Glacial Lake Outburst Floods

Why in news?

Recently Birendra glacial lake in Nepal collapsed due to avalanche.

What is the glacial lake outburst flood?

- **Glacial lakes**- They are large bodies of water that sit in front of, on top of, or beneath a melting glacier.
- **Glacial Lake Outburst Floods (GLOFs)-** They are sudden and often catastrophic events that occur when water contained within or underneath a glacier or a moraine-dammed glacial lake is released rapidly.
- **Causes-** These floods typically result from the failure of natural dams made of ice, moraine (a mixture of rock, soil, and other debris), or both.



- **Ice and debris avalanches**- Avalanches of ice, rock and debris can impact glacial lakes, causing the release of large volume of water, avalanches occur due to various factors such as seismic activity, steep slopes or destabilization of ice and rock masses.
- **Ice dammed lakes-** Some glacial lakes are dammed by ice instead of moraine, when the ice dam melts or collapse, it can release large volumes of water downstream triggering GLOF.
- **Earthquake**- Seismic activity, including earthquakes can destabilize glacial lakes and their surrounding terrain, leading to failure of natural dams and release of water.
- **Volcanic eruption**- It can trigger GLOFs by melting ice, causing landslides or generating lahars (volcanic mudflows) that can impact glacial lakes.
- **Anthropogenic activities**- Activities such as mining, construction, and deforestation can destabilize the landscape, increase erosion, and contribute to the risk of GLOFs.
- **Vulnerable-** GLOFs pose a significant risks to communities living downstream of glacial lakes, especially in mountainous regions like Himalayas, Andes and Alps, where such lakes are common.



Why Himalayas are more prone to Glacial Lake Outburst Floods?

- **High glacial activity**- The Himalayas are called as ***Third Pole*** it harbours world's largest glaciers after Arctic and Antarctic ice sheets.
- **Glacial melting**- As temperatures rise due to climate change, these glaciers are melting at an accelerated rate, leading to the formation of numerous glacial lakes which increases the risk of GLOFs.

ISRO said that 130 of the 676 lakes are situated in India, in the Indus (65), Ganga (7), and Brahmaputra (58) river basins have expanded as glaciers are retreating at an ever faster rate due to global warming.

- **Glacial lake formation**- Glacial lakes in the Himalayas are often dammed by unstable moraines, ice, or bedrock, these natural dams are susceptible to erosion, melting, and other forms of degradation, increasing the likelihood of failure and the release of floodwaters downstream.
- **Steep terrain-** The Himalayan region is characterized by rugged, steep terrain, which can contribute to the destabilization of glacial lakes and their surrounding moraines.
- **Unstable movements**-Avalanches, landslides, and rockfalls are common in this environment, posing risks to the stability of natural dams and increasing the likelihood of GLOFs.
- **Seismic activity**- The Himalayas are seismically active, with frequent earthquakes and tectonic activity, they can trigger landslides, avalanches, and the destabilization of glacial lakes, leading to GLOFs.
- **Monsoon climate-** The Himalayan region experiences heavy monsoon rains during the summer months, which can increase the volume of water in glacial lakes and contribute to the weakening of natural dams.
- **Population density**- The Himalayan region is densely populated, with communities living in valleys downstream of glacial lakes. This increases the potential impact of GLOFs on human lives, infrastructure, and livelihoods.

Instances of GLOFs in Himalayas	Location
Uttarkhand flash flood (2013), South Lhonak lake GLOF (2023)	India
Lugge Tso GLOF (2015)	Tibet, China
Birendra Lake GLOF (2024), Imja Lake GLOF (2016),	Nepal

What can be done to mitigate GLOFs?

- **Artificial drainage**- Lowering the water level of glacial lakes can significantly reduce the risk of outburst floods.
- **Study of Ghepan Gath lake, Himachal Pradesh**- It showed that lowering lake levels by 10 to 30 meters had a significant impact reduction on Sissu town, the risks were not completely eliminated but still can minimize potential consequences of GLOF.
- **High Density Polyethylene (HDPE) pipes-** In 2016, Sikkim used HDPE pipes to reduce water levels in South Lhonak Lake.
- **Risk assessment**- Researchers need to continuously monitor the lakes for signs of instability and potential outburst events, this includes using satellite imagery and developing models to predict GLOF risk.

Satellite remote sensing technology by ISRO proves to be an excellent tool for monitoring due its wide coverage and revisit capability

- **Early warning systems-** Establishing effective early warning systems is critical for minimizing damage and casualties, these systems should utilize real-time monitoring data to provide timely alerts to downstream communities in the event of a GLOF threat.
- **International cooperation**- The GLOFs in the Himalayas can affect multiple countries, international cooperation is essential which can foster collaborative efforts such as sharing data, resources and expertise to better understand and mitigate the risks posed by glacial lakes.
- **Research**- Continued research into glacial dynamics, climate change impacts, and GLOF mitigation strategies is necessary to develop innovative approaches that reduce GLOF risk.

Quick facts

Steps taken by India to prevent GLOFs
• **Sendai Framework (2015-2030)** – It is a global blueprint for disaster risk reduction and prevention. • **Coalition for Disaster Resilient Infrastructure** - CDRI is an international climate initiative by India in 2019 to promote resilient climate-proof critical infrastructure in member countries. • **National Disaster Management Authority (NDMA)** - NDMA, headed by the Prime Minister of India, is the apex body for Disaster Management in India. • **Institutional mechanism**- Central Water Commission (CWC)/ National Remote Sensing Agency (NRSA)/ State governments also check for landslides and blockages in rivers with the help of satellite imageries. • **Aapda Mitra** – Launched in 2016, it is a central sector scheme implemented by NDMA to train community volunteers in disaster response in selected 30 most flood prone districts of 25 states including Sikkim. • **Doppler radars -** The India Meteorological Department (IMD) has been using Doppler radars, a flash floods forecasting and warning systems.

References

1. The Print- Avalanche sets off glacial lake outburst in Nepal
2. Indian Express- Anlysis of glacial lake by ISRO

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