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2025 Pakistan Floods

Causes, Impacts, and Future Strategies for Managing **Water Extremes** in a
Changing Climate

Introduction



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- 💧 Unusually heavy rainfall during 2025 monsoon season led to widespread flooding across Pakistan
- 🌡️ Combination of strong monsoon trough and climate signals (warm Indian Ocean) brought rainfall far above average
- 📍 Record rainfall totals in Balochistan and Sindh provinces, surpassing levels seen during 2022 floods
- ⚠️ Extreme weather amplified by climate change, environmental degradation, and infrastructure challenges



Aerial view of flood-affected areas in Pakistan during the 2025 monsoon season

Meteorological and Climatic Causes



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Strong Monsoon Trough

Exceptionally strong monsoon brought heavy rainbands into Pakistan, breaking daily rainfall records in many districts during July–August 2025



Climate Change Impact

Warmer air holds more moisture, intensifying rainfall. Studies attribute increased severity to climate change accelerating the water cycle



Warm Indian Ocean

Lingering climate signals including warmer sea temperatures contributed to rainfall far above average levels



3-
4×

Normal monsoon rainfall levels, similar to the catastrophic 2022 floods

↑7%

Atmospheric moisture capacity per 1°C warming, leading to more extreme downpours



Record rainfall totals in **Balochistan** and **Sindh** provinces, surpassing 2022 levels

Environmental and Infrastructure Factors



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Deforestation

Decades of deforestation in **Himalayan foothills** and arid zones reduced vegetation cover that normally slows and absorbs rain runoff



Wetland Encroachment

Riverbanks and wetlands encroached by housing or farming, allowing floodwaters to spread more rapidly into settlements

Infrastructure Challenges

Major reservoirs (**Tarbela** and **Mangla**) near capacity from earlier rains, leaving little room to store monsoon inflows



Urban Drainage Failure

Urban drainage systems in large cities (**Karachi, Quetta**) overwhelmed by the deluge, causing severe urban flooding



Natural flood buffers



Floodwater spread
rate

~90%

Urban drainage
capacity exceeded

Human-Induced Factors



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Unplanned Urban Growth

Unregulated settlements on **floodplains** and along riverbeds increased vulnerability to flooding



Inadequate Early Warning

Insufficient warning systems left communities with **limited time** to prepare or evacuate before floodwaters arrived



Zoning Enforcement Challenges

Difficulty enforcing floodplain zoning regulations despite warnings issued after the 2022 floods



Community Vulnerability

Lack of social safety nets and disaster preparedness education left communities **exposed to flood risks**



Increased population
in high-risk areas



Limited response
time



Recurring flood
damage

Climatic Impacts



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Seasonal Variability

"Feast-or-famine" pattern: extreme rainfall in monsoon months followed by sharp dry-season water shortages

Soil Damage

Increased erosion and nutrient loss from intense downpours, reducing agricultural productivity

Groundwater Depletion

Much water ran off quickly to the Arabian Sea rather than soaking in or being stored



Glacier and Snowpack Impact

Erratic flooding harms long-term climate resilience of region's glaciers and snowpacks by altering melt patterns

< 1,000

m³/year per capita
renewable water
(below scarcity
threshold)



Continuing decline in
water availability



Water stress despite
flooding

Socio-Economic Impacts



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Mass Displacement

Thousands of villages inundated, displacing **millions of people**, with some provinces reporting 500,000+ displaced at peak



Agricultural Devastation

Millions of acres of **cotton, rice** and other kharif crops waterlogged, threatening next season's yields



Livestock Losses

Significant livestock deaths and ruined standing crops drove up food prices, pushing rural families toward food insecurity



Health and Education Crisis

Stagnant floodwaters led to **disease outbreaks** (diarrhea, dengue). Damaged hospitals and schools left communities vulnerable

10-15%

GDP impact (similar to 2022 floods)

~\$15B

Estimated economic damage



Child malnutrition and education disruption

Comparison with 2022 Floods



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🕒 2022 Floods

- 👥 Affected ~33 million people
- 📖 Inundated ~1/3 of country's land area
- 💰 Wiped out 10-15% of GDP (~\$15 billion)
- ⚠️ One of the **worst** in Pakistan's history



🔄 2025 Floods

- 👥 Displaced **millions** (500,000+ in some provinces)
- 📖 **Smaller scale** than 2022 but still widespread
- 💰 Expected to **similarly strain** government budgets
- ⚠️ Confirmed **ongoing vulnerability** to monsoon extremes



💡 Key Similarities & Lessons

Both events linked to **climate-driven monsoon extremes**. Lack of preparedness – from weak embankments to inadequate social safety nets – turned heavy rains into disasters. Experts warn that without addressing underlying causes (warming climate, deforestation, inadequate planning), such costly floods will **recur more frequently**.

Water Conservation and Capture Strategies



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Rainwater Harvesting

Investing in **rooftop and roadside collection systems** in urban and rural areas to divert runoff into local ponds or recharge wells



Floodwater Retention Basins

Piloting small retention basins ("**talaabs**") in Punjab and Sindh to capture excess flows for later use during dry seasons

Small Dam Revival

Expanding small dams (< **50 MW capacity**) that serve dual purposes of irrigation and flood control



Irrigation Canal Rehabilitation

Rehabilitating old irrigation canals to **reduce seepage** and improve water distribution efficiency



Groundwater
recharge



Water storage
capacity



Drought mitigation

Infrastructure Improvements



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Major Dam Projects

Diamer-Bhasha and **Mohmand dams** in pipeline to help regulate river flows and provide multi-purpose storage



Urban Drainage Upgrades

Cities like Karachi investing in **bigger drains** and pump stations to prevent urban inundation during heavy rainfall

Embankment Reinforcement

Repairing and raising embankments along the **Indus River** and its tributaries through Federal Flood Protection program



Nature-Based Solutions

Reforestation in upper catchments, restoring wetlands and mangrove forests along the coast, preserving natural flood plains



Enhanced flood protection



Hydropower generation



Biodiversity conservation

Policy and Governance Reforms



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Water Agreement Updates

Modernizing **Water Apportionment Accord** and **Indus Water Treaty** to reflect changing river flows under climate change



Floodplain Zoning Enforcement

Preventing settlements and critical infrastructure construction on high-risk riverbeds to reduce flood vulnerability



Water-Saving Regulations

Implementing water-pricing and efficiency measures to curb waste in agriculture, which uses **~90%** of water with up to half lost in transit



Disaster Management Enhancement

Strengthening **NDMA/PDMAs** and community-based early warning systems to provide more time for evacuation and preparation



Dedicated "flood buffer fund"



Mandatory flood insurance



Community resilience

Climate Resilience and Adaptation



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Crop Diversification

Implementing **flood-resistant agricultural practices** like salt-tolerant rice varieties in coastal Sindh to reduce future losses



Research Investment

Pakistan Council for Research in Water Resources focusing on **efficient irrigation** (drip/sprinkler systems) and groundwater recharge techniques



Education & Livelihood Programs

Training flood-affected communities in **alternative livelihoods** like aquaculture or wetland farming in flood-prone areas



Integrated Solutions

World Bank, UNDP, WMO emphasize coupling **infrastructure with nature-based** and community solutions for best outcomes



Environmental
sustainability



Water security



Community resilience

Key Findings

-  **Extreme monsoon rains** combined with systemic vulnerabilities caused severe flooding
-  **Climate change** intensifies rainfall and increases flood frequency
-  Environmental degradation and inadequate infrastructure worsened impacts
-  Millions displaced, agriculture devastated, economy strained

Strategic Priorities



-  **Capture and store** floodwater for drought periods
-  Upgrade water infrastructure with nature-based solutions
-  Enforce prudent land use policies and zoning regulations
-  Build climate resilience at all levels of society

Future water security depends on turning floods from a **hazard** into a **resource**