glaciers, while 30–40% remains under seasonal snow cover[7] varying from 0.48 ± 0.43 to 2.20 ± 1.25 million km^2. Despite the vast water resources (1,200,000 million m^3 annual flow of Himalayan rivers) trends such as diminishing regulatory effects of glaciers, streams and rivers are gradually occurring in the region. This region has a total geographical area of about 530,795 km^2 inhabited by 31,593,100 people, representing 16.16% of the total area and 3.73% of the total population of India. The literacy rate (7 years and above) of IHR (about 67%) is marginally higher than the national average (65.4%) recorded in the 2001 census. Its forests display phenomenal biodiversity that is used to meet diverse needs of the people[8]. The forest biomass value in some oak forest stands of Central Himalaya, 545–782 t ha^{-1} yr^{-1}, is typical for the region[8]. The Himalaya with its vast green cover acts as 'sink' for carbon dioxide. Estimates of annual carbon sequestration by the forests of western and northeastern Himalaya are computed to 6.49 mt, that values to 843 million US$ (A. K. Tewari, unpublished data). This is one of the important ecosystem services being performed by the Himalayan forests[9]. The beautiful landscapes, numerous rivers and streams cascading down the mountain slopes, diversity of cultures and religions, and colourful festivals of indigenous/ethnic communities present strong attractions for people from all over the globe, be they nature-lovers, tourists, or seekers of peace and truth.

Environmental security and peoples' aspirations

The people of the IHR, like elsewhere in other mountain ecosystems, are heavily dependent for their livelihood on their immediate natural resources and production from primary sectors such as agriculture, forestry, livestock, etc. The dependency of the continually growing population on finite resources, lack of viable technologies to mitigate the mountain specificities and enhanced production to meet the demands are depleting the resources along with increasing marginality of farmers, ultimately promoting poverty[10]. Despite its rich biological and cultural resources, the region is under-developed. Present trends of environmental health suggest that existing interventions are unsustainable. Economic indicators also do not reflect the desired effects on economic upliftment. In addition, the inherent fragility of the mountains as well as the increased vulnerability of the Himalaya to human-induced environmental impacts make people live in the shadow of fears of natural hazards. Large number of studies carried out in the region focusing on development interventions/initiatives reflect the unscientific exploitation of resources leading to increasing environmental degradations. Reduced dense forest cover[11,12], accelerated soil erosion and increased silting of water bodies[13,14], drying-up of springs[15,16], replacement and disappearance of species[17,18] and increased ratio of energy expended in fodder, fuel collection, and agricultural activity that increase drudgery of the womenfolk[19] are some of the tell-tale symptoms of environmental ill-health.

Environment as a holocoenotic resource system

Ecology is the science that elicits the functional interrelationships among the different components of environment on the one hand, and between the organisms and environment on the other. A major ecological principle states that the environment is holocoenotic in nature, and therefore any change in one component is bound to change the states of all other components. For example, deforestation leads to increased run-off (hence floods), increased soil erosion (hence siltation of water bodies), disappearance of species (hence gene erosion), and atmospheric loading of CO_2 (hence global warming). Thus the demand for timber and firewood across the country has had an impact on the forests of the Himalaya and deforestation in the Himalaya affects the flood situation in the Gangetic Plains. This explains how the scale of deforestation effects ranges from local to regional to global. Thus environment not only comprises the life-support system for biological organisms, but is also a system of interacting resource subsystems. The term resource implies management. Proper management will not disrupt a system because a dynamic equilibrium will be maintained among its subsystems and components[20]. Therefore, environmental degradation is the outcome of mismanagement leading to imbalance and over-exploitation of resources.

Interdependence of ecological and socio-economic activities

The problems in the Himalaya are complex, having intricate linkages between social, economic and ecological concerns. The solutions, therefore, cannot be addressed in isolation. To cite an example, the agro- and forest ecosystems are so intricately inter-related and inter-dependent that it is futile to talk of forest management in isolation without considering the cropland. In the Central Himalayan region, it is estimated that the cost of subsistence agriculture on the forest ecosystem is high. For example, for each unit of energy obtained in agronomic production, seven units of energy are expended from the forest through the use of firewood, fodder and vegetal manure[19]. A greater ratio of forest to cropland (5.18 : 1) is needed for sustenance of agriculture against the present ratio of 1.66 : 1. Problems have appeared because of the reduction in this ratio, implying that the carrying capacity of forests has already been exceeded. Similarly, pasture development or revegetation of wasteland without solving the problems of animal husbandry, fodder and fuel is not possible. The traditional agri–silvi–pastoral mode of subsistence living of the inhabitants of the region is no more sustainable, both ecologically and economically[21].

It is apparent that sectoral practices of management (or development) will not work, and therefore, the only approach which will work is a holistic one consistent with ecological and social principles. This approach also implies that the hill and adjoining plains must be taken as the macro-planning unit, with smaller structurally and functionally definable units for micro-level planning. The various ecosystems should be categorized into protective, productive and waste-dissipative systems and should be managed according to their roles[22]. Therefore, the basis of any planning for sustainable development in mountain areas has to be centred around man's relationship with nature. The relationship is desired to be governed by a sense of justice and equity. Each culture is the result of the people trying to survive within their environment and indeed of an attempt to optimize the use of its resources[23]. Lifestyle and production systems develop steadily by experimentation and observations over centuries, till they become so culturally incorporated that they are like genetic knowledge. This has been inherent in many tribal societies, but in the modern acquisitive society 'economy' gets priority over 'ecology'. There is need to evolve a new paradigm to restore balance between economic interests and ecological imperatives. Although the ecological and economic systems have a myriad of inter-connections, the most simple and most obvious is this: ecological system provides raw materials to the economic system and absorbs the waste generated by the economic system (Figure 1). Therefore, the system will be constrained by the productive and waste-absorption capacities of the ecological system. When one or both these capacities are exceeded, ecological backlashes are bound to occur. Once the waste-dissipative capacity of the Ganga was exceeded, severe pollution problem emerged which is now costing the government a huge sum of money, with still doubtful level of final outcome. Similar is the case for water bodies in the hills. When timber extraction or biomass extraction exceeded the limit of harvestable productivity of the forest, the latter began to diminish[20].

The ecological and economic considerations are therefore to be combined to attain ecologically sustainable development. Both ecological and economic values can be served individually in a variety of ways, but combining ecological and economic considerations adds geometrically to the complexity of development programmes[24]. When socio-cultural systems are added onto the ecological–economic relationships, the situation becomes further complicated (Figure 2). However, development driven solely by economic considerations has changed the aspirations, value systems and management priorities. Demographic and legal factors further complicate the application of ecological considerations to development of goals and processes. It is advisable that the management of such ecological resources upon which local communities depend should be decentralized, and these communities should be

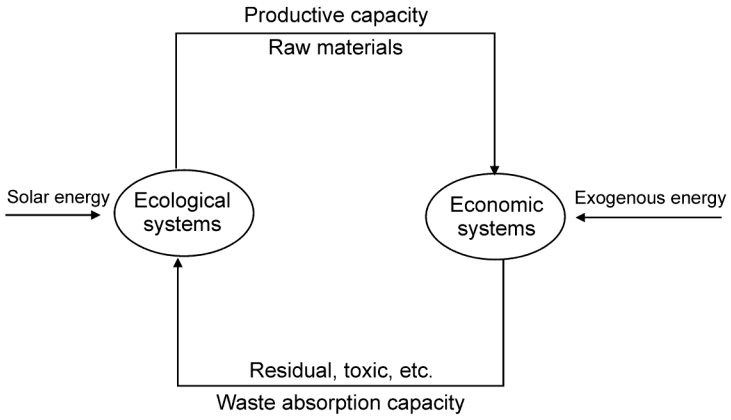

Figure 1. Inter-relationship between ecological and economic systems (after Singh[20]).

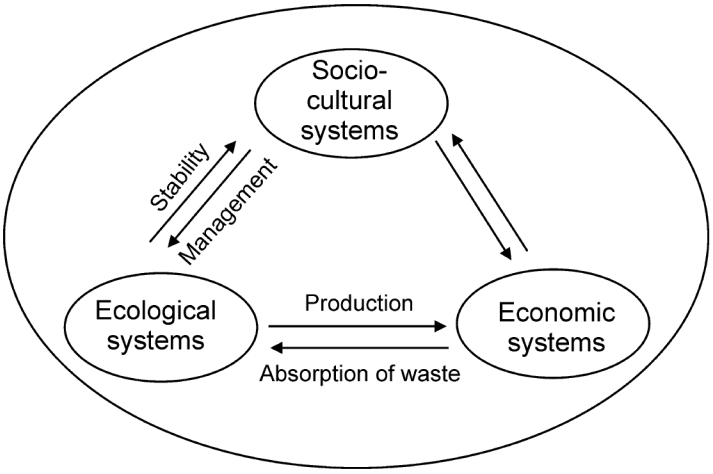

Figure 2. Superimposition of socio-cultural system on relationship of ecological and economic systems (after Singh[20]). Arrows between socio-cultural and economic systems represent 'aspirations' and 'value systems'.

given an effective say over the use of these resources[25]. This is presently the greatest challenge nationally as well as in the global context.

Achieving sustainable development

Simply stated, sustainable development implies the use of ecological system in a manner that satisfies current needs without compromising the needs or options of future generations[25]. Strategies for sustainable development must be based on reliable and comprehensive data on natural, socio-cultural and socio-economic resources, as well as on the environmental set-up. These strategies should incorporate traditional knowledge and established production systems after they have been carefully evaluated. The aim of sustainable development should be to maximize human well-being or quality of life without jeopardizing the life-support environment. Although there is no unique definition of quality of life, the following groups of variables together might be considered its indicators: (i) economic variables: per capita income, employment stability, income distribution; (ii) ecological variables: ecological degradation, environmental quality, use of renewable and non-renewable resources, human-initiated energy consumption; (iii) social variables: social security, emotional support, intellectual growth and mental satisfaction; (iv) cultural heterogeneity, and (5) political variables: scope and use of government services, political participation, political power advantage and policies.

Solutions to the ecological and economic problems in the IHR are to be sought within the permissibility of mountain specificities and adaptability of people, which is governed by socio-cultural principles. Identifying sustainable landuse practices, promotion of on-farm activities, value addition to all resources and adoption of environment-friendly technologies, restoration of degraded ecosystems, biodiversity conservation, water resource and hydro-power development, promoting community-based management, upgrading infrastructure, improving quality education and capacity building to ensure benefits, are but a few priority activities to improve livelihoods, income and environment of the IHR.

Conclusion

The unique majestic Himalaya has provided immense ecosystem goods and services in the past and, with proper planning and management will be able to provide the same in the future also. However, we must acknowledge the fact that the whole IHR is facing anthropogenic pressure leading to overall degradation of its environment. Once symptoms of environmental deterioration become apparent, most often the only option left is to react to the situation and try to cure the problems by costly corrective measures. It is much better however, to be able to anticipate the problem and take up preventive measures in the beginning. Proper education at various levels, long-range database and a holistic approach would bring us nearer to sustainable development ensuring better quality of life, improved economic status, and minimized adverse effect on life-support environment. There is also a need to experiment and devise ways and means to ensure that the development does not destroy its bio-cultural diversity and social fabric. The Himalayan region should not be burdened with backward-dragging heritage of the past, nor be constrained by the mistakes that bigger states have committed. I dream of a revolution sweeping the Himalayan region and a new age of plenty and progress coming with the ushering in of the next millennium. Our present embodies our future also. It is only the future that we have to think about.

1. Jodha, N. S., Sustainability issues in the mountain context: Emerging scenario. Paper presented in the workshop on Approaches to

Sustainable Development of the Indian Himalaya, Manali, Himachal Pradesh, 1–4 August 1992.
2. Zobel, D. B. and Singh, S. P., Himalayan forests and ecological generalizations. *BioScience*, 1997, **11**, 735–745.
3. Rao, R. R., *Biodiversity in India: Floristic Aspects*, Bishen Singh Mahendra Pal Singh, Dehradun, 1994.
4. Samant, S. S., Dhar, U. and Palni, L. M. S., *Medicinal Plants of Indian Himalaya: Diversity, Distribution, Potential Values*, Gyanodaya Prakashan, Nainital, 1998.
5. Khoshoo, T. N., Plant diversity in the Himalaya: Conservation and utilization. II Pandit Govind Ballabh Pant Memorial Lecture, G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora, 1992.
6. Dhar, U. (ed.), *Himalayan Biodiversity – Action Plan*, Himvikas Publication No. 10, G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora, 1997.
7. Bahadur, J., *Himalayan Snow and Glaciers – Associated Environmental Problems, Progress and Prospects*, Concept Publishing Co, New Delhi, 2004.
8. Singh, J. S. and Singh, S. P., *Forests of Himalaya: Structure, Functioning and Impact of Man*, Gyanodaya Prakashan, Nainital, 1992.
9. Singh, S. P., Balancing the approaches of environmental conservation by considering ecosystem services as well as biodiversity. *Curr. Sci.*, 2002, **82**, 1331–1335.
10. Samal, P. K., Palni, L. M. S. and Agrawal, D. K., Ecology, ecological poverty and sustainable development in Central Himalaya region of India. *Int. J. Sustain. Dev. World Ecol.*, 2003, **10**, 157–168.
11. FSI, State Forest Report 2001, Forest Survey of India, Dehradun, 2003.
12. Singh, J. S., Tiwari, A. K. and Saxena, A. K., Himalayan forest: A net source of carbon for the atmosphere. *Environ. Conserv.*, 1985, **12**, 67–69.
13. Valdiya, K. S., Accelerated erosion and landslide-prone zones in the Central Himalayan region. In *Environmental Regeneration in Himalaya: Concepts and Strategies* (ed. Singh, J. S.), Central Himalayan Environmental Association and Gyanodaya Prakashan, Nainital, 1985, pp. 312–380.
14. Valdiya, K. S., Developing a paradise in peril. VII G.B. Pant Memorial Lecture, G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora, 1997, p. 26.
15. Valdiya, K. S. and Bargarya, S. K., Hydrological studies of springs in the catchment of Gaula river, Kumaun Lesser Himalaya, India. *Mt. Res. Dev.*, 1991, **11**, 239–258.
16. Negi, G. C. S. and Joshi, V., Drinking water issues and development of spring sanctuaries in a mountain watershed in Indian Himalaya. *Mt. Res. Dev.*, 2002, **22**, 29–31.
17. Singh, J. S., Rawat, Y. S. and Chaturvedi, O. P., Replacement of Oak forest with pine in the Himalaya affects the nitrogen cycle. *Nature*, 1984, **311**, 54–56.
18. Saxena, A. K., Singh, S. P. and Singh, J. S., Population structure of forest of Kumaun Himalaya: Implications for management. *J. Environ. Manage.*, 1984, **19**, 307–324.
19. Pandey, U. and Singh, J. S., Energy-flow relationships between agro- and forest ecosystem in Central Himalaya. *Environ. Conserv.*, 1984, **11**, 45–53.
20. Singh, J. S., Sustainable development: An ecological viewpoint. In *Perspectives for Planning and Development in Northeast India* (eds Sundriyal, R. C., Uma Shankar and Upreti, T. C.), Himavikas Occasional Publication, No. 11, G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora, 1998, pp. 5–16.
21. Singh, S. P., Negi, G. C. S., Pant, M. C. and Singh, J. S., Economic considerations in the Central Himalayan agroecosystems. In *The Price of Forest* (ed. Agrawal, A.), Centre for Science and Environment, New Delhi, 1992, pp. 291–296.
22. Singh, S. P. and Singh, J. S., Analytical conceptual plan to reforest Central Himalaya for sustainable development. *Environ. Manage.*, 1991, **15**, 369–379.
23. Agrawal, A., Community participation in restoration of environment. In *Restoration of Degraded Land: Concepts and Strategies* (ed. Singh, J. S.), Rastogi Publication, Meerut, 1992, pp. 291–310.
24. Caldwell, L. K., Political aspects of ecological sustainable development. *Environ. Conserv.*, 1984, **11**, 299–308.
25. World Convention on Environment and Development. In *Our Common Future*, The World Commission on Environment and Development, Switzerland, 1987, p. 400.

Received 5 September 2005; accepted 2 October 2005