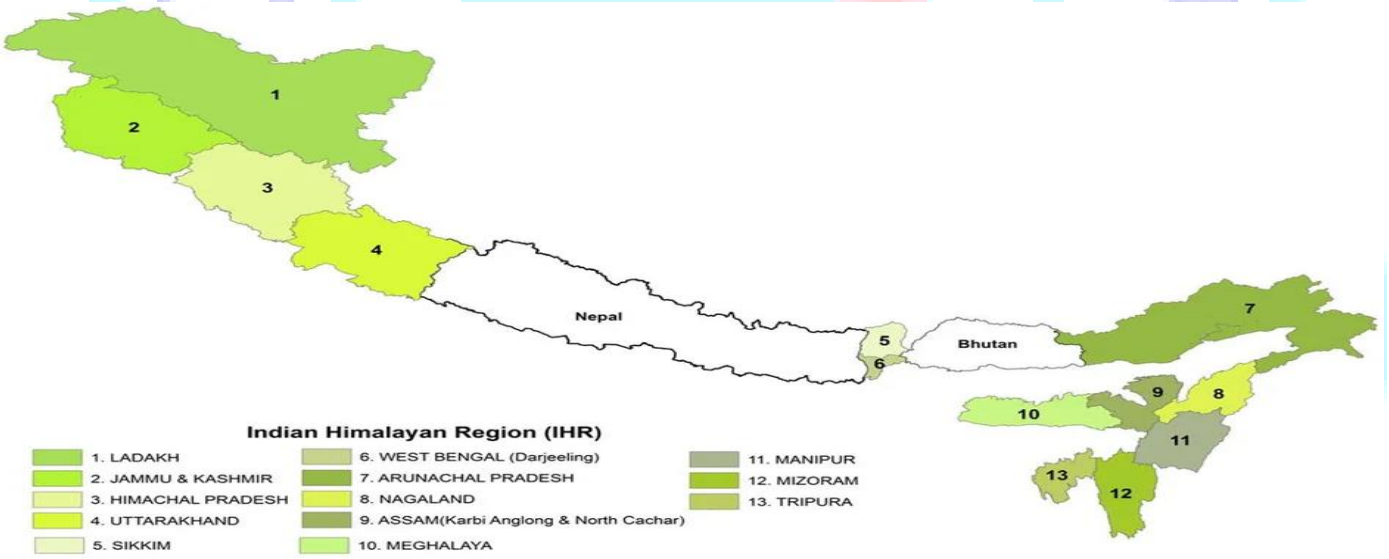
DISASTER RESILENCE IN HIMALAYAS - GEOGRAPHY

The flash flood that struck Dharali village in Uttarkashi, Uttarakhand, is a stark reminder of the increasing threat of disasters caused by extreme weather events in the Indian Himalayan Region (IHR).

Factors Driving Frequent Disasters in the IHR

Tectonic Activity and Earthquake Risk

The Himalayas are still geologically active because the Indian Plate is colliding with the Eurasian Plate, causing the mountains to rise by a few millimeters each year. This tectonic activity makes the IHR one of the world's most seismically active zones, leading to frequent earthquakes. Major fault lines like the Dhaulagiri Fault, Main Boundary Thrust, and Indus–Ganga Fault store enormous stress. Sudden release of this stress leads to destructive earthquakes. Earthquakes destabilise slopes, triggering landslides, avalanches, and flash floods by blocking or diverting rivers. Example: The 2005 Kashmir Earthquake (Magnitude 7.6) caused over 80,000 deaths in J&K and Pakistan-administered Kashmir.



Fragile Geology

The Himalayas are young fold mountains composed mainly of sedimentary and metamorphic rocks, which are loosely compacted and prone to erosion. Steep slopes combined with loose rock material create natural instability, making the region highly susceptible to landslides and soil creep, especially after heavy rains or tremors. This geological fragility limits the capacity of slopes to withstand infrastructure development or deforestation.

Glacial and Snow-Related Hazards

The IHR hosts thousands of glaciers and snowfields, serving as Asia's water towers. Due to climate change, these glaciers are melting at unprecedented rates, leading to the formation of unstable glacial lakes. According to studies, the Hindu Kush–Himalaya region could lose up to 75% of its glacier volume by 2100, severely increasing risks of Glacial Lake Outburst Floods (GLOFs). Example: In 2023, the outburst of South Lhonak Lake in Sikkim triggered devastating floods that destroyed the Teesta III Dam at Chungthang.

Extreme Rainfall Events and Cloudbursts

The Himalayas experience orographic rainfall as moist monsoon winds rise and cool rapidly over the mountains. Cloudbursts (sudden downpours releasing more than 100 mm of rain per hour over a

small area) are common, overwhelming natural drainage systems. These events cause flash floods, debris flows, and massive landslides. Example: In July 2021, multiple cloudbursts in Chamoli, Uttarkashi, and Pithoragarh districts caused widespread floods and landslides, killing dozens and damaging infrastructure.

River Dynamics and Flash Floods

Himalayan rivers like the Brahmaputra, Ganga, and their tributaries are young, turbulent, and carry heavy silt loads. Landslides or glacial collapses often create temporary natural dams; when these burst, sudden flash floods occur downstream. Additionally, large-scale hydropower projects and transboundary river interventions (e.g., China's proposed mega-dam on the Brahmaputra) increase risks of altered river flows and "water bomb" scenarios for downstream India.

Deforestation and Land Use Changes

Expanding roads, hydropower projects, urban settlements, and agriculture have cleared large forest patches in the IHR. Tree roots naturally stabilise soil and slopes; their removal increases erosion, slope instability, and vulnerability to landslides. Example: In Joshimath (2023), land subsidence was linked to unregulated construction, tunneling for hydropower, and fragile slopes. Projects like Char Dham road widening have worsened slope fragility in Bhagirathi Eco-Sensitive Zone, leading to landslides and glacier retreat.

Key Committees and Their Recommendations

Mishra Committee (1976)

Investigated the sinking of Joshimath and identified it as a landslide-prone zone. Recommended immediate suspension of construction activities in slip zones until detailed stability studies were conducted. Suggested banning tree-felling, quarrying, or boulder removal in fragile hill slopes to minimise landslide risk.

J.C. Pant Committee (1999)

Classified disasters into five categories: water & climate-related, geological, chemical/industrial/nuclear, accident-related, and biological. Called for including Disaster Management in the Constitution's Schedule 7, giving it federal importance. Advocated for a National Disaster Management law and state-level legislations for enforcement of building codes, zoning laws, and safety standards. Recommended setting up a Cabinet Committee on Disaster Management and a National Council under the Prime Minister. Proposed creation of a dedicated Ministry of Disaster Management for policy coordination. Suggested institutions like National Centre for Calamity Management and National Institute for Disaster Management (NIDM) for capacity building. Stressed on restructuring the Calamity Relief Fund, creating two national funds (for disaster response and prevention), and earmarking 10% of plan funds for disaster risk reduction. Emphasised risk assessment, human resource training, SOPs, and a culture of preparedness to minimise future disaster losses.

Measures to Mitigate Disaster Risks in the IHR

Early Warning Systems (EWS)

Install solar-powered automated sensors, weather radars, and remote cameras to monitor glacial lakes and unstable slopes in real-time. Ensure quick dissemination of alerts to downstream communities via SMS, sirens, and community radios to save lives.

Engineering and Geo-Technical Interventions

Build check dams, spillways, controlled drainage channels, and catchment dams to reduce the force and volume of water during flash floods. Strengthen slope stability through bio-engineering techniques like grass matting, bamboo check-dams, and retaining walls in fragile slopes.

Sustainable Tourism Management

Implement a Green Tourism Framework by fixing tourist carrying capacity in ecologically sensitive zones. Promote eco-friendly homestays, local guides, and regulated trekking routes to reduce ecological stress. Channel part of tourism revenue into ecosystem restoration, slope stabilisation, and disaster preparedness.

Region-Specific Environmental Impact Assessments (EIA)

Design customised EIAs for Himalayan projects considering unique geology, seismicity, and climate sensitivity. Revise the National Building Code for hill states to mandate earthquake-resistant and landslide-resilient designs.

Climate and Disaster-Resilient Development

Integrate Sendai Framework for Disaster Risk Reduction and climate adaptation strategies into infrastructure and urban planning. Prioritise nature-based solutions (afforestation, wetland revival, slope stabilisation) over hard-engineering models.

Integrated Watershed and River Basin Management

Adopt ridge-to-valley watershed management with afforestation, streambank stabilisation, and revival of traditional water systems. Enforce floodplain zoning laws to prevent construction in high-risk areas. Establish basin-level governance systems for coordinated upstream–downstream water management.

Community Awareness and Preparedness

Conduct awareness campaigns, hazard mapping exercises, and mock drills to prepare local populations. Empower Panchayati Raj Institutions for localised disaster preparedness and relief distribution. Build community-owned multipurpose shelters for flood and landslide emergencies.

Multi-Agency Coordination

Strengthen cooperation between NDMA, NRSC, Central Water Commission, IMD, and State Disaster Authorities. Develop data-sharing platforms for real-time hazard information. Promote joint research with scientific institutions like Wadia Institute of Himalayan Geology and IIT Roorkee for disaster forecasting.

Conclusion

The Indian Himalayan Region is highly disaster-prone due to its tectonic activity, fragile geology, glacial systems, and intense rainfall patterns. Rapid and unregulated development is amplifying these risks, making ecological safeguards urgent. A balanced approach combining climate-resilient infrastructure, strengthened early warning systems, community empowerment, and strict land-use regulations can mitigate risks. Government programmes like the National Mission on Himalayan Studies (NMHS), if effectively implemented, can ensure safe and sustainable settlements in the IHR.

Source: https://indianexpress.com/article/explained/explained-climate/complex-uncertain-relationship-extreme-rain-landslides-flash-floods-10178912/