

Himalaya Commons Dialogue 21 September 2026

Session Note - From Warning to Action: Integrated Risk Assessment for the Himalayas

Context and Rationale

The Hindu Kush Himalaya (HKH) is an ecologically important region with far-reaching implications for people and economies across Asia. It spans more than 4.2 million km², contains the largest volume of ice outside the polar regions, encompasses four global biodiversity hotspots, and supplies water to 12 major river basins. Around 240 million people live in the HKH itself, and another 1.65 billion people downstream depend directly or indirectly on the freshwater and ecosystem services originating in the region. The Indian Himalayan Region (IHR) is a critical part of this larger system, supporting water security, economic activity, and strategic interests that extend well beyond the mountain states. It is home to ~50 million people, contains the headwaters of major river systems, supports a large tourism economy, and hosts major hydropower projects and transport networks.

The HKH has always been ecologically sensitive, and climate change is making its risk landscape more complex. The region's steep terrain, fragile geology, high seismicity and variable rainfall have always made it prone to floods, landslides, avalanches and earthquakes. More recently, climate change is altering the conditions that cause some of these hazards. Temperatures across the HKH have risen by an average 0.28°C per decade since 1951, and glaciers lost 12% of their area and 9% of their estimated ice reserves between 1990 and 2020¹. These climatic changes are also unfolding unevenly across the region. For instance, glacier loss has been much faster in the Ganges and Brahmaputra basins than in the Indus basin, with the eastern Himalaya expected to reach peak GLOF² risk earlier. Meanwhile, in the western Himalaya, widespread permafrost degradation³ is weakening the structural integrity of high-altitude terrain. Together, these shifts are changing snowmelt, river flows, slope stability and glacial lakes, as well as the conditions under which high-altitude landforms can become unstable.

Moreover, growing exposure is amplifying the consequences of hazards. Population growth, expanding roads, hydropower and other infrastructure, and growing economic activity are placing more people and assets in exposed mountain landscapes. In some catchments, infrastructure development can further alter slopes and sediment flows, changing how hazards propagate through the landscape. A cryosphere-related disturbance can therefore trigger a chain of physical failures, with the failure of one exposed asset potentially generating additional debris or flows and causing downstream infrastructure failures. Impacts can consequently propagate far beyond the initial trigger, accumulating across settlements, transport and energy systems, and local economies, as illustrated in Figure 1. Figure 2 captures this growing burden of disaster events in the HKH across successive decades.

¹ ICIMOD, [HKH Glacier Outlook](#), 2026

² Glacial Lake Outburst Flood

³ estimated 8,340 km² lost between 2002–04 and 2018–20

Figure 1: A single cryosphere disturbance can propagate through multiple connected hazards

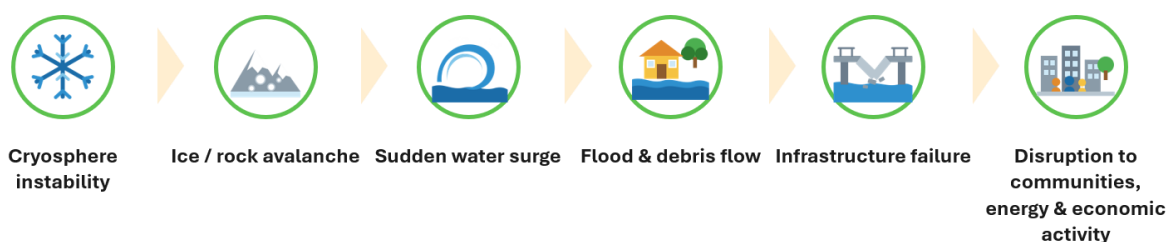
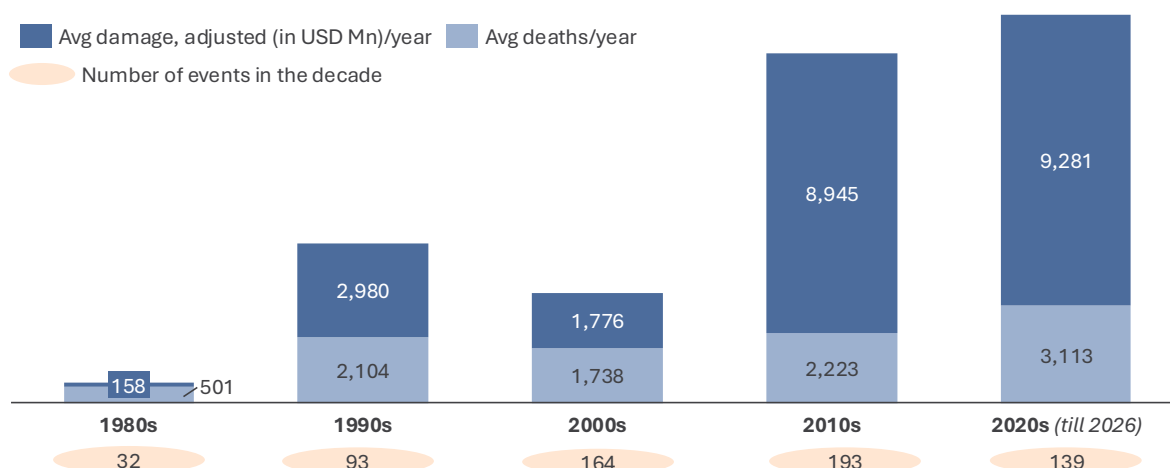


Figure 2: Growing burden of climate and cryosphere-linked disaster events in the HKH region⁴

Recorded events, deaths and economic losses in the HKH by decade



India has strengthened its capacity to observe, forecast and communicate multi-hazard information across the IHR⁵. India now has specialized monitoring and forecasting capabilities across meteorology, hydrology, geology and the cryosphere. The India Meteorological Department (IMD) provides high-resolution weather and precipitation forecasts, the Central Water Commission (CWC) provides short-range and seven-day flood forecasts, the Geological Survey of India (GSI) provides daily regional landslide forecasts up to the taluk/sub-divisional level; and the Indian Space Research Organisation (ISRO), National Centre for Polar and Ocean Research (NCPOR) and other institutions monitor glaciers and glacial lakes through satellite and field-based approaches. These capabilities are complemented by national warning and decision-support systems. The Ministry of Earth Sciences (MoES)' Multi-Hazard Early Warning System (MHEWS) brings together observational networks, forecasting models and a GIS-based Decision Support System, and warnings from agencies such as CWC are disseminated through channels including the National Disaster Management Authority (NDMA)'s SACHET platform.

However, important gaps remain, pointing to the need for proactive, integrated risk assessment and management

- **Our understanding of the sources and triggers of high-altitude risk is limited.** For hazards such as potentially dangerous glacial lakes, we have substantial capability to identify and monitor high-risk systems. But other forms of instability, including ice and

⁴ (1) Covers 8 HKH countries: Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan. (2) Includes events located within the HKH mountain region, or spanning both mountain and lowland areas; Nepal and Bhutan are included in full. (3) Excludes earthquakes, which are a persistent geological hazard rather than a changing climatic one; Wenchuan (2008) and Kashmir (2005) alone account for 89% of recorded deaths in the 2000s and would otherwise dominate the decade. Climate and cryosphere-linked hazards, including rock avalanches, GLOFs, wildfires and droughts, are retained. (4) Pre-2000 data are particularly subject to reporting biases, as cautioned by EM-DAT. (5) The recent Nepal disaster is not yet captured in the dataset.

⁵ Gol, Parliament question - [MHEWS in Himalayan States](#), 2026

rock failures and other high-altitude slope failures, can arise through different mechanisms. We do not yet have a systematic understanding of which landforms are most susceptible or what conditions could trigger failure. This creates uncertainty at the start of the risk chain.

- **Field-based monitoring remains sparse and uneven across the HKH.** Only 38 glaciers have been observed in the field out of approximately 63,700 in the HKH, and these observations are unevenly distributed⁶. Not a single Himalayan glacier currently qualifies as a WGMS *reference glacier*⁷ and only seven qualify as *benchmark glaciers*, of which just two (Chhota Shigri and Hoksar) are in India. Large parts of the Karakoram, Sikkim, Zaskar and Bhutanese Himalaya remain underrepresented in field monitoring.
- **Existing capabilities to assess downstream and cascading impacts are not yet used routinely.** Once a plausible initiating event is defined, hydrodynamic and other models can in many cases estimate where flood or debris flows may travel, which settlements and infrastructure are exposed, and how infrastructure failure could amplify downstream impacts. However, these assessments are not yet routinely undertaken across priority Himalayan landscapes or embedded in operational risk management.
- **Risk information does not always translate into decisions that reduce risk.** Responsibilities for monitoring hazard risk are distributed across institutions with different mandates. Moreover, the institution generating information about an upstream hazard is not the institution responsible for deciding how downstream infrastructure should be designed, operated or protected. This creates a gap between identifying a risk and acting on it. For instance, South Lhonak Lake had been recognised as a rapidly growing and potentially hazardous glacial lake, and concerns about GLOF risks to the Teesta basin had been raised before Teesta III was commissioned. Yet the project was not designed around a GLOF of the magnitude that ultimately occurred.

This panel brings together scientists, policymakers, disaster-management experts to explore how we can better understand, plan for and act on the interconnected and cascading risks facing the Himalayas.

Potential Opportunities and Challenges

The opportunities to strengthen ecological security and Disaster Risk Reduction (DRR) in the HKH region include:

- **Stress-test priority Himalayan landscapes from hazard sources to cascading downstream impacts.** For selected catchments, valleys and other high-risk landscapes, risk assessments should begin by identifying the glaciers, glacial lakes, slopes and other high-altitude systems that could generate damaging events, the conditions that could trigger them, and the settlements, infrastructure and services exposed downstream. Where a plausible initiating event can be defined, existing hydrodynamic and other modelling capabilities can be used to estimate impact footprints and examine how infrastructure or other failures could amplify the event. Combining source susceptibility, trigger conditions, exposure, vulnerability, ecosystem condition and critical dependencies would help identify where preventive action is most urgent.

⁶ ICIMOD, [HKH Glacier Outlook](#), 2026

⁷ World Glacier Monitoring Service defines reference glaciers as those with 30 years of continuous measurement

- **Target additional monitoring and instrumentation to priority risk systems and exposed assets.** Continuous ground monitoring across the entire Himalayas is neither feasible nor necessary. The opportunity is to use regional screening and existing hazard information to identify high-risk source systems and critical exposed infrastructure where additional field observations or site-specific instrumentation would materially improve risk assessment or preparedness.
- **Create site-specific resilience packages for high-risk landscapes and critical assets.** Once priority risks and plausible impact pathways are identified, bring together the measures needed to reduce the most consequential losses. Depending on the landscape, this could include reducing source hazards where technically feasible, stabilising slopes and catchments, strengthening or retrofitting exposed roads, bridges or energy infrastructure, avoiding infrastructure failure that could amplify downstream impacts, creating redundancy in power and communications, and relocating exposed households. These measures can be site-specific depending on the identified hazard source, topography, exposed assets and likely pathways of impact. The resilience package would bring these interventions together around a single resilience outcome, with clear ownership and financing across the departments and schemes responsible for delivery. Progress could then be measured by whether the landscape can better withstand predicted extreme-event scenarios.
- **Strengthen the link between early warning and timely response for high-risk hazards.** India already has substantial capabilities to detect and disseminate warnings, including through MHEWS and SACHET. The opportunity is to ensure that a warning triggers a clear chain of actions at the state, district and community levels, with predefined thresholds, responsibilities, response measures, communication channels and resources. This could be prioritised for fast-onset hazards such as GLOFs, flash floods and landslides, where lead times can be short and impacts can cross administrative boundaries.

Challenges that would need to be overcome to leverage these opportunities:

- **The Himalayas are difficult places to install and maintain continuous monitoring systems.** Remote locations, extreme weather, limited seasonal access, and unreliable power and communications make it difficult to service and replace equipment. Many high-risk glacial lakes are above 17,000 feet and accessible for only around four months a year, making both field visits and continuous automated monitoring difficult. Gaps in monitoring can, in turn, weaken both the risk assessments needed to understand changing hazards and the early-warning systems needed to act on them.
- **Preventive resilience has visible costs today while many benefits appear only as avoided future losses.** Investments in monitoring, retrofitting, source-risk reduction, relocation or restrictions on exposed development may compete with immediate development priorities and impose real economic and social costs. Because the disaster being prevented may never occur, these measures can be politically difficult to justify, particularly where costs and benefits fall unevenly on different communities, sectors or levels of government.
- **Resilience investments are difficult to develop and deliver across institutions.** Dedicated mitigation funding now exists through the NDMF and SDMF, but it has not yet translated into a strong pipeline of projects. As of March 2024, only 12% of the ₹5,950

crore allocated under NDMF had been released and 14% of SDMF had been utilised⁸, with constraints including limited technical capacity and weak engagement from sectoral departments. The challenge is even greater for landscape-level resilience, where the actions needed may sit with different departments, each with separate mandates, project pipelines and funding sources.

- **Warning and response systems are vulnerable at the last mile, particularly when disasters disrupt the systems they depend on.** Local authorities need reliable connectivity, functioning monitoring equipment, trained personnel and established communication channels to turn a warning into action, but these can be difficult to maintain in remote, high-altitude locations. For instance, during the 2023 South Lhonak GLOF, the lake's monitoring station stopped transmitting days before the outburst, and an Indo-Tibetan Border Police (ITBP) post downstream manually detected the event and issued a warning. Subsequent power and communication failures made it harder to confirm the timing of the dam breach and coordinate information during the response.
- **Cross-border risk creates a coordination problem that national systems cannot solve alone.** Glaciers, rainfall, rivers and hazard pathways cross political boundaries, yet monitoring, data governance, warning protocols and decision-making remain primarily national. For the broader HKH, the challenge is therefore also creating mechanisms for routine cross-border risk information exchange.

Discussion Questions

- **Are we still assessing Himalayan risks hazard by hazard when many impacts arise from interactions among hazards and ecological change?** What are we missing, and what would an integrated, landscape-level risk picture need to capture, including slow-moving changes such as spring depletion, soil loss, forest degradation and permafrost thaw?
- **Do we need more information, or do we need to use the information we already have differently?** What would it take to bring monitoring, modelling and local knowledge together into a shared, decision-relevant picture of how risk is evolving?
- **We will rarely be able to predict complex Himalayan risk with certainty. So how much certainty is enough to act?** What thresholds, decision protocols or institutional arrangements are needed to turn evidence of increasing or potentially severe risk into timely action, even when the likelihood or pathway remains uncertain?
- **How reliable are the systems that detect, communicate and respond to an unfolding hazard?** How do we ensure that warning, authority, communication and response are connected, and that the chain still works when the hazard itself disrupts power, communications or monitoring systems?

⁸ World Bank, [Closing the Financing Gap: New Frontiers for DRM Financing in India](#), 2025