



Glacial Lake Outburst Flood in Sikkim

For Prelims: [Glacial Lake Outburst Flood](#), [Teesta River](#), [Indian Himalayan Region](#), [Climate change](#), [National Disaster Management Authority](#), [Avalanche](#)

For Mains: Factors Responsible for GOF and Measures to Mitigate the Risk, Important Geophysical Phenomena.

Source: [IE](#)

Why in News?

Sikkim recently experienced a [Glacial Lake Outburst Flood \(GLOF\)](#). The **South Lhonak Lake**, a **glacial lake** located at an altitude of 17,000 feet in the state's northwest, experienced a **rupture as a result of continuous rainfall**.

- Consequently, water was discharged into the downstream regions, causing flooding in the [Teesta River](#) and impacting four districts of Sikkim: Mangan, Gangtok, Pakyong, and Namchi, as reported by the Sikkim State Disaster Management Authority (SSDMA).
- This flooding also caused the **Chungthang Hydro-Dam in Sikkim (on Teesta river) to breach**, worsening the overall situation.

// **Waiting to Happen! What was the Trigger?**

The infographic is divided into several sections:

- Map:** Shows the location of South Lhonak Lake in Sikkim, India, near the border with China and Nepal. It marks the Teesta River, Chungthang Dam, and an area enlarged in West Bengal, India.
- Text:** "As South Lhonak glacier continued to retreat amid global warming by another 400 m between 2008 and 2019, lakes only grew".
- Text:** "Glacial lake outburst flood (Glof) like disaster was waiting to happen".
- Text:** "Trigger could be anything from cloudburst to landslide, avalanche or earthquake".
- Mitigation Steps:**
 - "First field expedition of glacial lake conducted in August 2014, followed by another in 2016 which resulted in a project to start siphoning off lake water".
 - "Three pipelines were installed to siphon off 150 mlitres of water per second at that time".
 - "Early warning system was set in place in some locations by Centre for Development of Advanced Computing".
 - "Central Water Commission initiated an advisory to evaluate the South Lhonak glacier".
- Himalayan Problem:**
 - "Problem of receding glaciers and the spectre of Glof devastation faces the entire Himalayan region as global warming provides new triggers in the young mountain ranges".
 - "Add to that the build-up of infrastructure, habitation, road networks and hydropower plants".
 - "A 2021 study warned that 'both the existing and planned hydropower plants are exposed to potential outburst floods from glacial lakes'".

What is Glacial Lake Outburst Flood?

- About:**

- A **GLOF (Glacial Lake Outburst Flood)** is a sudden and potentially catastrophic flood that occurs when water stored behind a glacier or a moraine (a natural accumulation of ice, sand, pebbles, and debris) is released rapidly.
 - These floods happen when glacial lakes formed by melting ice accumulate water behind weak moraine dams.
 - Unlike sturdy earthen dams, these moraine dams can fail abruptly, releasing large volumes of water in minutes to days, leading to devastating downstream flooding.
- The **Himalayan terrain**, with its **steep mountains**, is particularly vulnerable to GLOFs.
 - **Climate change**, accompanied by **rising global temperatures**, has expedited the process of glacier melting in the **Sikkim Himalayas**.
 - The region now boasts more than 300 glacial lakes, with ten identified as susceptible to outburst floods.
- GLOF can be triggered by several reasons, including **earthquakes, extremely heavy rains and ice avalanches**.
- **Impact:**
 - GLOFs can result in catastrophic **downstream flooding**. They have the potential to release millions of cubic meters of water in a short period of time.
 - Peak flows during GLOFs have been recorded as high as **15,000 cubic meters per second (as per [National Disaster Management Authority](#))**.

How Susceptible is South Lhonak Lake to GLOFs?

- The **South Lhonak lake** in northern Sikkim is situated about 5,200 meters above sea level.
 - Scientists have previously warned that the **lake had been expanding over years**, possibly from the melting of the ice at its head.
 - Notably, seismic activities, including a **2011 magnitude 6.9 earthquake**, escalated the GLOF risk in the area.
- In 2016, the **Sikkim State Disaster Management Authority** and other stakeholders launched a critical plan to drain excess water from South Lhonak Lake.
 - Visionary innovator **Sonam Wangchuk** led the effort, employing **High Density Polyethylene (HDPE) pipes** to siphon off water from the lake.
 - This initiative successfully reduced the lake's water volume by approximately 50%, mitigating the risk to some extent.
- However, the recent tragedy is believed to be caused by an **avalanche originating from the ice-capped feature surrounding the lake**.

What are the Other Recent GLOF Incidents in India?

- In **June 2013**, Uttarakhand had received an **unusual amount of rainfall leading to the melting of the Chorabari glacier** and the eruption of the **Mandakini river**.
- In **August 2014**, a glacial lake outburst flood hit the village of Gya in Ladakh
- In February 2021, Chamoli district in Uttarakhand witnessed flash floods which are suspected to have been caused by GLOFs.

What Actions be Taken to Reduce the Risk of GLOFs?

- **Glacial Lake Monitoring:** Establishing a comprehensive monitoring system to track the growth and stability of glacial lakes in vulnerable regions.
 - Satellite imagery, remote sensing technology, and **field surveys through drones** can be used to **regularly assess changes in glacial lakes and their associated moraine dams**.
- **Early Warning Systems:** and early warning systems that can provide timely alerts to downstream communities in the **event of a GLOF**.
 - Also, there is a need to complement it with **flood protection measures**, such as **constructing protective barriers, levees, or diversion channels** to redirect floodwaters away from populated areas.

- **Public Awareness and Education:** There is a need to **raise public awareness about the risks of GLOFs and educate communities** living downstream about evacuation procedures and safety measures, as per NDMA's guidelines related to GLOF.
 - Conduct drills and training programs to ensure that residents know how to respond in case of a GLOF.
- **International Cooperation: India can collaborate with neighboring countries in the Himalayan region**, as GLOFs can have transboundary impacts.
 - Sharing information and best practices for GLOF risk reduction and management with neighboring countries can help to mitigate the risk.

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