



Assessing GLOF vulnerability in the Punatshangchhu Basin

Background

The Punatshangchhu Basin in Bhutan has a concentration of potentially dangerous glacial lakes. The Watershed Management Division under the Department of Forests and Parks is carrying out a socio-economic survey and a vulnerability assessment of the basin to understand how communities perceive glacial lake outburst floods (GLOFs) and climate change, and adapt to future disasters. The goal is to provide information for proper land use planning in the basin.

The assessment is a part of the Cryosphere Monitoring Programme in Bhutan, implemented by the National Centre for Hydrology and Meteorology (NCHM) in collaboration with the International Centre for Integrated Mountain Development (ICIMOD).



Figure 1: A Google Earth image showing a concentration of potentially dangerous glacial lakes in the Punatshangchhu basin

The Punatshangchhu basin's Lunana valley has the highest number of potentially dangerous glacial lakes in Bhutan. As such, it is one of the most studied areas in the country. All four glacial lakes—Baychung, Raphstreng, Thorthormi, and Luggye—are located in close proximity to each other. A breach in any one of these lakes has the potential to trigger a cascading glacial lake outburst. The area has already experienced two GLOF incidences in the past—one in 1994 and the other in the ~1960s.

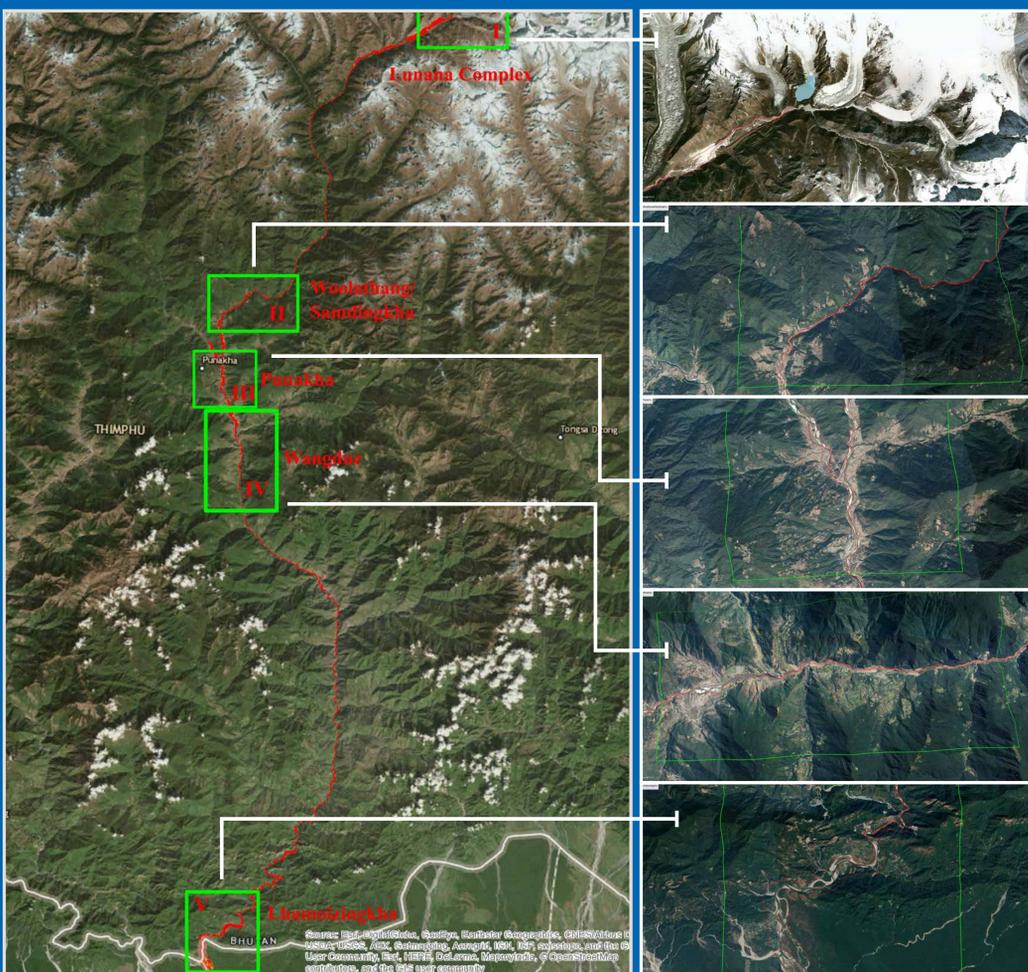
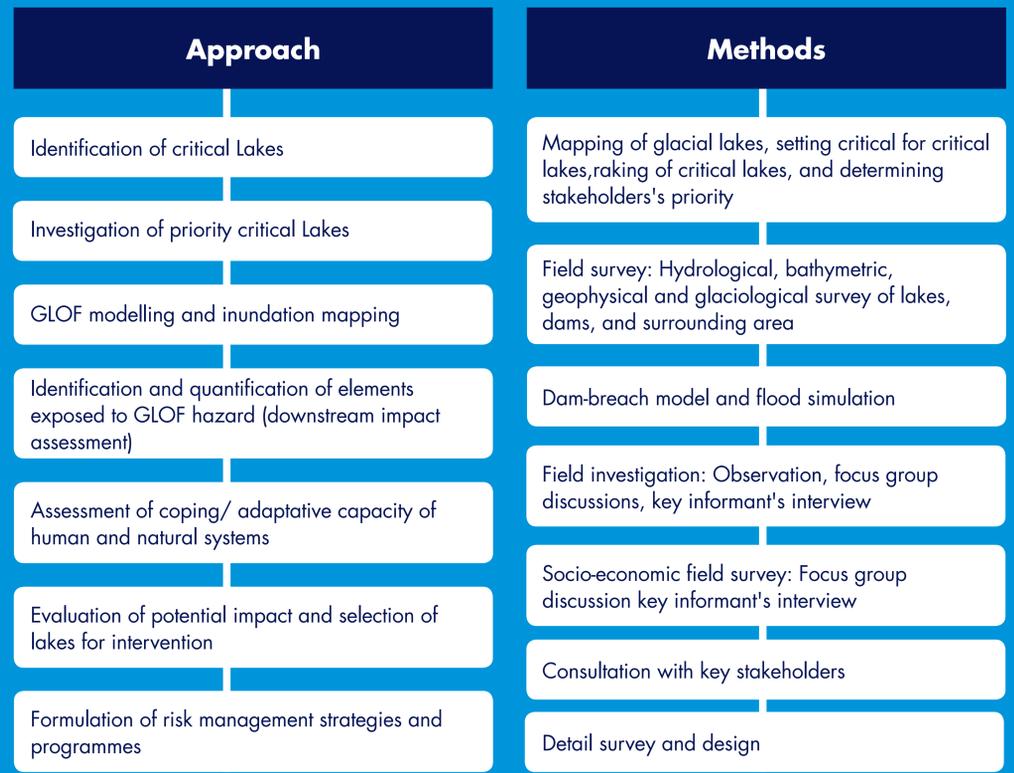


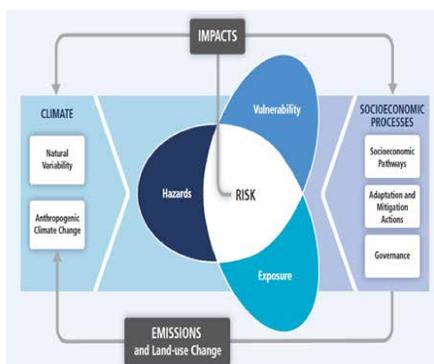
Figure 2: A hazard zone map identifying five important downstream settlements in the Punatshangchhu basin

Methodology

The assessment focuses on the linkages between nature and humans. The associated inundation map provides information on the physiography of the region and identifies important human settlements. The socio-economic assessment, which uses tools such as questionnaire surveys and focus group discussions, will enable researchers to better assess the exposure level of local communities and recommend adaptation interventions based on the survey results.

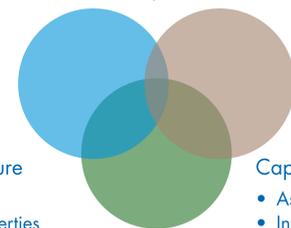


The Concept of Vulnerability



Conceptual Framework for Vulnerability Assessment

Vulnerability and Conflict



Exposure

- Life
- Properties
- Infrastructure
- Livelihood supplies system
- Environmental resources

Capacity

- Assets/wealth
- Information
- Technology/skills
- Service infrastructure
- Institutions

Hazard, vulnerability, and risk assessment
 $Risk = f(hp * dp)$
 $Vulnerability = f(E * S / A)$ or $dp = f(e-a) * s$

hp = hazard probability
 dp = damage probability
 E = exposure
 S = sensitivity
 A = adaptive capacity



Bathymetry survey (measurement of glacial lake depth)



Topographic survey



Shear test of moraine



Socio-economic survey

Anticipated outcome

- Vulnerability assessment of the Punatsangchhu Basin.
- Improved understanding of the climate-cryosphere-water nexus in Bhutan.
- Decision support tools for policy makers on sustainable adaptation interventions.
- Better GLOF risk scenarios and assessments.

The results of the action research will be presented to the government as a policy directive. This will enable concerned government agencies to come up with more effective disaster risk and disaster management plans.

Implementing partners

Watershed Management Division, Department of Forests and Park Services
 Department of Geology and Mines
 National Centre for Hydrology and Meteorology
 Department of Disaster Management