Glacial Lake Outburst Flood Risks in the Everest Region, Nepal:
Analyzing the Governance and Institutional Factors of Mitigation Options

Sonam Futi Sherpa* and Milan Shrestha
School of Sustainability, Arizona State University
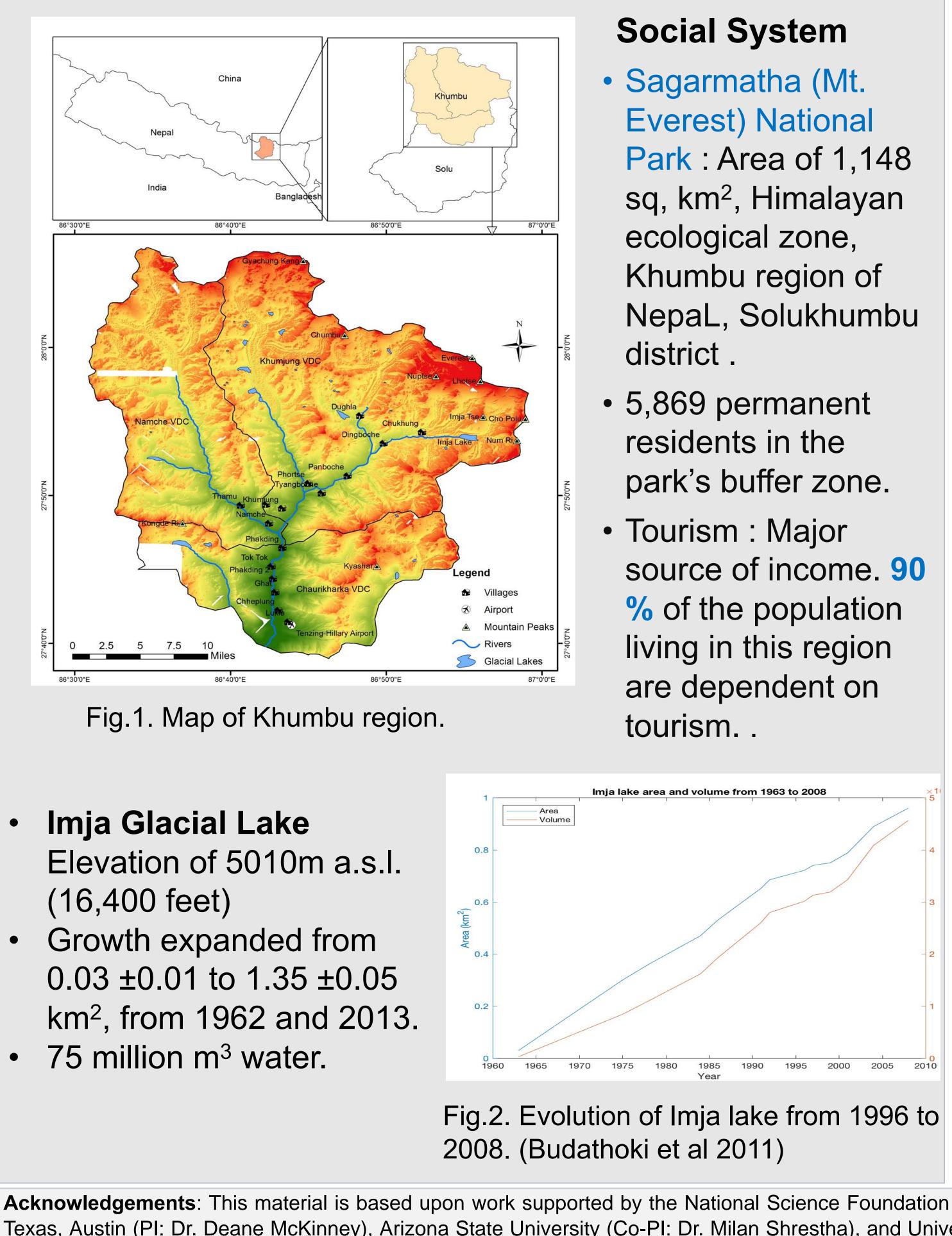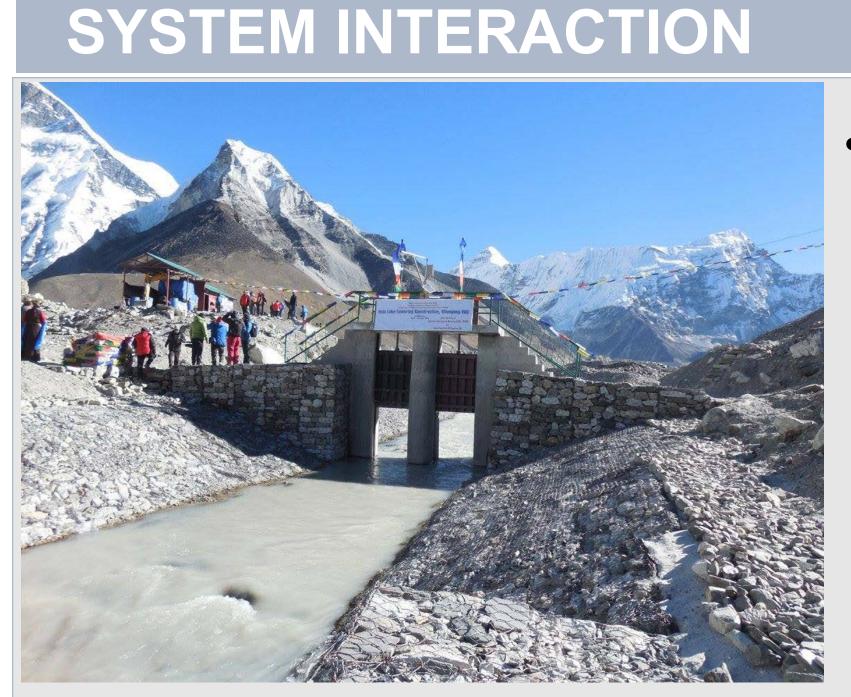sonam.sherpa@asu.edu

RESEARCH FRAMEWORK

Glacial lake outburst floods (GLOFs) are a serious climate change risk, but little attention has been paid to make GLOF risk reduction strategies **socially responsive and sustainable.** Glacial lakes in the Himalayas may be far from urban system research, GLOFs are threats to the lowland cities and urban infrastructures. For GLOF risk mitigation in the Everest region, it is important to analyze the institutional factors governing local resources and disaster management.

This poster introduces how a **socio-ecological and technical systems (SETS) framework** can be used to analyze how GLOF **risks and vulnerability** for the mountain villages and the downstream lowland cities.

Fig.1. Map of Khumbu region.

Social System

• Sagarmatha (Mt. Everest) National Park : Area of 1,148 sq, km^2, Himalayan ecological zone, Khumbu region of NepaL, Solukhumbu district .

• 5,869 permanent residents in the park's buffer zone.

• Tourism : Major source of income. **90 %** of the population living in this region are dependent on tourism. .

• **Imja Glacial Lake**
  Elevation of 5010m a.s.l. (16,400 feet)
• Growth expanded from 0.03 ±0.01 to 1.35 ±0.05 km^2, from 1962 and 2013.
• 75 million m^3 water.

Fig.2. Evolution of Imja lake from 1996 to 2008. (Budathoki et al 2011)

SYSTEM INTERACTION

Fig. 3 Remedial action being taken in Imja lake.

• **Technological System:** Development of concrete dam .Use of different lowering technologies such as pumping method as well and use of gate to control the flow of the river to facilitate the lowering work.
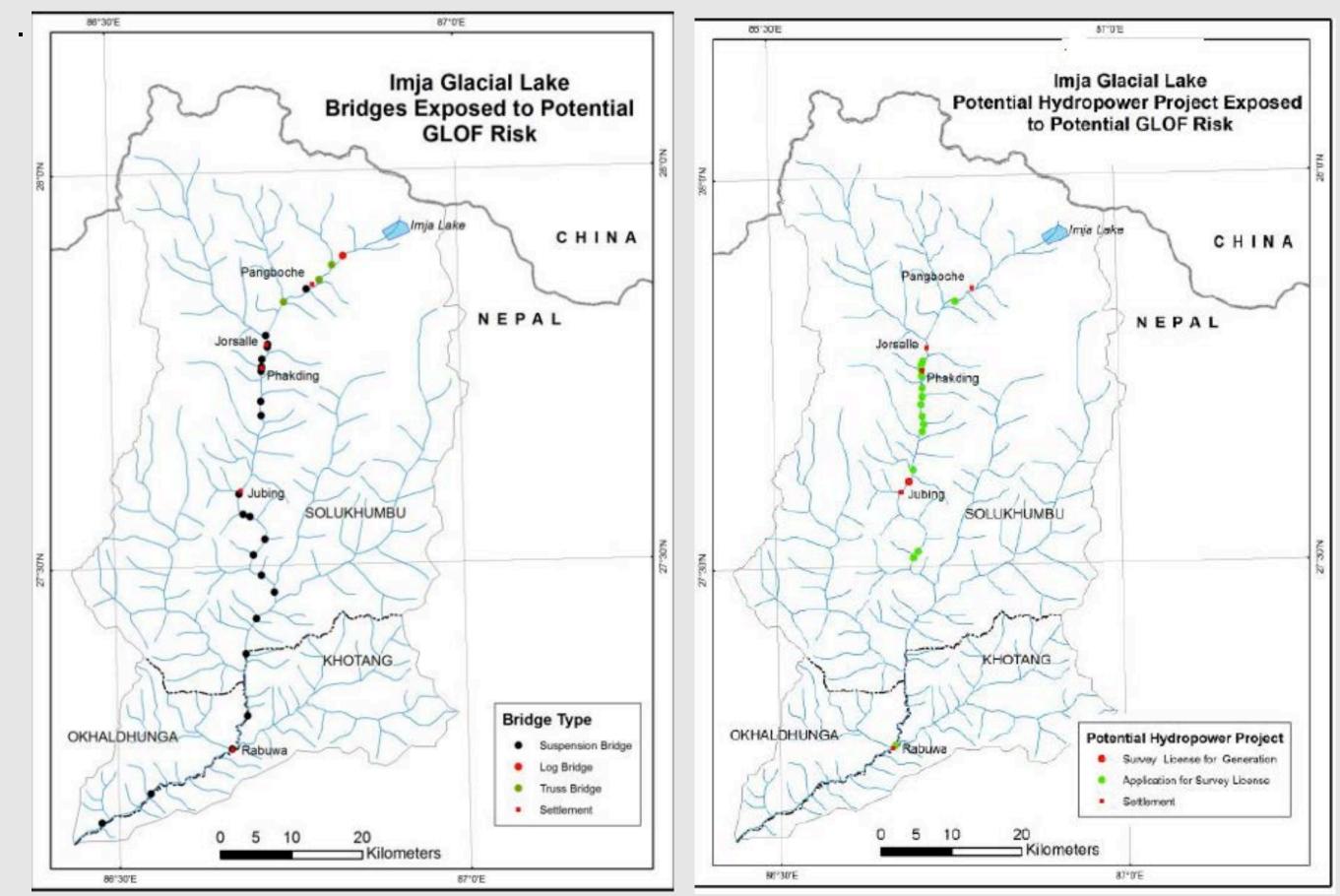

Fig. 4. Map of Solukhumbu district. Bridges and hydropower exposed to GLOF risk from Imja Lake (CFGORRP report).

Methods and Analysis

• This study integrates both qualitative and quantitative methods.
• 150 Household Surveys and 26 In-depth Semi-structured Interviews and three Focus Groups were carried out to understand individual risk perceptions and village priorities
• Two Vulnerability Maps were created assessing priorities & preparedness.

o Social data is being quantified, ranked, and analyzed to describe GLOF risks.

o Institutional Analysis is further planned to analyze the policy and governance of GLOF response.

ANALYSIS AND SYSTEM ROBUSTNESS

HAZARDS	FREQUENCY (%)	AVERAGE RANK	SALIENCE
Erratic rainfall	100.00	4.67	0.47
Avalanche	100.00	4.33	0.54
Landslides	100.00	4.00	0.65
GLOF	83.30	2.60	0.63
Earthquake	66.70	1.50	0.62
Wind storms	50.00	5.33	0.25
Droughts	50.00	7.67	0.08
Flood	50.00	5.67	0.15
Fire	50.00	5.00	0.27
Falling rocks	33.30	4.50	0.20
Blizzards	33.30	5.00	0.16

(n = 6)

Table 1. Free listing of the major hazards in the Khumbu region.

Institutional Arrangements

First tier : National GLOF Risk Reduction Fund that is established for research, awareness.

Second tier: Government of Nepal (GoN), Department of Hydrology and Meteorology (DHM) and Army people who are responsible for the creation, design, and implementation of mitigation as well as adaptation measures.

Third tier: Local organizations and active stake holders in the community so as to make the risk reduction method community based and long lasting.

A robust design of community-based engineering and Culturally sensible adaptive responses is needed.

Strong local collaboration and Empowering communities GLOF risk reduction strategy should be developed.

Strong communication among locals and scientists are the must.

Understanding societal perceptions of future scenarios and risks associated with GLOFs and glacial lake management is important.

Robustness analysis

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