Glacial Lake Outburst Flood (GLOF)

Mains: *GS-I Important Geophysical Phenomena such as earthquakes, Tsunami, Volcanic activity, cyclone etc.*

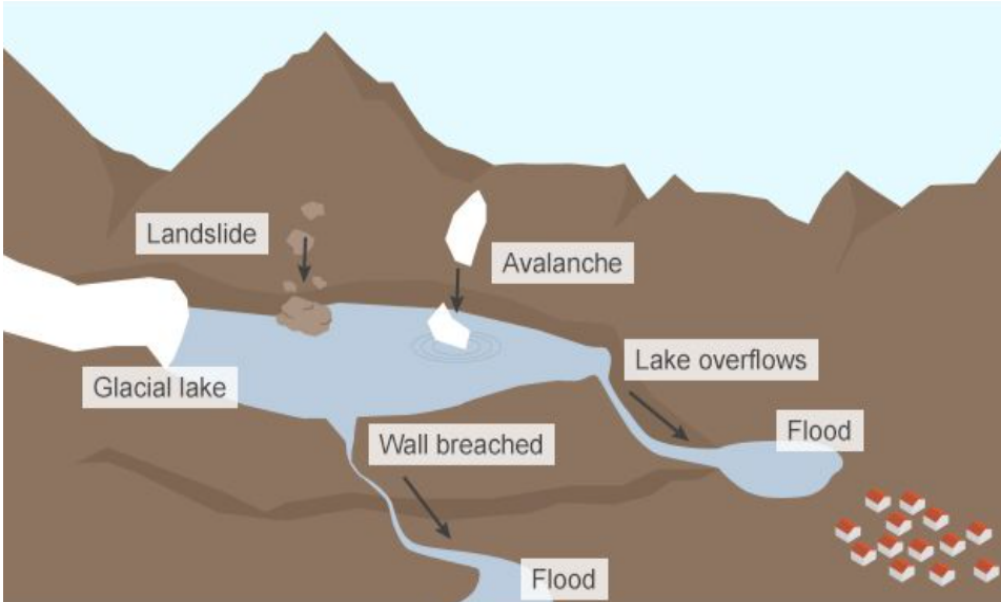
GS-III- Disaster and Disaster Management.

Why in news?

Recently scientists from the International Centre for Integrated Mountain Development (ICIMOD) found that supraglacial lake melting is also a reason for glacial lake outburst.

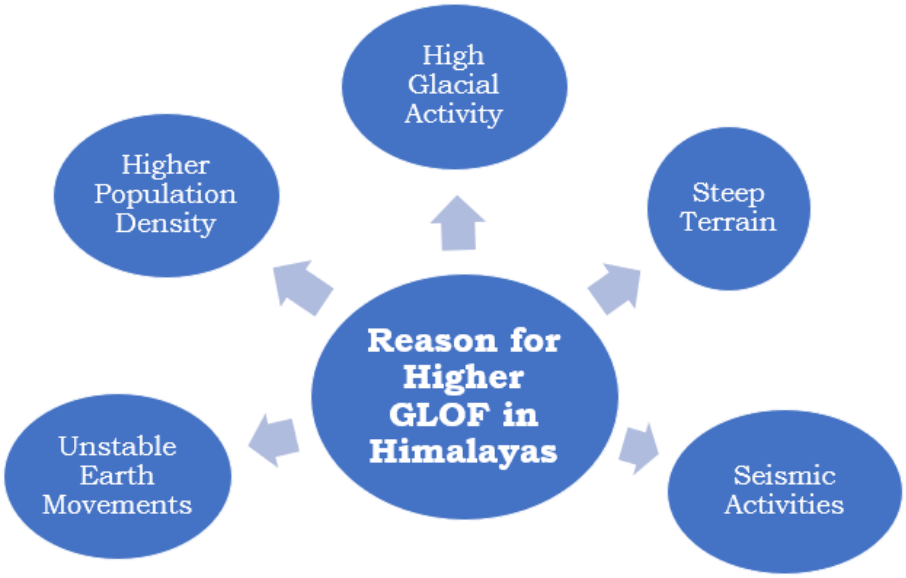
What are glacial lake outbreak floods?

- **Glacial lakes** – A glacial lake is a *body of water that originates from a glacier.*
- **Formation** – It usually forms in *front of, on top of, or beneath a melting glacier.*



- **Classification** - ISRO classifies, glacial lakes into 4 broad categories based on their formation
  - Moraine-dammed glacial lakes
  - Ice-dammed glacial lakes
  - Erosion-based glacial lakes
  - Other glacial lakes.
- **Glacial lake outburst flood (GLOF) -** It occurs when *water is suddenly released* from a lake fed by a melting glacier.
- **Vulnerable regions –** Hindukush Himalayas, Andes, Alaska and Alps mountainous

regions



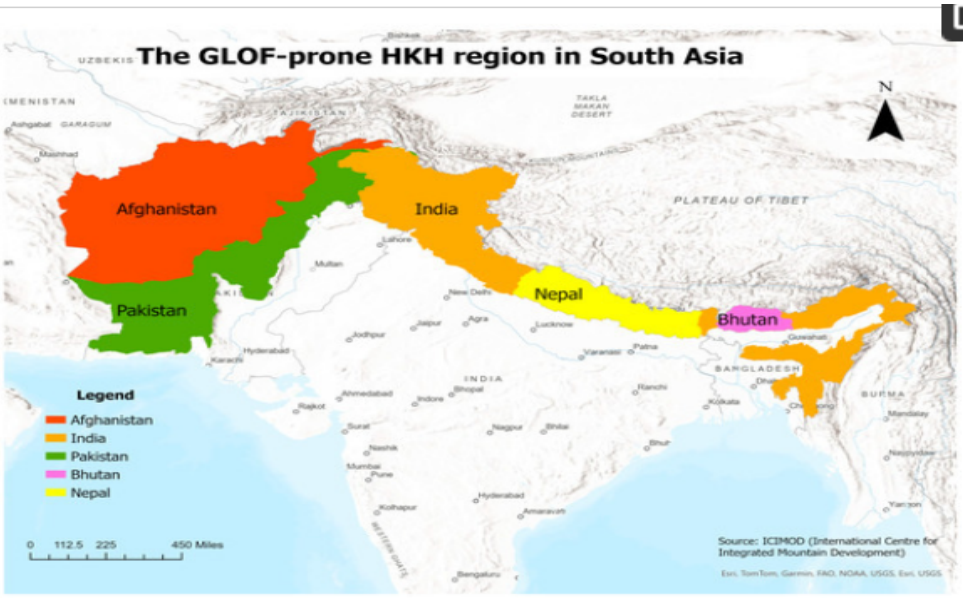
- **Recent incidents**
  - Nepal (Limi)
  - Afghanistan (Andorab valley)
  - Pakistan (Chitral, Hunza)

What are its causes?

- **Climatic Reasons** - Sustained warming plays a key role in the formation and gradual expansion of glacial lakes.
- **Draining of supraglacial lakes** – Recent GLOF events have occurred due to the draining of newly formed (supraglacial) ice-dammed glacial lakes.
- **Short term heat variations** - Extreme Short-term temperature can also trigger sudden events such as ice avalanches, ice calving, or slope failures related to thawing of permafrost.

> *Permafrost is any type of ground from soil to sediment to rock that has been frozen continuously for* ***a minimum of two years***

- **Glacial overflow** - Severe rapid glacier movement caused due to *Sudden movement of ice* over a relatively short time.
- **Glacial retreat** - Hindu Kush Himalayas has given rise to the *formation of numerous new glacial lakes* due to climate change occurring in most parts of the region.



- **Structural weakness of moraines** - Unconnected and weak moraines, which are unstable, can *collapse due to structural weakness.*
- **Seismic exertion** - Sudden structural change in glacier can be created due to t*ectonic movements in mountainous region*.
- **Anthropogenic reasons** - Extensive mining, deforestation, hydropower projects, unregulated urbanization.
- Greenhouse gas emission can also alter drainage patterns.

Challenges in identification of dangerous lakes
• **Limited resolution of data** - Freely available satellite data, such as from *Landsat and Sentinel-2, have limited resolution*. • It can only identify lakes above a certain size threshold, potentially missing smaller or short-lived water bodies. • **Less monitoring and mapping -** There is a *shortage of available mapping* and monitoring efforts. • **Lack of assessment -** There is a decrease in regular assessment and analysis of potentially risky glacial lakes.

What are the 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)** - 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

What measures can be taken?

- **Regular monitoring –** Regular analysis and *updating potentially dangerous glacial lakes inventories*, analysing smaller, short-lived ice dammed lakes can be done.

  Potentially dangerous Glacial lakes *can increase the vulnerability of GLOF. Nepal has 25, Tibet autonomous region of China has 21 and India has 1 potentially dangerous Lake.*

- **Encompassing the process** - The processes involved in glacier *retreat and lake formation should* be incorporated in monitoring methodology for more dynamic and accurate hazard assessment.
- **Technological solutions** - Synthetic-Aperture Radar imagery can be used to automatically *detect changes in water bodies, new lake formations.*
- **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.
- **Uniform construction guidelines** - Developing a uniform framework for infrastructure development, construction, and excavation.
- **Early Warning Systems (EWS)** - Development of new EWS and enhancing existing EWS can be done in vulnerable areas.
- **Research** - Continued research into glacial dynamics, climate change impacts, and GLOF mitigation strategies is necessary to develop innovative approaches that reduce GLOF risk.

Hindu Kush Himalayan Region
• **Length** - 3,500 kilometres across Asia, • **Countries covered** - Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan. • **Significance** - Up to two billion people are dependent on the region for food, water, and energy security. • It is also home to many irreplaceable species.

Reference

Down To Earth| Glacial Lake Outburst Floods