

Himalayan Disasters - A Warning for India

Mains: GS I - Geography

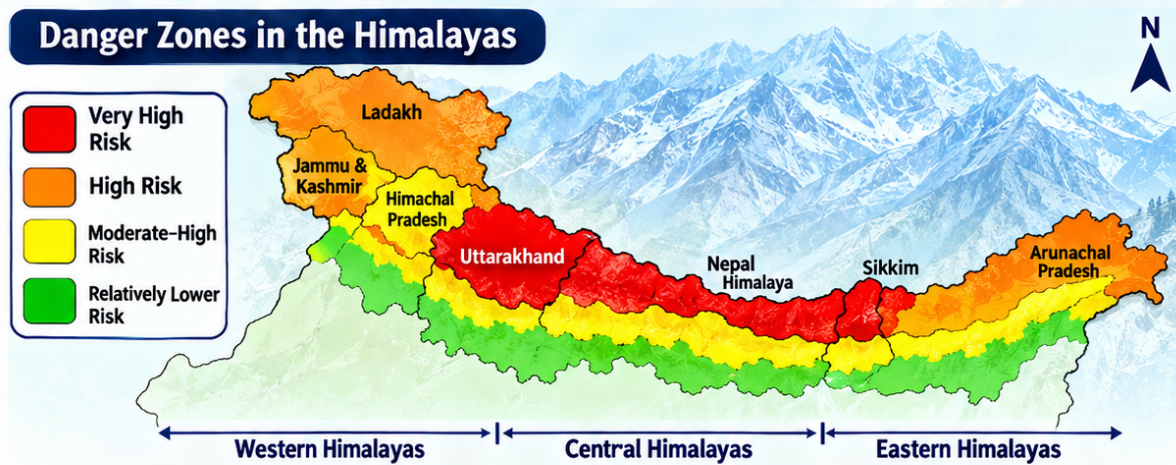
Why in News?

Recent Devastating floods in Nepal's Bhotekoshi-Trishuli river have claimed over 350 lives, underscoring the Himalayan region's acute vulnerability to climate-induced disasters.

Why are the Himalayas considered a dangerous zone?

- **Transboundary Dynamic Ecosystem** - Himalayan rivers cross several national borders, so disasters in Nepal, Tibet, or Bhutan often have downstream effects in India.
- Effective management of shared river systems requires real-time information sharing and coordinated disaster response among affected countries.
- **Geologically Young and Fragile Mountain Systems** - The Himalayas are classified as young fold mountains characterised by unstable slopes.
- Elevated rates of erosion and persistent slope instability significantly increase the region's vulnerability to landslides.
- **High Seismic Vulnerability** - The Himalaya is situated along the active tectonic collision zone between the Indian and Eurasian plates.
- Seismic activity frequently triggers landslides, avalanches, and breaches of glacial lakes.

Himalayan Hazard Map – Danger-Level Zonation



Risk Zonation Details

Risk Level	Himalayan Areas	Major Risks
 Very High	Sikkim, Uttarakhand, Nepal Himalaya, parts of Himachal Pradesh	 GLOF, landslides, earthquakes, flash floods
 High	Arunachal Pradesh, Jammu & Kashmir, Ladakh, remaining Himachal Pradesh	 Earthquakes, landslides, avalanches, glacier-related hazards
 Moderate-High	Eastern Himalayan foothills & selected Himalayan valleys	 Landslides, floods, extreme rainfall
 Relatively Lower	Lower Himalayan/foothill areas away from high-risk valleys	 Floods, landslides and seismic risks still remain



Key Takeaway: The Himalayas are a fragile and dynamic region, where steep terrain, earthquakes, climate change and increasing human activity make natural hazards a serious and growing risk.

- **Rapid Glacier and Cryosphere Changes** - Increasing temperatures contribute to glacier retreat and heightened instability within the cryosphere.
- The formation and expansion of glacial lakes elevate the risk of glacial lake outburst floods (GLOFs).
- **Extreme Rainfall Events** - Short-duration, high-intensity rainfall events frequently trigger flash floods and landslides.
- **Steep River Gradients** - Rivers in the region descend rapidly through narrow valleys.
- Water, rocks, ice, and debris accumulate significant destructive energy as they move through these steep gradients.

- **Plate Collision** - The collision of the Indian Plate subducting beneath the Eurasian Plate results in significant stress accumulation, which frequently leads to high-magnitude earthquakes.
- **Locked Faults** - The release of accumulated pressure along locked faults can trigger massive earthquakes.
- **Unregulated Construction** - Unregulated construction activities, including road building, dam construction, deforestation, and increased tourism, place additional stress on the region's fragile terrain.
- **Carrying Capacity Failures** - Failures to respect the carrying capacity, such as overcrowded towns and unchecked infrastructure development, further amplify environmental and seismic risks.
- **Cascading Multi-Hazard Risks** - A single trigger can produce multiple hazards:



Himalayan Disaster Chain

From Trigger to Impact



**Earthquake / Extreme Rainfall /
Glacier Collapse**



Landslide / Avalanche

Instability in mountains leads to massive rock, ice and soil movement



GLOF / Flash Flood

Sudden release of water from glacial lakes or heavy rainfall causes flash floods



Debris Flow + River Erosion

Water, rocks and soil rush downstream, eroding river banks and carrying huge debris



Secondary Landslides

Raging flows and weakened slopes trigger more landslides in the downstream areas



**Damage to Roads, Bridges,
Houses & Hydropower**

Infrastructure, homes and vital services are severely damaged or destroyed

What are the past calamities faced by India?

I HIMALAYAN DISASTERS



Kedarnath, 2013: In June, Uttarakhand received an unusually high amount of rainfall, leading to the melting of the Chorabari glacier and the Mandakini river overflowing. The floods affected large parts of Uttarakhand, Himachal Pradesh and Western Nepal, causing massive flash floods and landslides. Nearly 6,000 people were presumed dead.



Chamoli, 2021: A large glacier broke away and set off a flood, leading to surging waters in the Rishiganga river in Uttarakhand. Over 200 people were reported dead.



Sikkim, 2023: A glacial lake (large bodies of water that sit in front of, on top of, or beneath a melting glacier) situated in northwest Sikkim at 5,000 metres burst due to incessant rains. It led to the release of water in downstream areas and the deaths of at least 55 people.



Dharali, 2025: The terrain of the region in Uttarakhand (6,900 metres above mean sea level), combined with continuous rain for days, triggered mudslides, debris slides and flash floods. At least 69 people were reported dead.

What are the steps taken by government?

- **National GLOF Risk Mitigation Programme (NGRMP)** - The National Disaster Management Authority (NDMA) initiated this programme following the Sikkim disaster.
- **Objective** - To establish early-warning systems for glacial lakes identified as high risk.
- It targets **195 glacial lakes** located in the following regions:
 - Sikkim
 - Uttarakhand
 - Himachal Pradesh
 - Arunachal Pradesh
 - Jammu & Kashmir
 - Ladakh

- The total programme outlay is ₹150 crore.

- **Additional Risk Mitigation Measures**

- Glaciers and glacial lakes are monitored using remote sensing and satellite technology.
- Disaster management planning is conducted under the guidance of the NDMA and State Disaster Management Authorities.
- Early-warning and emergency communication systems are being developed.
- Hazard and vulnerability mapping is undertaken to identify at-risk areas.
- Preparedness for search, rescue, and evacuation operations is being enhanced.

What are the key challenges?

- **Inadequate Early-Warning Coverage** - Numerous vulnerable glacial lakes lack real-time early warning systems.
- **Limited Scientific Data** - Continuous monitoring is hindered by challenging terrain and extreme weather conditions.
- **Unplanned Construction** - The development of roads, hotels, hydropower projects, and settlements frequently increases exposure to hazards in fragile valleys.
- **Climate Change Uncertainty** - Alterations in temperature and precipitation patterns reduce the reliability of historical risk assessments.
- **Transboundary Coordination** - Although Himalayan hazards are transboundary, real-time data sharing and coordinated warning mechanisms are still limited.
- **Difficult Terrain** - Limited accessibility frequently delays rescue operations, relief efforts, and post-disaster communication.
- **Development-Ecology Conflict** - Infrastructure and energy demands must be balanced with the carrying capacity of fragile mountain ecosystems.

What steps need to be taken?

- **Universal Early-Warning Coverage** - Deploy real-time sensors and automated warning systems in areas surrounding high-risk glacial lakes and vulnerable valleys.
- **Strengthen Himalayan Risk Mapping** - Develop micro-level hazard maps that address glacial lake outburst floods (GLOFs), landslides, earthquakes, avalanches, and flash floods.
- **Regulate Construction** - Mandate carrying-capacity assessments and implement strict land-use zoning prior to infrastructure approval.
- **Climate-Resilient Infrastructure** - Ensure that roads, bridges, hydropower projects, and settlements are designed in accordance with disaster-resilient standards specific to mountainous regions.
- **Strengthen Transboundary Cooperation** - Establish real-time information-sharing mechanisms among India, Nepal, Bhutan, and China for monitoring floods, glacial activity, and earthquakes.
- **Community-Based Disaster Preparedness** - Provide training to local communities in the following areas:
 - Early evacuation
 - Emergency communication
 - First response
 - Safe evacuation routes
- **Ecosystem-Based Disaster Risk Reduction** - Conserve forests, wetlands, and natural drainage channels to enhance ecosystem-based disaster risk reduction.
- Prohibit excessive slope cutting and riverbed encroachment to maintain natural landscape stability.
- **Integrated Himalayan Disaster Observatory** - Integrate satellite data, ground sensors, weather forecasts, seismic monitoring, and artificial intelligence-based risk

modelling to enable predictive disaster management.

What lies ahead?

- The Nepal floods illustrate that disasters in the Himalayan region are not isolated incidents but represent cascading multi-hazard phenomena.
- The interaction of climate change with geological fragility, rapid infrastructure development, and increasing population pressure significantly amplifies associated risks.
- Consequently, India should transition from a reactive, relief-based approach to an anticipatory and ecosystem-sensitive disaster management strategy.

Reference

[Indian Express | Warning for India](#)

