



## Expanding Glacial Lakes in the Himalayas

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

**For Mains:** Factors Responsible for Expansion of Glacial Lakes in Himalayas, GLOF and Measures to Mitigate the Risk, Important Geophysical Phenomena.

[Source: TH](#)

### Why in News?

Recently, satellite monitoring data by the [Indian Space Research Organisation \(ISRO\)](#) has shown a large expansion in glacial lakes between 1984 and 2023 in the [Himalayan region](#), which has posed an alarming situation for the downstream areas.

### What are ISRO's Observation on Expansion of Himalayan Glaciers?

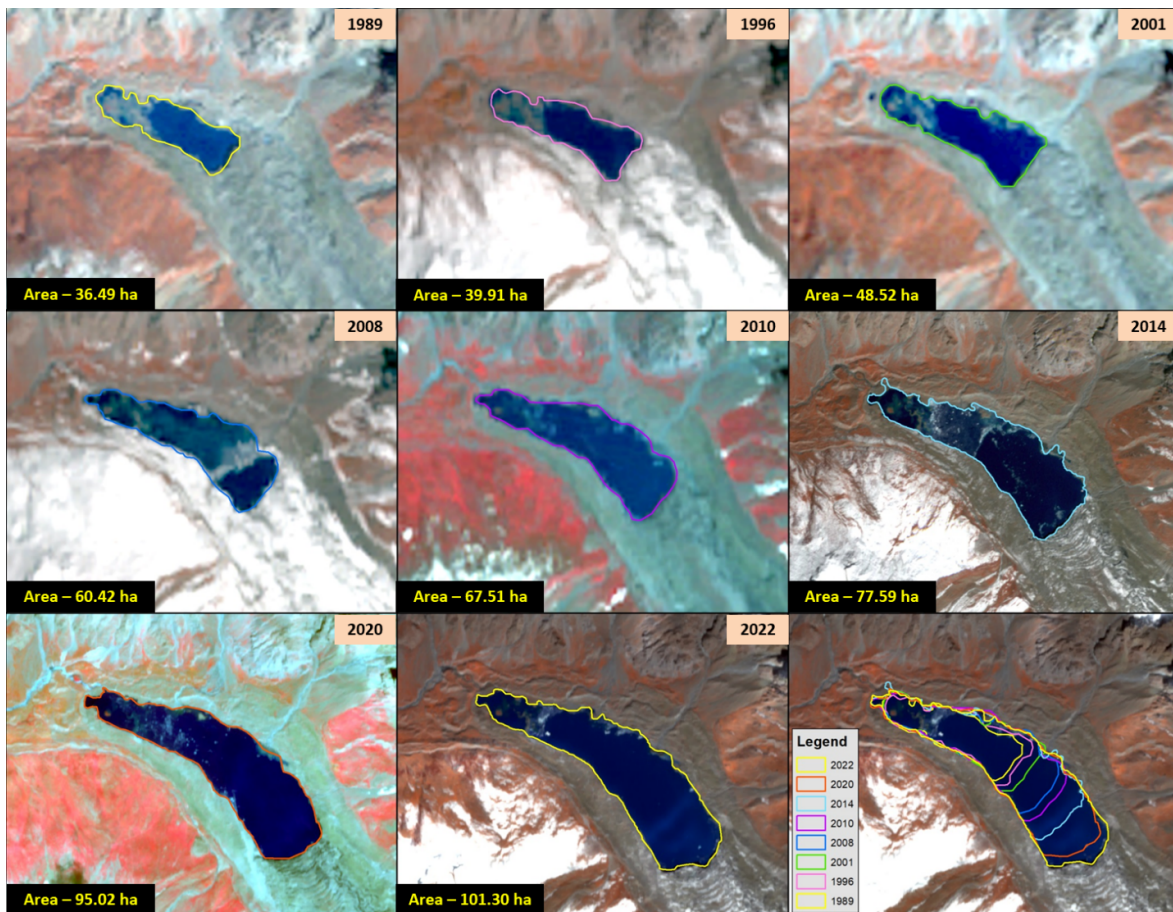
#### ▪ Key Findings:

- Of the 2,431 lakes larger than 10 hectares identified during 2016-17, **676** glacial lakes have notably expanded since 1984.
  - 130 of these lakes are situated within India, with 65, 7, and 58 lakes located in the [Indus, Ganga, and Brahmaputra](#) River basins, respectively.
  - Of these lakes 601 lakes (89%) have expanded more than twice, 10 lakes have grown between 1.5 to 2 times and 65 lakes at 1.5 times.
- **Elevation-based analysis reveals** that 314 lakes are located in the 4,000 to 5,000 m range and 296 lakes are above 5,000 m elevation.
- Long-term changes in the **Ghepang Ghat glacial lake (Indus River Basin)** at an elevation of 4,068 m in Himachal Pradesh, India, show a **178% increase** in size from 36.49 to 101.30 hectares between **1989 and 2022**.

#### ▪ Types and Number of Glacial Lakes in Himalayas:

- **Moraine-dammed (307):** They are formed when piles of rocks and debris (moraines) left behind by retreating glaciers block valleys, creating natural dams that hold back meltwater.
- **Ice-dammed (8):** They are formed when a glacier itself acts as a dam, blocking the flow of meltwater.
- **Erosion (265):** These lakes occupy depressions carved directly into bedrock by glaciers.
- **Other Glacial lakes (96)**

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## What are the Causes of Expanding Glacial Lakes in Himalayas?

- **Global Warming:** It is causing temperatures to rise in the Himalayas, leading to increased **melting of glaciers**. This meltwater feeds into existing glacial lakes, causing them to expand in size.
- **Retreating Glaciers:** As glaciers melt, they not only contribute water to the lakes but also expose new land surfaces. This allows for the formation of new glacial lakes.
- **Weakening Moraines:** Glaciers are often dammed by natural walls of rock and debris called **moraines**.
  - As glaciers shrink, these moraines become weaker and more susceptible to collapse. A sudden collapse can trigger a **Glacial Lake Outburst Flood (GLOF)**, a catastrophic event where a large volume of water is released downstream.
- **Increased Precipitation:** Changes in precipitation patterns, including increased rainfall and snowfall in the region, can contribute to the expansion of glacial lakes by providing more water to fill them.
- **Permafrost Thaw:** **Permafrost**, which is soil that remains frozen year-round, acts as a natural barrier to water drainage.
  - As permafrost thaws due to warming temperatures, it can create depressions that collect water, contributing to the expansion of glacial lakes.
- **Human Activities:** Infrastructure development, such as roads and hydropower projects, can alter the natural drainage patterns of glacial lakes, leading to their expansion.
  - Additionally, activities such as mining and deforestation can indirectly contribute to glacial lake expansion by accelerating climate change.

## Recent Cases of GLOF in India

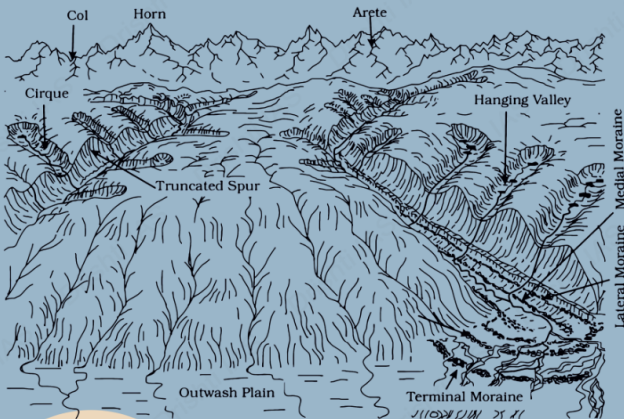
- In June 2013, **Uttarakhand had received an unusual amount of rainfall** leading to the melting of the Chorabari glacier and the eruption of the Mandakini river.
- In August 2014, a glacial lake outburst flood hit the village of Gya in **Ladakh**.

- In February 2021, **Chamoli district in Uttarakhand witnessed flash floods** which are suspected to have been caused by GLOFs.
- In October 2023, 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.**

# GLACIAL LANDFORMS

“Glacier is any large mass of perennial ice that originates on land by the recrystallisation of snow or other forms of solid precipitation”

## EROSIONAL LANDFORMS



### Cirque/ Cirque/ Cwm

- \* Small glaciers and are characteristically bowl-shaped
- \* Found at the heads of glacial valleys

### Horns and Serrated Ridges

- \* Form through headward erosion of the cirque walls
- \* Present in areas where multiple glaciers flow in multiple directions

### Glacial Valleys /Troughs

- \* Trough-like and U-shaped with broad floors and relatively smooth, and steep sides
- \* Fjords are deep glacial troughs filled with seawater, forming shorelines

### Bergschrund

- \* A crevasse/crack or series of crevasses often found near the head of a mountain glacier

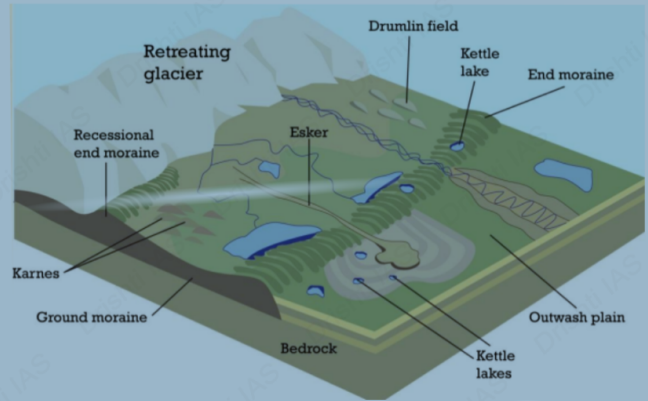
### Hanging Valley

- \* Form when glacier ice deeply erodes a main or trunk valley, leaving tributary valleys hanging far above the main valley floor.

### Crag and Tail

- \* **Crag:** Mass of hard rock with a precipitous slope.
- \* **Tail:** Formed by the deposition of glacial debris or till as the glacier retreats.

## DEPOSITIONAL LANDFORMS



### Moraines

- \* **Lateral Moraines:** Form on the sides of glaciers
- \* **Ground Moraines:** Deposits varying greatly in thickness and in surface topography
- \* **Medial Moraines:** Form where two tributary glaciers come together

### Eskers

- \* Winding ridges of sand and gravel formed by streams flowing within or beneath glaciers

### Outwash Plains

- \* Deposit of sand and gravel carried by running water from the melting ice of a glacier

### Drumlins

- \* Hills of sediment that have been streamlined by glacier flow.
- \* Up to 1 km in length and 30 m or so in height
- \* So commonly described as having a **‘basket of eggs’ topography**



- **Climate Change Mitigation:** Addressing the root cause of glacial melt and retreat by reducing **greenhouse gas** emissions is crucial.
  - This involves global efforts to mitigate climate change through measures such as transitioning to renewable energy, increasing energy efficiency, and implementing policies to reduce carbon emissions across various sectors.
- **Early Warning Systems:** Developing and implementing early warning systems for monitoring of glacial lakes, weather forecasting, and communication networks to disseminate timely alerts to at-risk communities.
- **Engineering Measures:** Implementing engineering measures to stabilize and manage glacial lakes can help reduce the risk of **GLOFs**.
  - This may involve constructing infrastructure such as spillways, drainage channels, and dams to control water levels and prevent uncontrolled releases of water.
- **Natural Infrastructure:** Restoring and conserving natural ecosystems, such as wetlands and forests, can help regulate water flow. These natural infrastructure solutions can also provide additional benefits, such as habitat conservation and carbon sequestration.
- **Community Engagement and Capacity Building:** Involving local communities in risk assessment, planning, and decision-making processes is essential for effective glacial lake management.
  - Building local capacity for disaster preparedness, including training in emergency response and evacuation procedures, can help communities better cope with **GLOFs** and other hazards.
- **International Cooperation:** Given the transboundary nature of many **glacial lakes** in the Himalayas, international cooperation is essential for effective management and risk reduction.
  - Collaborative efforts among countries sharing glacier-fed river basins can facilitate information sharing, joint monitoring, and coordinated action to address common challenges.

**Drishti Mains Question:**

What are the causes for the expansion of glacial lakes in the Himalayan region, and what are its implications and mitigation strategies?

**UPSC Civil Services Examination, Previous Year Questions (PYQs)**

**Prelims**

**Q. When you travel in Himalayas, you will see the following: (2012)**

1. Deep gorges
2. U-turn river courses
3. Parallel mountain ranges
4. Steep gradients causing land sliding

**Which of the above can be said to be the evidence for Himalayas being young fold mountains?**

- (a) 1 and 2 only
- (b) 1, 2 and 4 only
- (c) 3 and 4 only
- (d) 1, 2, 3 and 4

**Ans: (d)**

**Mains**

**Q. Dam failures are always catastrophic, especially on the downstream side, resulting in a colossal loss of life and property. Analyze the various causes of dam failures. Give two examples of large dam failures. (2023)**

**Q.** Bring out the causes for more frequent landslides in the Himalayas than in Western Ghats. **(2013)**

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