



GLACIAL LAKE OUTBURST FLOODS (GLOFS) AND DAM CONSTRUCTION IN SIKKIM - ENVIRONMENT

NEWS: Over a year after a glacial lake outburst flood (GLOF) ravaged parts of Sikkim and washed away the Teesta-III hydel project, a proposal to build a new gravity dam in its place has been approved by the environment ministry panel.

WHAT'S IN THE NEWS?

Here's a detailed elaboration of each sentence from your background and analysis of the GLOF disaster in Sikkim:

Background: GLOF Disaster in Sikkim

Event: A devastating Glacial Lake Outburst Flood (GLOF) ravaged parts of Sikkim in recent years, washing away a 60-metre-high rockfill concrete dam of the 1,200-MW Teesta-III hydel project.

- A **Glacial Lake Outburst Flood (GLOF)** is a sudden and violent release of water from a glacial lake, often triggered by the failure of its natural or man-made barriers.
- In recent years, such an event struck **Sikkim**, a mountainous state in northeastern India, causing widespread destruction.
- The GLOF was so powerful that it **completely destroyed a 60-metre-high dam**, which was a **rockfill concrete structure** built as part of the **1,200-megawatt (MW) Teesta-III hydropower project**.
- The destruction of this dam not only disrupted power generation but also led to **severe flooding in downstream areas**, affecting communities, infrastructure, and the local ecosystem.

Current Proposal: The Environment Ministry's Expert Appraisal Committee (EAC) has cleared a proposal to construct a 118-metre-high dam at the same location.

- In response to the destruction caused by the GLOF, a new proposal has been put forward to **rebuild a dam at the same site** where the previous one was washed away.
- This new dam is designed to be **118 metres high**, making it even taller than the previous 60-metre structure.
- The proposal has been approved by the **Expert Appraisal Committee (EAC)**, which operates under India's **Ministry of Environment, Forest and Climate Change** and is responsible for evaluating the environmental feasibility of such projects.



- Despite the EAC's approval, the decision has raised concerns regarding **safety, environmental risks, and the potential for another disaster in a GLOF-prone region.**

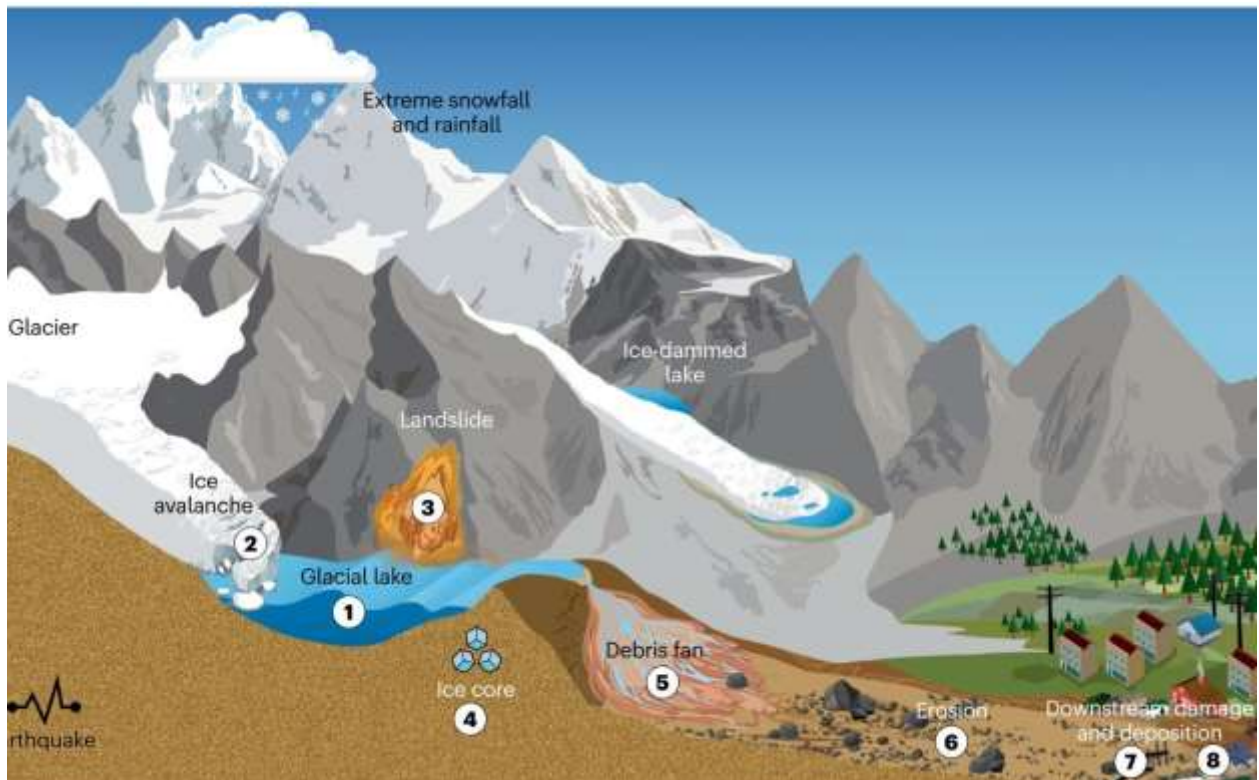
Concerns Over the New Dam Proposal

The design of the new dam has not been approved by key agencies like the Central Water Commission (CWC), Geological Survey of India (GSI), and Central Soil and Materials Research Station (CSMRS).

- Even though the EAC has approved the project, three **critical agencies** responsible for ensuring the **safety, stability, and feasibility of large-scale hydropower projects** have **not yet granted clearance**:
 - **Central Water Commission (CWC):** The top government body that assesses **flood control, dam safety, and water resource management** in India.
 - **Geological Survey of India (GSI):** The national authority responsible for **geological assessments**, including the impact of earthquakes, landslides, and soil stability on infrastructure.
 - **Central Soil and Materials Research Station (CSMRS):** A research institution that evaluates the **quality and durability of construction materials** used in large hydropower and irrigation projects.
- The **lack of approvals from these key agencies** raises concerns that the **structural integrity and environmental impact of the new dam** have not been thoroughly evaluated.

No public hearing has been conducted to address the concerns of local communities.

- Before large-scale infrastructure projects are undertaken, **public consultations** are required to ensure that **local communities are informed and their concerns are addressed.**
- In this case, **no public hearing has been conducted**, which means that affected people, including **tribal communities, local residents, and environmental activists**, have **not been given a platform to express their views.**
- Without such hearings, **potential risks, environmental consequences, and socio-economic impacts** may not be fully considered before project approval.



What are Glacial Lake Outburst Floods (GLOFs)?

Definition: GLOFs are catastrophic events caused by the sudden discharge of water from glacial lakes, which form in depressions left by retreating glaciers.

- **Glacial lakes** are bodies of water that accumulate in depressions left behind by retreating glaciers.
- Over time, as **glaciers melt**, they create lakes that are often **dammed by ice, loose sediment, or rock debris**.
- A **Glacial Lake Outburst Flood (GLOF)** occurs when these natural barriers fail, leading to a **sudden and massive release of water** downstream.
- Such floods are **highly destructive**, as they carry **huge volumes of water, rocks, and debris** at high speeds, causing significant damage to human settlements and infrastructure.

Formation of Glacial Lakes

As glaciers melt, they leave behind depressions that fill with meltwater, forming lakes.

- **Glaciers** are large masses of ice that slowly move downhill due to gravity.
- Due to **climate change and rising temperatures**, glaciers worldwide are **melting at an accelerated pace**.
- When glaciers retreat, they leave behind **natural depressions (hollows) in the land**, which gradually **fill with meltwater**, forming glacial lakes.



These lakes are often dammed by unstable ice or loose sediment.

- Many glacial lakes are **held back by fragile natural barriers** made of **ice, rock, or loose sediment (moraines)**.
- These **barriers are highly unstable**, making them **susceptible to sudden collapse** under certain conditions.

Triggers of GLOFs

Glacial calving: Large chunks of ice breaking off and falling into the lake, displacing water.

- **Glacial calving** refers to the process in which **large pieces of ice break off from the glacier and fall into the lake**.
- When this occurs, it **causes a sudden displacement of water**, similar to an object being dropped into a full container, which **creates waves that can breach the lake's natural dam**.

Avalanches or landslides: Destabilizing the lake's natural barriers.

- **Avalanches (massive snow slides) or landslides (rockfalls or soil displacement) can increase pressure on the lake's barriers**, leading to their sudden collapse.
- These natural disasters **destabilize the already fragile ice or sediment walls** holding the water back, triggering an outburst flood.

Impact of GLOFs

GLOFs release massive volumes of water, sediment, and debris downstream with high velocity.

- Once the **natural dam of a glacial lake collapses**, the stored water **rushes downstream at extremely high speeds**, carrying along **rocks, sediments, and uprooted trees**.
- This floodwater **has enormous force and can travel for long distances**, devastating everything in its path.

They can submerge valleys, destroy infrastructure (roads, bridges, buildings), and cause significant loss of life and livelihoods.

- **Valleys located downstream of glacial lakes are highly vulnerable**, as the water spreads across **vast areas**, submerging homes, agricultural lands, and forests.
- GLOFs often **wash away critical infrastructure** such as:
 - **Roads, making transportation impossible**



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- **Bridges, severing connections between towns and villages**
- **Buildings, including homes, schools, and hospitals**
- In many cases, **entire communities are displaced**, leading to **significant loss of lives and livelihoods**.

Conclusion

The EAC's **decision** to clear the **118-metre-high dam** in Sikkim raises significant concerns due to the **lack of clearances** and **public consultation**. The region's vulnerability to **GLOFs**, as highlighted by recent studies and past disasters, underscores the need for **rigorous risk assessment** and **community involvement**. Addressing these challenges requires a **balanced approach** that prioritizes **safety, sustainability, and inclusive development**.

Source: <https://indianexpress.com/article/upsc-current-affairs/upsc-essentials/glacial-lake-outburst-flood-glof-prelims-2025-upsc-knowledge-nugget-9810155/>

