8. Conclusions and Recommendations

Development of mountain specific and sustainable infrastructures in mountainous areas requires multidisciplinary inputs that give due consideration to highland-lowland interdependencies. Environmentally-sound infrastructural development plans in mountainous areas must provide for the economic upliftment of the local people in the short term as well as in the long term.

Luxury-waste as a result of engineering-geological hazards and high initial costs, high maintenance costs, and high rehabilitation costs means that infrastructures in mountainous areas with minimal economic bases are not affordable for developing countries.

The quality of national level plans for infrastructures in mountainous regions is a function of the quality and extent of the data on and analysis of geological, engineering, socioeconomic, and environmental factors. Absence of an integrated development strategy based on geological, socioeconomic, and ecological interactions, and the absence of a 15-20-year master plan and priorities lead to misappropriation of investments and wastage of scarce resources. Traditional economic feasibility studies alone are not adequate for decision-making on the viability of mountain infrastructures in a developing country.

Optimisation of returns on investment in transportation in mountainous regions is possible by comparative analysis of various transport modes such as roads, airways, and waterways.

Air transport and tourism are potential sectors for rapid and environmentally-friendly, economic development activities in mountain regions.

Risk-based approaches to infrastructures in mountainous regions provide a sound decision-making tool. Communicating engineering-geological, environmental, and technological risks to decision-makers and local people requires an approach which is simple, illustrative, concise, demonstrative, participatory, and free from technical jargon.

The costs for database and analytical aids, such as computer applications and use of GIS (Geographical Information System) for national level planning and for major infrastructural planning, are far lower than the losses from frequently failing infrastructures in mountainous regions.

Mountain-specific designs of linear infrastructures, such as roads and irrigation canals, in mountain areas require access to comprehensive treatise, or handbooks, or guide books covering the necessary aspects of geology, geotechnics, engineering, environment, ecology, bio-engineering, and economic analysis.

Traditional geologists and civil engineers must be trained in mountain-specific skills for investigation, analysis, design, and implementation for infrastructural works in mountain areas. Development of rapidly effective and sustainable infrastructures in mountainous regions necessitates a continuous process of basic research, action-research, development of specific handbooks and guidelines, specific training for various levels of engineers, geologists, and technicians, as well as participatory awareness programmes for decision-makers and local people.