

CONCLUSIONS

This report has provided a general description of the *jokulhlaup* phenomenon and its highly destructive potential, drawing on examples in various parts of the mountain world.

It has also discussed the *jokulhlaup* situation in the Nepal Himalaya. In particular, it has used the 4 August 1985 catastrophe (Langmoche *Jokulhlaup*) in Khumbu Himal as a case study. It has concluded that the lack of awareness of the possibility for such an event is unfortunate. Steps should be taken to reduce the prospects for future catastrophes by the introduction of appropriate legislation and development planning regulations. Finally, an outline has been sketched for initiation of a remote sensing survey and modest field programme as part of a measured response to reduce the likelihood of future disasters.

The main conclusions and recommendations are as follows:

1. *Jokulhlaup* will continue to occur in the Central Himalaya with sufficient frequency and magnitude to cause significant loss of life and property and severe disruption of community activities.
2. As the development of infrastructure, especially hydro-electric facilities and increases in trekking tourism continue to expand, the potential for a major disaster will progressively heighten. A major disaster is defined as loss of life in excess of 100 persons and/or the destruction of a medium or large-scale engineering structure, or comparable private property.
3. Many potential *jokulhlaup* source areas (especially sub-aerial lakes) can be easily and inexpensively located and mapped. Some source areas, such as englacial and sub-glacial water bodies, cannot be readily identified but mapping in indirect indicators, such as unusual accumulations of coarse grade alluvium and stripped bedrock, provides some indication of a potential hazard.
4. A much clearer understanding of the potential for *jokulhlaup* occurrence can be gained from a better assessment of the dynamics of Himalayan glaciers. In some cases a high degree of predictive capability could be generated.
5. All development projects and especially hydro-electric projects, should be required by law or regulation to examine the natural hazard potential, and especially the *jokulhlaup* hazards, of the immediate area (catchment). Siting, design, and final development decision making should be integrated with the hazard assessment findings.
6. The development response to the *jokulhlaup* (and debris flow) hazard within the Water and Energy Commission of HMG/N should be formalized. This should include a modest applied glaciological programme with emphasis on the *jokulhlaup* danger. Remote sensing techniques (through the HMG/N Remote Sensing Centre) should be developed and applied. The programme could be enlarged to take on an international mode through the participation of ICIMOD or the United Nations University. A training component, for field work and remote sensing, should be part of any programme development. Ethnographic studies to examine the behaviour and attitudes of local communities to the *jokulhlaup* and related hazards, are also recommended. The resources and training capabilities of the Department of Meteorology, Tribhuvan University, should be utilized.
7. An effort should be made to increase public, government, and development agency awareness of the *jokulhlaup* hazard.