

Chapter 1

Introduction to Inventory of Glaciers and Glacial Lakes

1.1 INTRODUCTION

Nepal is a mountainous country, where mountains and hills occupy most of the area. The country is vulnerable to various hazards due to fragile geological conditions, great elevation differences and steeply sloping terrain. Apart from landslides and river erosion, the mountainous region is also quite susceptible to disastrous hazards due to glacial lake outburst floods (GLOF). In general, the area higher than 4,000 metres above sea level (masl) is mostly covered by snow and ice throughout the year. The glaciers, some of which consist of a huge amount of perpetual snow and ice, are found to create many glacial lakes. These glaciers as well as glacial lakes are the sources of the headwaters of many great rivers in the region. Most of these lakes are located in the down valleys close to the glaciers. They are formed by the accumulation of vast amounts of water from the melting of snow and ice cover and by blockage of end moraines. The sudden break of a moraine may generate the discharge of large volumes of water and debris causing floods.

In the last half century, several glacial lakes have developed in the Hindu Kush-Himalayas and the Tibetan Himalayas. This may be attributed to the effect of recent global warming. The glacial lakes are formed on the glacier terminus due to the recent retreating processes of glaciers. The majority of these glacial lakes are dammed by unstable moraines, which were formed by the glaciation of the Little Ice Age. Occasionally a lake bursts releasing an enormous amount of its stored water, which causes serious floods downstream along the river channel. This phenomenon, generally known as GLOF, is recognised to be a common problem in Hindu Kush-Himalayan countries such as Nepal, India, Pakistan, Bhutan, and China (Tibet).

There have been several occurrences of GLOF events in different parts of the Hindu Kush-Himalayan region. After the severe impact of the 1985 Dig Tsho GLOF, glacial lakes and the GLOF phenomenon in the Nepal Himalayas drew great attention and led to study and field investigation of several glacial lakes such as the Dig Tsho, Imja, Lower Barun, Tsho Rolpa, and Thulagi.

The study of satellite images indicates the presence of glaciers and glacial lakes and occurrences of GLOFs in the Himalayas. Downstream impacts of these GLOFs are reported to be highly destructive in nature and to lead to long-term secondary environmental degradation in the valleys, both physically and socioeconomically.

For the mapping and writing of the inventory of glaciers and glacial lakes, the methodology in this study is based on the research study of the Temporary Technical Secretary (TTS) for the World Glacier Inventory (WGI) of the Swiss Federal Institute of Technology (ETH), Zurich (Muller et al. 1977; World Glacier Monitoring Service [WGMS] 1989).

1.2 OBJECTIVES

- To understand the GLOF phenomenon by creating an inventory of existing glacial lakes and monitoring the GLOF events on a regular basis
- To establish an effective early warning mechanism to monitor GLOF hazards using remote sensing (RS) and geographic information systems (GIS) in the Hindu Kush-Himalayan region
- To develop the capacity building of national institutions to assess and monitor the GLOF phenomenon
- To disseminate the results and outputs to the relevant organisations in the region that could make use of this information for GLOF hazard prevention and mitigation planning

1.3 OUTPUTS

- An inventory of glaciers and glacial lakes of Nepal
- Identification of potential risk lakes
- Recommendations for the establishment of a system for monitoring potential risk lakes using RS and GIS
- Strengthening of capabilities of the national institutions to implement an early warning system for GLOF hazard monitoring
- Dissemination of the results and outputs to relevant institutions

1.4 ACTIVITIES

- Glacier and glacial lake inventory
 - Acquisition of Land Observation Satellite (LANDSAT) Thematic Mapper (TM) images of 1999 covering the northern part of Nepal
 - Collection of GIS data layers including Digital Elevation Models (DEM), geology, soils, hydrology (rivers), land use, infrastructure (roads), settlements, forest, administrative boundaries (districts and villages), urban areas, and tourist spots on a scale of 1:50,000
 - Data analysis and report writing
- Monitoring potential risk lakes
 - Acquisition of LANDSAT TM/ Stéréo Système Probatoire d' Observation de la Terre (SPOT)/RS images from 1990 and 1995 for four glacial lakes
 - Acquisition of time series satellite images for 1990 and 1995
 - Field checking and validation of results
 - Report writing
- Establishment of an early warning system
 - Developing the methodology using RS and GIS techniques for the inventory of glaciers and glacial lakes and for the GLOF monitoring and early warning system
 - Training two participants each from Nepal and Bhutan
- Results dissemination/publication
 - Publication of a comprehensive report including (1) to (3) above
 - Dissemination of results and outputs in the form of reports, on CD, and through the Internet
 - Organisation of a workshop to release the results and outputs

1.5 FLOW CHART



