# DEFORESTATION, FOREST DEGRADATION, AND FLOOD RISK IN PAKISTAN

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**AN ANALYTICAL REVIEW BY**

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# 1. INTRODUCTION

Pakistan's natural forests cover only about 5% of the country's land area, one of the lowest proportions in Asia. While national programs and political narratives highlight afforestation achievements such as the Billion Tree Afforestation Program (BTAP) and Ten Billion Tree Tsunami Programme (TBTTP), scientific data and monitoring reports continue to record ongoing deforestation and degradation of natural forest ecosystems, particularly in the Himalayan, Karakoram, Hindu Kush, and Suleiman ranges. These forests constitute the major watersheds of the Indus River system.

Simultaneously, Pakistan has experienced recurrent catastrophic floods over the last three decades, with the 2010, 2022 and 2025 floods ranking among the most destructive in its history. The link between watershed forest degradation and flood severity has become a central question in environmental policy and disaster management.
This review paper synthesizes available evidence from national forest monitoring systems (NFMS, REDD+ FRELs, and GHG Inventories), scientific literature, and official flood assessments to test the hypothesis that:

*"Despite claims of increased forest cover through plantation efforts, Pakistan's natural forest ecosystems in northern and southwestern mountain ranges continue to degrade. This degradation is a significant contributor to flood severity, and recovery of these ecosystems will take decades or even centuries."*

# 2. DEFORESTATION AND FOREST DEGRADATION: STATUS AND TRENDS

## 2.1 National-Level Monitoring

Pakistan's NFMS, FRELs, and REDD+ Strategy (2015–2024) acknowledge that forests remain under pressure from deforestation and degradation. The BUR and technical annexes submitted to the UNFCCC reiterate that forests are a net source of emissions (MoCC 2017, 2020).

While FRA 2020 and World Bank datasets suggest relatively stable or slightly increasing forest area, these indicators include plantations and tree cover outside natural forests. Satellite-based Global Forest Watch (GFW) reports approximately 9,000–10,000 ha of tree-cover loss between 2001–2023, with recent years showing fire as an increasing driver. These figures may appear modest but are highly significant given Pakistan's low baseline of forest cover.

## 2.2 Regional Evidence

- Khyber Pakhtunkhwa and Northern Highlands: Multi-date land use studies in the Swat Valley and Peshawar Valley corridors reveal deforestation and fragmentation, primarily due to agricultural expansion and urban sprawl (Ali et al. 2022).
- Former FATA (merged districts): Landsat analyses indicate high deforestation rates (1990–2010) due to uncontrolled felling and conflict-related drivers (Rahman et al. 2011).
- Gilgit-Baltistan: Significant land-use transitions from 1990–2016, with natural vegetation being replaced by built-up areas and croplands in upper Indus catchments (Ali et al. 2019).

- Balochistan Juniper Forests (Ziarat): Junipers are extremely slow-growing, with trees often exceeding 1,500 years. Recovery of these forests following disturbance takes centuries, making their degradation effectively irreversible on human timescales (UNESCO 2013).

### 2.3 Drivers of Degradation

The main drivers include fuelwood demand, illegal timber harvesting, overgrazing, expansion of agriculture, infrastructure projects (roads, dams, mining), and forest fires. In dry temperate and subalpine forests, degradation rather than outright deforestation is the dominant process, resulting in loss of canopy density and ecosystem functions.

Inappropriate and weak management planning and implementation have been one of the major drivers of forest degradation in Pakistan, particularly in natural forest ecosystems. Existing working plans are often outdated, sectoral in scope, and poorly aligned with ecological realities. They typically focus on timber extraction rather than holistic ecosystem services, lack integration across land uses in forest landscapes, and are implemented with limited technical oversight. Weak enforcement, insufficient community participation, and absence of independent monitoring further undermine their effectiveness, resulting in continued degradation of fragile mountain and watershed forests.

## 3. FLOODS IN PAKISTAN (1992–2025): EVENTS AND DAMAGES

### 3.1 Historical Overview

The Federal Flood Commission (FFC) documents 19 major flood events between 1950–2011, resulting in over 10,600 deaths and US$30 billion in damages. The most catastrophic floods of recent decades are 1992, 2010, 2011, 2014, and 2022. The current monsoon floods (2025) are again devastating and the damages are yet to be assessed and documented fully.

### 3.2 Major Flood Events

- 1992 Northern Floods: Struck Jhelum, Chenab, and Indus catchments, killing ~1,500 people and causing >US$1 billion in damages.
- 2010 "Super Flood": Affected 20 million people, inundated 160,000 km$^2$, caused nearly 2,000 deaths, and inflicted US$9.7 billion in damages (ADB/WB 2010).
- 2011 Sindh Floods: Affected 9.3 million people and killed 516, concentrated in Sindh's flat plains.
- 2014 Jhelum–Chenab Floods: Affected 2.5 million people and caused ~300 deaths.
- 2022 Catastrophic Floods: Affected 33 million people nationwide, killed >1,700, and caused US$14.9 billion in damages and US$15.2 billion in losses (Government of Pakistan 2022).
- The 2025 monsoon floods devastated northern KP (Buner, Swat, Bajaur, Battagram, Mansehra, Shangla) and Gilgit-Baltistan, where cloudbursts triggered flash floods and landslides. Over 700 people died, thousands were displaced, and critical infrastructure including roads and power lines suffered extensive damage.

# 4. LINKING FOREST DEGRADATION AND FLOOD SEVERITY

## 4.1 Scientific Evidence

Global and regional reviews (Bradshaw et al. 2007; FAO 2005) show strong correlations between deforestation and increased flood frequency and magnitude, especially in steep, developing-country watersheds. Mechanisms include:

- Increased surface runoff and peak discharges.
- Greater incidence of shallow landslides and debris flows.
- Sediment loads choking river channels, reducing conveyance.
- Loss of slope stability and water regulation functions.

## 4.2 Pakistan's Watershed Context

The Himalaya, Karakoram, Hindu Kush and Suleiman ranges are sensitive catchments. Studies in Swat and Peshawar valleys confirm that deforestation increases flood risk by accelerating runoff and destabilizing slopes (Ali et al. 2022). Gilgit-Baltistan's land-cover transitions similarly affect sediment and water flows.

The 2010, 2022 and 2025 floods, while primarily driven by extreme monsoon events, were amplified by land-use changes, sedimentation, and weakened watershed resilience. Downstream infrastructure (embankments, barrages) was overwhelmed partly due to sediment deposition from degraded catchments.

## 4.3 Restoration vs Reality

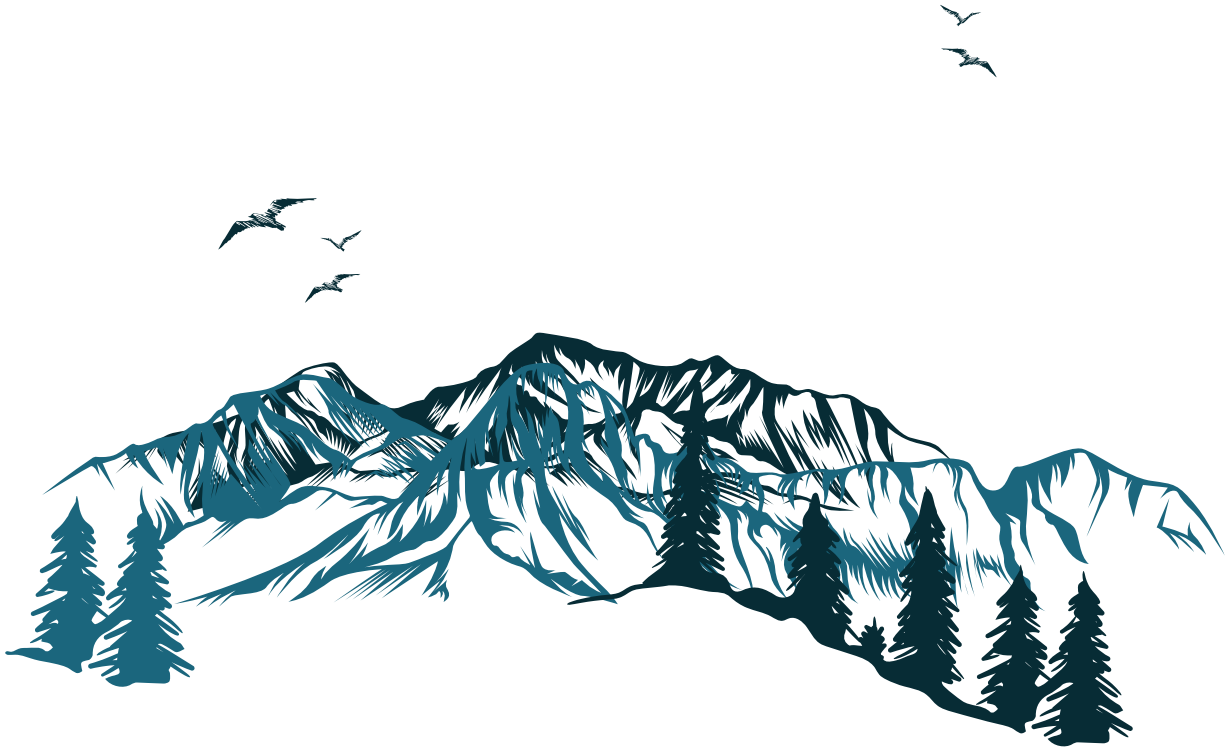
While tree plantation drives increase tree cover, they do not replicate the hydrological services of old-growth montane forests. In particular, junipers, pines, and moist temperate forests provide slope stabilization and groundwater regulation that young plantations cannot match for decades. Hence, even if "forest cover" expands, natural forest degradation continues to undermine flood resilience.

# 5. CONCLUSIONS AND POLICY IMPLICATIONS

- Evidence supports the hypothesis: Natural Forest degradation in Pakistan's headwaters is a significant contributor to flood damages.
- Restoration timelines are long: Recovery of intact ecosystem functions (e.g., juniper forests) may take centuries.
- Plantations Alone Cannot Ensure Ecosystem Recovery: Plantations and agroforestry are valuable but cannot replace degraded montane ecosystems in the short or medium term.
- Urgent and precautionary management of natural forest ecosystems in mountain headwaters is essential to safeguard downstream communities, protect critical watersheds, and sustain long-term ecosystem services.

## 5.1 Policy and Strategic Recommendations

- Safeguard Remaining Natural Forests: Ensure strict protection of intact forests, particularly in critical headwater regions, to preserve their ecological and hydrological functions.
- Prioritize Watershed-Scale Restoration: Implement landscape-level restoration using native species to restore degraded catchments and enhance flood resilience.
- Integrate NFMS Data into Planning: Incorporate findings from the National Forest Monitoring System (NFMS) into flood-risk models, water resource management, and land-use planning.
- Strengthen the management of Pakistan's natural forest ecosystems by replacing outdated, timber-focused working plans with integrated, science-based forest landscape management plans. These should emphasize ecosystem services, watershed protection, and climate resilience, while ensuring community participation, strict enforcement, and independent third-party monitoring and validation. Such reforms are essential to halt ongoing degradation of fragile mountain and watershed forests and to reduce downstream flood vulnerability.
- Mobilize International Climate Finance: Leverage mechanisms such as the Green Climate Fund (GCF) to support large-scale, ecosystem-based disaster risk reduction and climate resilience initiatives.



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