

SUMMARY

On 4 August 1985, a glacial lake drained suddenly and sent a 10 to 15 metre high surge of water and debris down the Bhote Koshi and Dudh Koshi rivers, for more than 90 km. An estimated 1 mill. m³ of water was released, creating an initial peak discharge of 2,000 m³/sec; two to four times the magnitude of maximum floods due to heavy monsoon rains.

This spectacular natural event destroyed the nearly completed Namche Small Hydel Project, at a cost of about NRs 40 million. It eliminated all the bridges, including new high suspension bridges, for 42 km downstream between Thamo and Jubing; four or five people lost their lives.

In addition, more than 30 houses were destroyed, as well as considerable cultivable land, livestock, and forest, together with long stretches of the Lukla- Namche Bazar main trail. If the flood had occurred two months later, during the trekking season, the death toll could have been as high as 100 to 200 persons.

This type of catastrophic natural phenomenon is called a *jokulhlaup* (glacier leap or burst in Icelandic) since such terrifying events were first recognised and studied in Iceland. They are not unusual in the Himalaya. In 1984 a much larger *jokulhlaup* devastated the China- Nepal road. Much loss of life and property resulted over 30 km of the highway on the China side of the frontier; the Friendship Bridge was destroyed, and downstream impact extended for 30 km into Nepal. In 1977, a potentially lethal *jokulhlaup* originated from a glacier on the slopes of Ama Dablam, also in the Khumbu, and destroyed bridges for 35 km downstream.

With the accelerating development of small hydel projects, engineering works, and trekking tourism in the Himalaya, the potential for a

major disaster during the next decade is very high. Of equally serious concern is that *jokulhlaup* cause massive changes to the river channels along which they flow. They prompt landslides and slumps, and undercut sections of the river terraces, thus dumping vast amounts of debris into river beds, forming high river sediment for years, if not decades, following a *jokulhlaup* event. This is of critical concern because it leads to excessive silting of reservoirs and the possibility of damage to large-scale hydroelectric and irrigation facilities in the outer regions and the Terai.

This ICIMOD Occasional Paper provides a general description of the *jokulhlaup* phenomenon, introducing examples from other parts of the mountain world. It also gives a detailed account of the 4 August 1985 Langmoche *jokulhlaup* and the siting and destruction of the Namche Small Hydel Project. A proposal for a glaciological survey and monitoring programme is introduced.

It is concluded that many of the potential *jokulhlaup* danger areas can be identified and monitored at modest cost, insignificant when the potential for heavy loss of life and destruction of engineering works is considered.

New regulations are recommended so that future engineering projects include a prior assessment of *jokulhlaup* and related hazards. As in industrialized countries, blind development in the face of high natural risk should not be tolerated in Nepal and neighbouring Himalayan countries.

It is hoped that important lessons can be learned from the 4 August 1985, Khumbu disaster; prevention is always better than cure, especially when **prevention** is inexpensive and when **cure** is very costly and sometimes impossible to achieve.