Glacial lake outburst flood (GLOF)

November 16, 2020

GLOF occurrence has become common in mountainous regions. The catastrophic outcomes due to these events largely depend on urban planning, the size of the glacial lake, the valley section and some more aspects. It is necessary to monitor GLOF as their impacts are important for future hazard mitigation.

In news: Using remote sensing data, researchers from Germany have mapped the evolution of Gya glacial lake flood that hit the village of Gya in Ladakh in 2014.

Placing it in syllabus: Indian geography

Static dimensions

1. What is glacial lake outburst flood?
2. What are the different kinds of glacial landforms?
3. Types of glacial lakes
4. Causes of GLOF

Current dimensions

1. Gya glacial lake outburst flood
2. Monitoring of GLOF

Content:

Gya glacial lake outburst flood:

- Findings show that the cause of the flood was not a spill over but a **tunnelling drainage process.**
- Flooding did not happen due to the spill overs due to an avalanche or landslide.
- But there was a thawing of the ice cores in the moraine which drained through the subsurface tunnels.
- It is noted that thawing of ice cores may accelerate in

the future due to global climate change.

- It is also certain that other glacial lake outburst floods will happen all over the Indian Himalaya.
- These events have been regarded as a major risk in the central Himalayan region including Sikkim, as cloudbursts can trigger glacial lake outburst flood events like in the Kedarnath disaster in 2013.
- In the arid Trans-Himalayan regions of Ladakh the glaciers are located at high altitudes not lower than 5,200 m and most glaciers and glacier lakes are quite small in size.
- In the case of the Gya lake at 5,400 m, the lake is almost always ice-covered, even during summer.

What is glacial lake outburst flood?

- A glacial lake outburst flood (GLOF) is a **release of meltwater from a moraine or ice-dam glacial lake due to dam failure.**
- GLOFs often result in catastrophic flooding downstream, with major geomorphic and socioeconomic impacts.

GLOFs have **three main features:**

- They involve sudden releases of water.
- They tend to be rapid events, lasting hours to days.
- They result in large downstream river discharges.

Some of the largest floods have caused large-scale landscape change and even altered regional climate by releasing huge quantities of freshwater to the oceans.

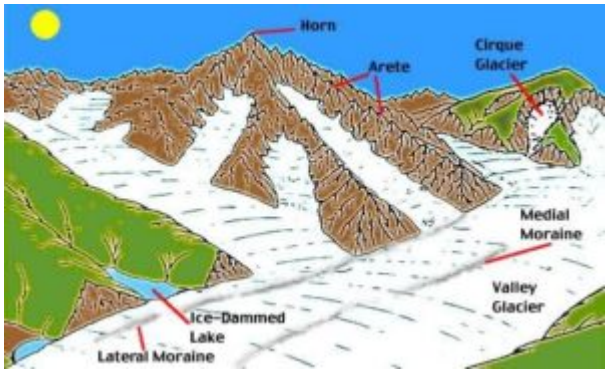
GLOFs pose a risk to downstream communities and infrastructure. They have killed hundreds to thousands of people in mountain regions like the Himalayas, and destroyed roads, bridges, and hydroelectric developments.

The general global trend of glacier shrinkage through the 20th and 21st centuries has seen the number and size of glacial

lakes increase.

What are the different kinds of glacial landforms?

- Glaciers carve a set of distinctive, steep-walled, flat-bottomed valleys.
- **U-shaped valleys, fjords, and hanging valleys** are examples of the kinds of valleys glaciers can erode.



- **Cirques** are bowl-shaped, amphitheater-like depressions that glaciers carve into mountains and valley sidewalls at high elevations.
- **Aretes and horns** are the result of glacial erosion in areas where multiple glaciers flow in multiple directions.
- When the ice is present, they form stark, rocky outcrops above it, adding to the beauty of these harsh landscapes.
- **Lateral and Medial Moraines:** These consist of glacially-transported rock and debris. They form on the sides of glaciers (lateral moraines) or at the boundary between two tributary glaciers (medial moraines). Either way, they often mark the edges of an ice body.
- **Terminal and Recessional Moraines:** These moraines mark the farthest reaches of a glacier, its terminus at a given point in time. They are usually built from rocks and debris that are transported to the glacier toe in the ice and melt out there.
- **Glacial Till** contains sediments of every size, from tiny particles smaller than a grain of sand to large

boulders, all jumbled together.

- **Glacial flour** is that smallest size of sediment (much smaller than sand) and is responsible for the milky, colored water in the rivers, streams, and lakes that are fed by glaciers.
- **Esker:** It is a built-up bed of a subglacial stream.
- **Outwash plain:** Braided stream flowing from the front end of a glacier.

Types of glacial lakes:

Glacial lakes were classified as 5 classes-

- **Glacial erosion lake** (including cirque lake, glacial valley lake and other glacial erosion lake),
- **Moraine-dammed lake** (including end moraine-dammed lake, lateral moraine-dammed lake and moraine thaw lake),
- **Ice-blocked lake** (including advancing glacier-blocked lake and other glacier-blocked lake),
- **Supraglacial lake**
- **Subglacial lake**

Causes of GLOF:

- Rapid slope movement into the lake
- Heavy rainfall/snowmelt
- Cascading processes (flood from a lake situated upstream)
- Earthquakes
- Melting of ice incorporated in dam/forming the dam
- Blocking of subsurface outflow tunnels
- Long-term dam degradation

Monitoring of GLOF:

- Himalaya has huge repositories of glaciers that are reportedly retreating leading to glacier thinning.
- This **glacier thinning due to melting has resulted in the**

development of new glacial lakes and the magnification of existing ones due to the accumulation of meltwater behind loosely consolidated end moraine dams.

- These moraine dammed glacial lakes are potential sources of catastrophic disaster as they are inherently unstable.
- **Lake Outburst and debris flow disaster in Kedarnath, Uttarakhand** in June 2013 was one the destructive disasters occurred in Himalayas.
- Hence glacial lake monitoring and preparedness for disaster risk reduction are the prime most needed of these fragile regions.
- ISRO among many other organisations has taken the responsibility and has been engaged in glacial lake monitoring and water bodies in the Himalayan region of Indian River Basins.
- High resolution data such as **Cartosat-2 Panchromatic, Resourcesat – 2 LISS VI multispectral and RISAT-1 SAR Radar images** are used to monitor glacial lakes.
- Glacial lake monitoring and water bodies with water spread area more than 50 hectare on monthly basis for June to October for 5 years (2011-2015) has been performed.
- **Inventory of glacial lakes and water bodies** with water spread over more than 10 hectare has been prepared.
- According to inventory **there are a total of 2026 glacial lakes and water bodies in Indian River basin of Himalaya out of which 503 are glacial lakes.**
- More than 50 per cent i.e. about 1167 glacial lakes and water bodies are located within the elevation range of 4000 to 5000m.
- A basin wise inventory showed that **Brahmaputra basin has the most number of glacial lakes** and water bodies followed by Indus (351) and Ganga basin (284).
- ISRO is regularly monitoring and providing information on inventory and monthly changes through **Bhuvan and India-WRIS portal.**

- It is very useful for identification of potentially dangerous lakes prone to GLOF and giving early warning to mitigate disasters.
- This monitoring also helps in prioritizing glacial lake monitoring for GLOF studies and climate change studies.

Mould your thought:

1. What are the causes for Glacial lake outburst flood (GLOF)? Why is the monitoring of GLOF necessary?

Approach to the answer:

- Define GLOF
- Mention the causes
- Write briefly about Gya GLOF
- Write the importance of GLOF monitoring
- Conclusion