

Glacial Lake Outburst Flood (GLOF)

Occurrences of glacial lake outburst floods or GLOFs are increasing in frequency and causing a lot of havoc for the people living in the Himalayan foothills. What are GLOFs? How are they caused? Why are they happening often now? Get answers to these questions in this article. This is an important topic covering the subjects of geography, disaster management, environment and ecology, for the [UPSC exam](#).

What are Glacial Lake Outburst Floods?

A glacial lake outburst flood (GLOF) is a release of meltwater from a moraine-dam or ice-dam glacial lake due to dam failure.

- They cause disastrous floods downstream and create a huge loss of lives and property.
- There are three chief features of GLOFs. They are:
 - There is a sudden release of water
 - They are generally rapid events, lasting hours to days
 - They cause large downstream river discharges
- In simple terms, a glacial lake outburst flood refers to the flooding that occurs when the water dammed by a [glacier](#) or a moraine is released suddenly.
- This flooding occurs because when glaciers melt, they accumulate behind moraine dams or glacial dams. When such natural dams break upon pressure from accumulating water, the water gushes down in a powerful flow due to the build-up. Moraine dams can break because they are generally weak structures and the pressure build-up can cause this rupture. They can also fail due to landslides, earthquakes or avalanches. Environmental pollution can also trigger GLOFs because of rise in temperatures due to anthropogenic activities that cause quicker melting of glaciers.
- Failure of moraine dams can release millions of cubic metres of water in a short period.
- When the water flows downstream suddenly and with such force, any human or natural structure in its wake is destroyed, including villages, power plants, etc.

What are Moraine Dams?

A moraine is material left behind by a moving glacier. It includes soil, rock, ice, small boulders, etc. As glaciers move, they carry this debris which keeps accumulating in places. Moraines only show up in places that have, or used to have, glaciers. Over time, such moraines form natural dams. The moraine creates a topographic depression in which the melt water is generally accumulated leading to the formation of a glacial lake. When this lake is watertight, melt waters will accumulate in the basin until seepage or overflow limits the lake level. Such moraine-dammed lakes appear to be the most common type of glacial lakes.

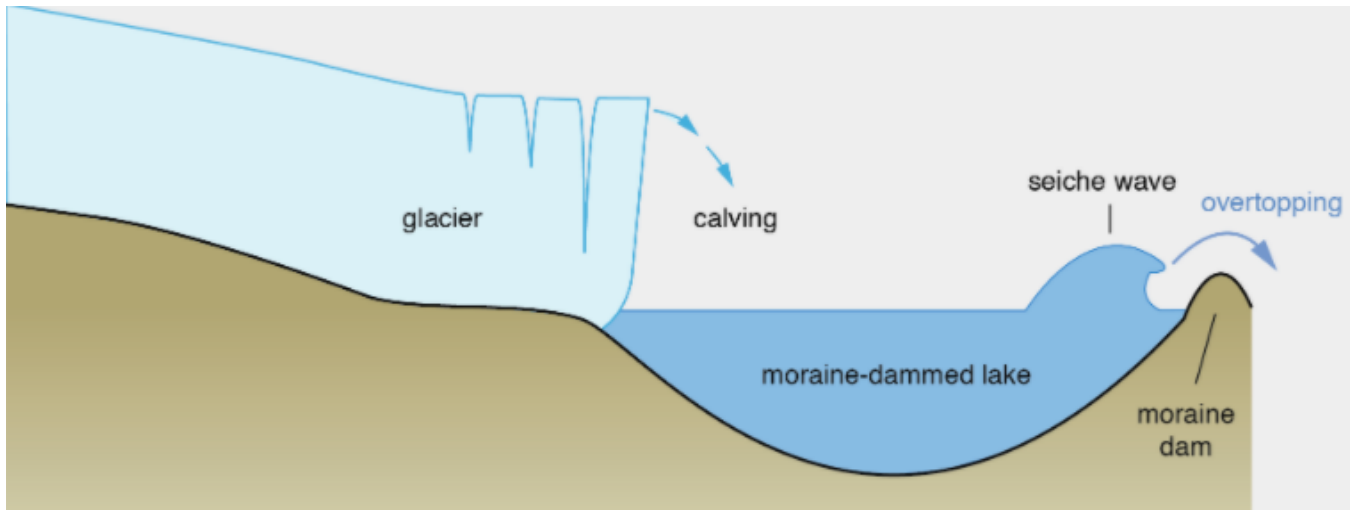


Image source: <http://www.antarcticglaciers.org/>

GLOF Significance

In February 2021, Chamoli district in Uttarakhand witnessed flash floods which are suspected to have been caused by GLOFs. The Kedarnath tragedy in 2013 which left about 5000 dead was also related to a glacial lake breach.

Continued glacier melt in the Himalayas has slowly spawned over 5,000 glacial lakes that are dammed by potentially unstable moraines. When such dams break, the resultant GLOFs can cause catastrophic societal and geomorphic impacts.

According to the [National Disaster Management Authority \(NDMA\)](#), glacial retreat due to climate change occurring in most parts of the Hindu Kush Himalaya has given rise to the formation of numerous new glacial lakes, which are the major cause of GLOFs. Since glaciers in the Himalayas are in a retreating phase, glacial lakes are growing and pose a potentially large risk to downstream infrastructure and life.

How to Mitigate the Impact of GLOFs?

In the wake of the disaster in Chamoli, the NDMA released guidelines on how to deal with disasters caused by GLOFs.

- According to the guidelines, risk reduction begins with the identification and mapping of glacial lakes, taking structural measures to avoid their breach and establishing robust mechanisms to save life and property in the event of a breach.
- How to identify potentially hazardous lakes?
 - Field observations
 - Past event records
 - Geotechnical and geomorphologic characteristics of the lake/dam and surroundings
 - Identifying other physical conditions
- The NDMA has suggested the use of Synthetic-Aperture Radar imagery to automatically detect changes in water bodies, including new lake formations, during the monsoon months.
- It has also suggested that methods could be developed to permit remote monitoring of lakes from space.

- To manage lakes structurally, the NDMA recommends decreasing the volume of water with methods like controlled breaching, pumping or siphoning out water, and making a tunnel through the moraine barrier or under an ice dam.
 - The guidelines also recommend restricting construction in GLOF prone areas as an easy low-cost manner to mitigate the disastrous impact of such events.
 - Apart from that, they suggest the relocation of existing infrastructure and habitations from high-hazard areas.
 - There should be proper land use planning for GLOF prone areas.
 - Another important measure is to train the local people in search and rescue operations since they are the first responders in a catastrophic event before the trained rescue personnel arrive.
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