Hydropower in the Himalayas

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Hydropower in the Himalayas: The Fragile Future of Teesta-3

Context

Dams play a crucial role in **electricity generation, irrigation, and flood control**. However, constructing and maintaining them in **geologically unstable areas like the Himalayas** comes with significant risks.

The **Teesta-3 dam in Sikkim**, once one of India's largest hydroelectric projects, was **destroyed by a Glacial Lake Outburst Flood (GLOF) in October 2023**.

Key Facts About the Disaster

- The **Teesta-3 dam**, commissioned in **2017**, was designed to generate **1,200 MW of electricity**.
- The disaster occurred when **South Lhonak Lake's moraine (natural dam) collapsed**, releasing:
  - **50 billion litres of water** into the valley.
  - **Massive debris**, which worsened destruction downstream.
- **Over 100 people lost their lives**, while **more than 80,000 people across four districts** were affected.
- The flood also triggered **multiple landslides** between **30 to 40 km downstream**.

Following this disaster, an **expert committee from the Ministry of Environment, Forests, and Climate Change** recommended **rebuilding the dam** on **January 27, 2025**. However, this proposal has raised concerns among environmentalists and scientists.

What Caused the Flood?

The **2023 flood was not caused by heavy rainfall** but by a **sudden collapse of the South Lhonak Lake's moraine**.

- The moraine suffered a **slope failure**, meaning **rocks from the side of the lake fell into the water**, creating a **powerful ripple effect**.
- This weakened the **lake's outlet**, leading to a **massive overflow** of water.
- Once the water was released, it **picked up debris**, acting like a **battering ram**, destroying everything in its path.

Scientists warn that **South Lhonak Lake remains unstable**, meaning **future GLOFs are likely**.

The Link Between Global Warming and Glacial Floods

Climate change has made disasters like the **Teesta-3 flood more frequent and severe**.

- **Rising global temperatures** are **accelerating the melting of Himalayan glaciers**.
- **Black carbon (soot) pollution**, from industrial areas, **settles on glaciers, reducing their ability to reflect sunlight and increasing melting rates**.
- **Glacial melt rates are inversely proportional to their size**—as glaciers shrink, **they melt faster**.

Evidence of Climate Change Impact

- A **2024 report by the Central Water Commission** found that between **2011 and 2024**:
  - The **number of glacial lakes in the Himalayas increased by 10.8%**.
  - Their **total surface area expanded by 33.7%**, meaning they now **hold significantly more water**.
- **South Lhonak Lake itself has been growing since the 1960s** and reached **167 hectares in 2023**.
- **Glacial retreat is also destabilizing the region's geological formations**, increasing the risk of **landslides and moraine collapses**.

Given this background, experts believe **rebuilding Teesta-3 in a high-risk zone is a serious mistake**.

The Debate Over Rebuilding Teesta-3

Despite these warnings, the **government plans to rebuild Teesta-3**, citing its **economic benefits**.

Reasons Behind the Decision

According to The Hindu, the **expert committee approved the reconstruction** because:

- Teesta-3 was considered **"successful" and "commercially viable"** before its destruction.
- The dam's **power-generating equipment remained largely intact** after the flood.

However, environmental activists and hydrogeologists **strongly oppose this decision**, raising several concerns.

Concerns Raised by Experts

1. **High Earthquake and Landslide Risk**
   - The **Himalayas are highly earthquake-prone**, meaning large infrastructure projects face **severe structural risks**.
   - The area is **also prone to landslides**, which could further destabilize the dam.

2. **Legal and Financial Issues**
    - **Multiple court cases (Public Interest Litigations)** have challenged Teesta-3 due to:
        - **Its location in an environmentally fragile zone**.
        - **Irregularities in its techno-economic clearance**.
        - **Non-compliance with a 1996 regulation requiring Sikkim to hold 51% equity**.
        - **Allegations of corruption in the project's approval and execution**.
3. **Flawed Flood Risk Assessment**
    - The **new dam design relies on rainfall-based predictions** from the **India Meteorological Department (IMD)**.
    - However, the **2023 flood was not caused by heavy rain**, raising doubts about **the reliability of these models**.

How Teesta-3 2.0 Will Be Different

The committee has proposed several **modifications to the dam's design**:

- **Concrete-only construction** (previously, a mix of **concrete and rock** was used).
- **A spillway three times larger**, allowing better flood management.
- **An early-warning system** to alert nearby communities of potential flooding.
- **Designed to withstand the "worst-case scenario" rainfall predicted for the next 100 years**.

However, **climate change is unpredictable**, and **relying on historical rainfall data alone is insufficient**.

Climate Change as a Risk Multiplier

- If **South Lhonak Lake had no water**, the slope failure would not have caused a flood.
- If the **moraine had not collapsed**, the lake might have **overflowed gradually**, causing **less destruction**.

This highlights how **climate change is making natural disasters more extreme**, making it **difficult to predict future risks accurately**.

Scientific Assessments and Expert Opinions

A **January 30, 2025, study** by experts from **IIT Bhubaneswar, IISc Bengaluru, the Indo-Tibetan Border Police, and the Government of Sikkim** analyzed the 2023 GLOF.

Key Findings of the Study

- **Current flood models underestimate risks** because they do not consider:
    - **Erosion and sediment transport**, which make floods more destructive.
    - **Landslides caused by riverbank collapses**, which worsen damage.
    - **The impact of fast-moving sediment waves**, which alter water levels unpredictably.

- **Professor Raghu Murtugudde**, an expert on climate change, warned:
    - **Climate models struggle to predict extreme rainfall accurately**.
    - Relying on **rainfall-based predictions alone is unreliable**.

Balancing Energy Demand and Climate Risks

India's **electricity demand is rising**, and hydroelectric projects **play an important role in energy production**. However, the **risks of rebuilding Teesta-3 outweigh its benefits**.

- The **2023 flood demonstrated that large dams can amplify disasters instead of preventing them**.
- If **Teesta-3 2.0 is built**, it **may withstand a similar flood**—but:
    - A **stronger or different type of disaster** could cause **even greater damage**.
    - **New infrastructure introduces new risks**, which may **not be fully understood yet**.

The Need for a People-Centric Approach

The **safety of local communities should come first**. This means:

- **Investing in disaster relief and financial support** for affected people.
- **Creating a comprehensive risk assessment framework** to evaluate long-term safety.
- **Ensuring that all disaster mitigation costs are included in electricity pricing**, rather than **placing the financial burden on locals**.

The Reality of Climate Change

Urban planning expert **Brian Stone, Jr.** wrote in 2024:

> **"We cannot engineer our way out of climate change; retreat is inevitable."**

This means that as climate risks **continue to increase**, some areas may **no longer be safe for large infrastructure projects**.

Conclusion

The decision to **rebuild Teesta-3 should not be based solely on its commercial success**. Instead, it should prioritize:

- **Reducing risks to people, property, and the environment**.
- **Ensuring long-term safety rather than short-term economic benefits**.
- **Exploring alternative, climate-resilient energy solutions**.

Given the **growing instability of the Himalayan region**, large dams may **no longer be**

sustainable, and India must **invest in safer energy alternatives**.