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GLOF Risk Management in Sikkim: A Strategic Approach

Introduction

The Indian Himalayan Region (IHR) is facing increasing challenges due to climate change. This includes acceleration of glacial retreat and thawing of permafrost in the underground, in turn contributing to the formation and expansion of glacial lakes and reduction in slope stability, respectively. As new lakes form and existing lakes grow, the risk of Glacial Lake Outburst Floods (GLOFs) also intensifies, posing a severe threat to downstream communities, infrastructure, and ecosystems. This evolving threat requires proactive risk assessment and management strategies.

Picture 1: South Lhonak Glacial Lake, Sikkim, India (NDMA/SDC, 2024)

Sikkim, a state located within the IHR, is particularly affected by GLOF risk, with several high-risk lakes identified across the state. The growing number of glacial lakes, coupled with rapid glacial melt driven by climate change, has significantly heightened the risk of GLOFs, threatening local communities and their livelihoods. As infrastructure development progresses in the region, the state's exposure to these hazards continues to grow. This escalating risk demands urgent action, including comprehensive risk assessments and effective management strategies to mitigate the impacts of GLOFs.

On October 3, 2023, a catastrophic GLOF was triggered at the South Lhonak Lake, causing widespread damage in Sikkim and West Bengal. This event served as a stark reminder of the devastating impact GLOFs can have on communities and infrastructure. The devastating event resulted in impacts across the Teesta Valley:

- Many lives were lost during the 2023 GLOF .
- Extensive destruction of homes and infrastructure, leaving countless families displaced.
- Severe damage to hydropower projects, disrupting regional energy supplies.
- Major disruptions to National Highway 10 (NH10) due to landslides and subsidence.
- Significant ecological damage, leading to long-term environmental degradation.

This tragic event underscored the urgent need for effective GLOF risk management and disaster preparedness.

Picture 2: Impact of 2023 GLOF on infrastructure in Sikkim, India (NDMA/SDC, 2024)

Picture 3: GLOF Triggered Landslide in Sikkim, India (NDMA/SDC, 2024)

SCA-Himalayas Project: Strengthening GLOF Monitoring and Preparedness

In response to the escalating GLOF risks in Sikkim, the **SCA Himalayas Project,** supported by the **Swiss Agency for Development and Cooperation (SDC),** has been collaborating with the **National Disaster Management Authority (NDMA)**, the **Sikkim State Government,** including the **Sikkim State Disaster Management Authority (SSDMA)** and the **Department of Science and Technology (DST)**. Together, they are implementing an integrated monitoring system for South Lhonak and Shako Cho lakes for comprehensive GLOF risk management. This pilot initiative aims to enhance disaster preparedness and guide policy interventions at both national and sub-national levels.

Picture 4 :Consultation between SDC and Govt. of Sikkim, India (NDMA/SDC/DST 2024)

Key components of the initiative

Figure 1: Key components of the GLOF Risk Management initiatives under SCA Himalayas Project (SDC, 2025)

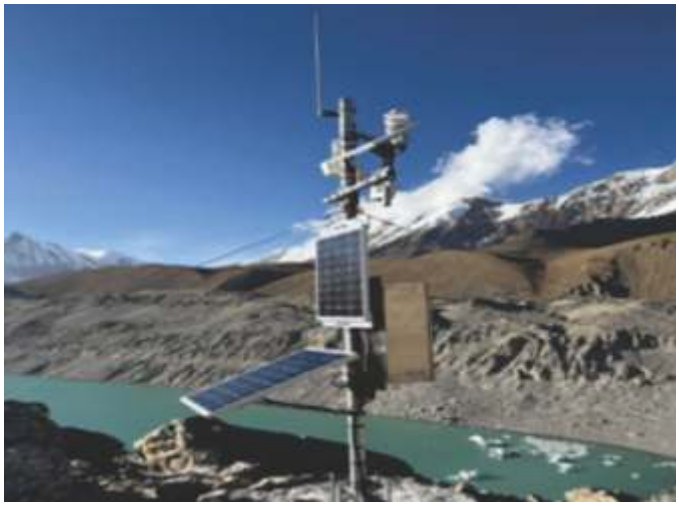
Strategic Interventions and Outcomes:

Some of the key interventions implemented under this initiative include:

- To address the growing GLOF threat, NDMA, with the support of SDC, has published **Guidelines on the Management of GLOFs*,** which provide comprehensive insights into managing GLOF risks across the IHR.
- **GLOF Hazard/Risk Assessment**
  - **First-Order GLOF Hazard & Risk Assessment -** First-order hazard and risk assessments was conducted for the entire upper Teesta basin, evaluating all glacial lakes in the regions. A preliminary assessment of GLOF risks to hydropower, roads, cropland and settlements, combined with a comparative study on lake evaluations, helped to prioritize the most critical lakes in the region.
  - **Detailed Hazard and Exposure Mapping -** Hazard and exposure mapping for GLOF events from Shako Cho and South Lhonak lakes in Sikkim was done, including a detailed GLOF hazard map of the entire area between the two lakes and Chungthang, providing valuable insights for future risk management.

Picture 5: Placement of pressure probes at high altitude lakes in Sikkim (SDC, 2024)

- **Monitoring Station Installation**



Picture 6: Monitoring station installed at South Lhonak lake, Sikkim (SDC,2024)

Cutting-edge monitoring stations have been established at both Shako Cho and South Lhonak lakes, contributing to enhanced data collection on weather parameters, lake water levels, and ground conditions. These installations were completed through multi-agency expeditions, involving experts from Switzerland, the Government of India, the Government of Sikkim, the Indian Army, and the Indo-Tibetan Border Police (ITBP). Key institutions at National and Sub-national level can access the data being generated at daily basis.

Key Highlights of the Initiative

- **Scientific Approach:** The initiative employs a scientific approach, integrating advanced risk assessment methodologies and leveraging technical expertise from Switzerland. This approach provides a model for managing risks at other high-risk lakes in the Himalayas.
- **Ownership and Stakeholder Involvement:** The project ensures strong ownership by government authorities at both national and sub-national levels, fostering long-term sustainability.

Picture 7: Expedition team at Shako Cho Lake, Sikkim, India (NDMA/SDC, 2024)

** https://ndma.gov.in/sites/default/files/PDF/Guidelines/Guidelines-on-Management-of-GLOFs.pdf*

Picture 8 : Expedition Team at Base Camp near the glacial lakes (SSDMA, Govt of Sikkim, 2024)

Picture 9 : Handing over monitoring station to Sikkim Government. (NDMA/SDC)

- **Capacity Building:** The initiative places a strong emphasis on capacity building. Stakeholders from various levels, including local representatives, state departments, and community leaders, were actively involved in training and expeditions to enhance local knowledge and preparedness.

Picture 10: Technical Workshop on GLOF Hazard & Risk Assessment and Management, (SDC 2025)

- **Policy Integration and Coherence:** This initiative has contributed to the development of the National GLOF Risk Mitigation Programme (NGRMP) for the IHR, enhancing efforts towards GLOF risk management in India.

Looking Ahead: Building Long-Term Resilience

While India has made significant strides in disaster response, there is an urgent need to focus on prevention and preparedness. Building long-term resilience against GLOFs requires the following:

Figure 2: Strategies for building long term resilience for GLOF management

The SCA-Himalayas Project exemplifies the power of collaboration, showcasing how experts, communities, and governments can work together to safeguard the Himalayan region from future GLOF disasters. By addressing the risks posed by climate change and strengthening local and national capacities, this initiative offers a model for sustainable disaster risk management in the IHR.

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For more information: https://climalayas.in/