

# PAKISTAN AT THE FLOOD TIPPING POINT

Systemic Risk, Climate Breakdown  
and the Pathway to Resilience



## WHY THIS REPORT MATTERS

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Pakistan ranks among the world's most climate-vulnerable countries, and this report argues that it may now have reached a dangerous tipping point.

This multi-authored, multidisciplinary report shows that without urgent, strategic, and effective action, Pakistan risks crossing a threshold beyond which increasingly erratic and compounding water-related disasters, heatwaves, droughts, accelerated glacier melt, and wider ecological breakdown will cause deeper and more sustained national harm.

These risks are no longer abstract. Recent catastrophic floods have already shown the scale of devastation and the science, data, and analysis brought together in this report make clear that the danger is real and escalating. The implications go far beyond environmental damage. Pakistan now faces severe and interconnected risks to development, food and water security, public health, economic stability, and national security.

Extreme weather events do not only destroy homes, crops, roads, and public infrastructure. They contaminate water, spread pollutants through soils and food systems, damage ecosystems, harm human health, reduce productivity, and weaken economic resilience. In a country already facing rapid population growth, constrained resources, fiscal pressure, and rising geopolitical instability, shocks of this scale cannot be absorbed indefinitely.

This report shows that Pakistan is inadequately positioned to confront these risks. The gaps are structural and severe. Financially, spending on adaptation and resilience has remained only a very small fraction of defence spending, despite cumulative economic losses from floods since 2010 being broadly similar in scale to defence spending. Institutionally, the report identifies a system that remains fragmented, reactive, and poorly aligned to the risks now unfolding: weak enforcement, floodplain encroachment, poor data-sharing, underinvestment in prevention, political distortion, and repeated failure to convert lessons

including those identified in formal and internal assessments into reform.

This report brings together expert insight, systems analysis, hydrology, climate science, governance review, adaptation strategy, community resilience, and environmental risk to explain why Pakistan is so critically exposed and what must now be done to protect it in the short, medium, and long term. It considers each of these elements through a systems lens to show how they interact and reinforce one another. It is not intended to be an exhaustive treatment of every issue in isolation, but to bring the scientific, institutional, environmental, and strategic dimensions together in support of effective action.

The report also makes clear that even effective domestic action will not be enough on its own. Pakistan shares river systems, cryosphere influences, atmospheric systems, and ecological linkages with neighbouring countries. Transboundary cooperation is therefore essential. Without stronger coordination, data-sharing, and ecological cooperation across shared systems, even the best internal reforms will remain constrained. Protecting ecosystems the foundation of life, resilience, and economic stability requires cooperation both within Pakistan and beyond its borders.

This report concerns everyone, because everyone is a stakeholder: government, public institutions, businesses, economists, national strategists, international experts, development partners, multilateral bodies, researchers and the wider public. It shows that Pakistan needs more than minor adjustment; it needs a strategic reset, and that reset must be discussed, funded, and implemented at every level. Without an informed plan and urgent call to action, Pakistan risks losing control of its ability to protect its people, economy, and ecosystems from the worst impacts of climate change and disaster. That is not simply an environmental danger. It is a national emergency and a national security risk.

## EXECUTIVE SUMMARY

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Pakistan's flood crisis is no longer a story of periodic natural disasters. It is the result of intensifying hydroclimatic extremes interacting with fragmented governance, high-risk development patterns, degraded ecosystems, repeated failures to convert lessons into reform, and a wider regional hydrological context in which upstream climate impacts and weak transboundary cooperation can amplify downstream risk in Pakistan.

The central finding of this report is that floods become disasters not simply because rainfall is extreme, but because risk is amplified across a system that is structurally exposed on multiple levels, institutionally disjointed, environmentally degraded, and exposed to interconnected and compounding risks.

The scale of the challenge is national in every sense: humanitarian, ecological, fiscal, and strategic. Between 2010 and 2025, cumulative flood losses are estimated at approximately US\$80-85 billion. The 2022 floods alone caused around US\$30 billion in damage and losses and generated US\$16.3 billion in resilient reconstruction needs. The 2025 floods added a further major shock, with losses estimated at approximately PKR 822 billion (US\$2.9 billion) and a projected reduction in GDP of 0.5-1.0%. These repeated shocks are not isolated events; they are systemic disruptions that undermine development, strain public finances, damage infrastructure, destabilise food systems, and erode long-term national resilience.

Crucially, these risks do not operate independently. They interact to produce compound and cascading impacts, where climate hazards, environmental degradation, governance failures, transboundary information deficits, and socioeconomic vulnerability reinforce one another. This report is therefore structured to move from diagnosis to solution, examining how these interacting forces shape outcomes and how they can be addressed through integrated reform.

The report begins by framing Pakistan's flood crisis as a systems problem (Chapter I). It shows that outcomes are shaped by the interaction of five interdependent subsystems: hydrology and environment, institutions and governance, socioeconomic and land-use dynamics, information and decision-making, and community resilience. Flood losses, urban inundation, infrastructure stress, and weak recovery are not isolated failures but recurring outcomes of reinforcing feedback loops. This systems perspective underpins the entire report and provides the analytical framework through which subsequent chapters interpret risk and identify leverage points for change.

Building on this foundation, Chapter II examines why floods become disasters by tracing both physical and human drivers. Pakistan experiences multiple flood types: riverine, flash, urban, glacial lake outburst floods,

cloudburst-induced floods, and coastal flooding all of which are intensifying as climate change alters rainfall patterns, moisture pathways, monsoon dynamics, and cryosphere behaviour. Large-scale climate drivers such as La Niña, the Indian Ocean Dipole, and land-sea thermal contrasts interact with local anthropogenic pressures including deforestation, biomass burning, urbanisation, and the expansion of irrigated agriculture. These intensifying hazard dynamics interact directly with the systemic vulnerabilities identified in Chapter I, transforming natural events into large-scale disasters.

Chapter III then examines the institutional dimension of this system. It shows that Pakistan's flood governance architecture is fragmented across federal, provincial, and local levels, with overlapping mandates, weak accountability, and inconsistent implementation. Critical functions including water management, infrastructure development, disaster response, and climate policy operate in silos that do not consistently align. This institutional fragmentation is a key mechanism through which the systemic risks identified in earlier chapters translate into real world disaster outcomes. The issue is not a lack of institutions, but a lack of coherence, coordination, and sustained implementation.

Chapter IV places these dynamics in historical, political, and regional context, demonstrating how Pakistan has become locked into a recurring cycle of loss and incomplete reform. Across major flood events 2010, 2022, and 2025 failures are repeatedly identified, yet structural change remains partial and uneven. Attribution science shows that climate change is already increasing the intensity and likelihood of extreme events, further raising the stakes. The chapter also highlights the transboundary dimension of flood risk: Pakistan and India are ecologically linked through shared river basins, the Hindu Kush-Karakoram-Himalaya cryosphere, deserts, and monsoon systems, yet they lack the scientific collaboration, real-time data exchange, and early warning cooperation needed to reduce downstream damages. The report argues that regional cooperation failure is not a secondary issue but a measurable amplifier of Pakistani flood losses.

The report then shifts toward solutions. Chapter V advances an adaptation-centred framework, arguing that Pakistan must move beyond the historic paradigm of attempting to control floods through rigid infrastructure alone. Instead, it calls for a more integrated approach that combines improved early warning systems, climate-informed planning, selective structural protection, and ecosystem-based measures such as floodplain reconnection and watershed restoration. This represents a shift away from the reactive patterns described in earlier chapters toward a more preventive and adaptive model of risk management.

Chapter VI builds on this by demonstrating the central

role of community-based disaster risk management. In many high-risk areas, communities are the first responders, yet local preparedness remains uneven and under-resourced. In the context of institutional limitations highlighted in Chapter III, community-based approaches are not supplementary; they are essential components of national resilience. Strengthening local capacity through training, early warning access, local planning, and integration with formal systems can significantly reduce disaster impacts and support more effective recovery.

Chapter VII adds a critical but often overlooked dimension by showing that floods are also pollution-redistribution events. Environmental contaminants including black carbon, particulate matter, chemical pollutants, and nano/microplastics are mobilised, transported, and concentrated during flood events, amplifying risks to ecosystems, agriculture, water systems, and human health. Black carbon contributes to cryosphere destabilisation, while particulate pollution can influence atmospheric processes and rainfall patterns. Emerging evidence on nano/microplastics raises particular concern because of their capacity to penetrate biological barriers, transport adsorbed toxins, and accumulate within human tissues. The chapter demonstrates that pollution is not a separate environmental issue, but a cross-cutting risk amplifier that interacts with hydrological processes, climate dynamics, and human exposure pathways. It therefore reinforces the need to integrate pollution control, clean air policy, and environmental health into flood-risk governance.

Taken together, the chapters reveal a consistent and urgent conclusion: Pakistan's flood crisis is driven by compound and cascading risks within a fragmented system. Climate change is

intensifying hazards, but it is the interaction with environmental degradation, institutional misalignment, transboundary cooperation deficits, and socioeconomic exposure that transforms these hazards into disasters. Addressing any one of these elements in isolation will be insufficient. Effective risk reduction requires integrated action across all parts of the system.

The report therefore calls for a fundamental shift from reactive disaster response to integrated flood-risk governance. This includes mainstreaming climate-risk assessment into infrastructure planning, enforcing floodplain management, strengthening institutional coordination, modernising early warning systems, prioritising maintenance, scaling community resilience, restoring ecosystems, integrating pollution and environmental health into national resilience strategies, and strengthening regional technical cooperation on data-sharing, forecasting, and shared hydrological risks. Flood risk must be treated not as a sectoral issue, but as a core national priority linked to economic stability, public health, environmental sustainability, and national security.

Pakistan does not lack knowledge. The science is clear, the risks are understood, and this report adds further insight into their interconnected and amplified nature. Lessons have been repeatedly identified; what is now required is decisive, coordinated action at scale. Without it, the country will remain locked in a cycle of escalating loss. With it, Pakistan has the opportunity to move toward a more resilient, adaptive, and secure future. The window for that transition is narrowing



# INTRODUCTION

## Background, Economic Context and Rationale

From the 2010 Indus Basin floods to the most recent major flood event in 2025, Pakistan has faced several major flood disasters that have claimed thousands of lives and left entire landscapes devastated. Across just these fifteen years, total flood-related loss and damage is estimated at approximately US\$80–85 billion. To put that in perspective, Pakistan's total GDP in 2025 was around US\$410 billion, meaning that cumulative flood losses over this period amount to roughly 20% of one year's GDP. This is an extraordinary economic burden for any country and demonstrates how deeply climate-linked disasters are already affecting Pakistan's development trajectory.

The comparison with national spending priorities is equally striking. Pakistan's total federal budget for FY2025–26 was PKR 17.57 trillion (about US\$62 billion), of which the federal defence budget accounted for PKR 2.55 trillion (about US\$9 billion), or 14.5% of the total federal budget. Defence spending was equivalent to approximately 1.9% of GDP. Yet climate resilience, disaster management, and flood protection receive only a small fraction of that level of support, despite the fact that the danger from recurrent flood disasters is far more certain and immediate than the outbreak of war. Over the period from 2010 to 2025, Pakistan has lost almost the same broad order of magnitude to floods as it has spent on defence, while spending on disaster prevention and climate resilience has remained only a very small proportion of defence expenditure.

This comparison is not intended to diminish the importance of defence. Rather, it highlights a strategic imbalance. Flood management, watershed restoration, resilient infrastructure, and early warning systems are not peripheral environmental concerns; they are core national security priorities. If Pakistan continues to underinvest in prevention while repeatedly absorbing catastrophic losses, it will remain trapped in a cycle of destruction, reconstruction, and declining resilience.

This pattern is reflected in the available financial data. Estimated total defence spending between 2010 and 2025 stood at approximately PKR 20–22 trillion (around US\$90–100 billion), while total flood losses over the same period reached roughly US\$80–85 billion, bringing them close to parity in strategic scale. By contrast, total spending on disaster preparedness and climate adaptation over the same period is estimated at only PKR 500–700 billion (about US\$2–3 billion), or around 3% of defence spending. Average annual flood protection spending has been in the range of PKR 25–40 billion, largely through provincial irrigation and flood protection programmes. Federal disaster management allocations have remained minimal, with the National Disaster Management Authority operating on roughly PKR 2–5 billion annually, while provincial disaster management budgets have generally remained in the range of PKR 10–15 billion annually, limiting both preparedness and capacity-building.

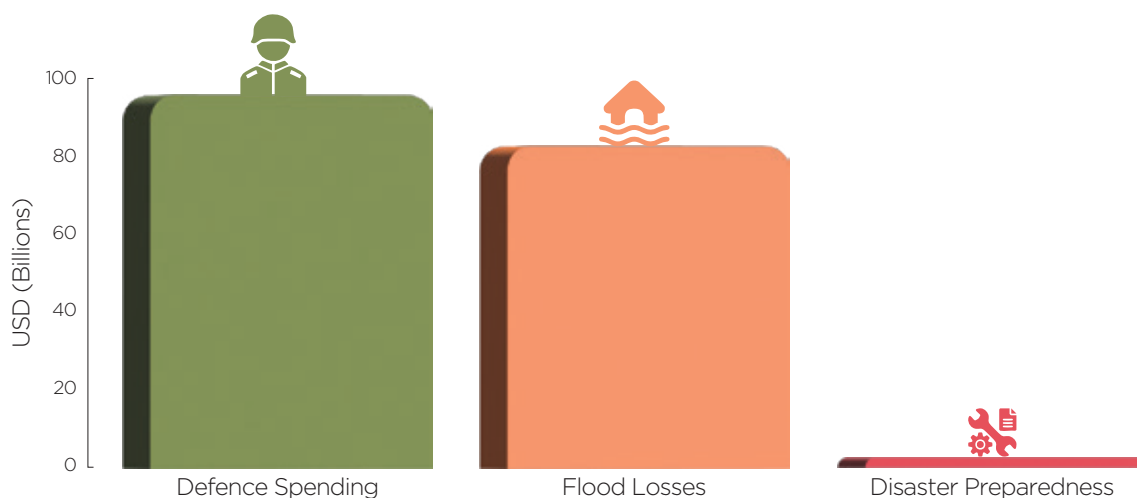


Indicator	Estimated Amount	Share / Comparison	Key Notes
Total Defence Spending (2010 - 2025)	PKR 20-22 trillion (≈ \$90-100 billion)	Baseline reference	Defence budget increased from PKR 442 billion in 2010 to about PKR 2.55 trillion by 2025.
Total Flood Losses (2010-2025)	≈ \$80-85 billion	Nearly equal to total defence spending	Includes major flood disasters in 2010, 2011, 2012-2015, 2022, and 2025.
Disaster Preparedness & Climate Adaptation Spending	PKR 500-700 billion (≈ \$2-3 billion)	~3% of defence spending	Includes spending on flood protection, climate resilience, and disaster management institutions.
Average Annual Flood Protection Spending	PKR 25-40 billion	Minimal national allocation	Mainly through provincial irrigation and flood protection programs.
Federal Disaster Management Budget	PKR 2-5 billion annually	PKR 2-5 billion annually	Managed by the National Disaster Management Authority.
Provincial Disaster Management Budgets	PKR 10-15 billion annually	Limited capacity building	Implemented through Provincial Disaster Management Authorities.

The wider economic burden is also severe in event-specific terms. The 2022 floods caused around US\$30 billion in damage and losses and generated US\$16.3 billion in resilient reconstruction needs under the Post-Disaster Needs Assessment. The 2025 floods alone caused losses estimated at Rs 822 billion (about US\$2.9 billion) and were expected to reduce GDP by 0.5-1.0%. Seen in this light, flooding in Pakistan is not a marginal

environmental issue. It is a recurring macroeconomic shock. Public resources are repeatedly diverted into relief, repair, and reconstruction. Productive assets are destroyed. Agriculture and transport systems are disrupted. Housing losses deepen social vulnerability. And because rebuilding often occurs within or near the same exposure zones, the country too often restores risk rather than reducing it.

## Pakistan: Defence spending vs Flood Losses vs Preparedness (2010- 2025)



This report has been prepared because Pakistan can no longer afford to treat floods as isolated emergencies or unavoidable acts of nature. It is an evidence-based report that examines the facts and the structural reasons behind Pakistan's recurrent flood crises, which are causing billions of dollars in damage to the economy as well as immense human suffering. It asks not only why these disasters keep happening, but how such astronomical losses can be prevented. At its core, the report argues that adaptation to climate change is not optional; it is essential if Pakistan is to reduce risk and vulnerability across a widening spectrum of natural hazards.

The broader framing is increasingly being recognised internationally. Governments are now seriously advancing assessments of biodiversity loss, ecosystem degradation, food insecurity, water disruption, health impacts, and climate-linked instability through a national-security lens, reflecting the reality that environmental breakdown can destabilise economies, supply chains, and social order. Recent international scientific and policy commentary has reinforced the same point from a water-security perspective: climate change and geopolitics are jointly threatening water systems, and the risk of disaster is real but not inevitable where institutions, cooperation, and long-term planning are strengthened. Pakistan should view recurrent extreme weather and ecosystem degradation with the same seriousness: not as isolated environmental concerns, but as systemic threats requiring proactive resilience planning.

The report begins from the premise that Pakistan's flood disasters are not inevitable. The country's exposure is shaped by a combination of intensifying climate hazards and human-made risk amplifiers. Climate change is increasing rainfall intensity, altering monsoon behaviour, and accelerating cryosphere change. At the same time, floodplain encroachment, rigid river engineering, degraded catchments, weak drainage, fragmented institutions, uneven enforcement, and underpowered local preparedness all magnify the impact of flood events.

That is why this report was assembled. Its purpose is not simply to document flood damage or repeat familiar warnings. It is to examine why the existing system remains fragmented and reactive, and to identify a more coherent pathway forward. The chapters that follow bring together systems analysis, hydrology, climate science, institutional review, adaptation strategy, community resilience, and environmental risk. Together they argue that Pakistan's flood challenge cannot be solved through isolated technical interventions or post-disaster response alone. It requires a proactive, systems-based approach that learns from past disasters, applies the best available global and emerging science, and builds stronger protective frameworks for the future.

A final principle underpins the report. Ecosystems are not secondary to resilience; they are part of its foundation. Rivers, wetlands, forests, upland catchments, floodplains, and coastal systems all help regulate water, reduce hazard, sustain livelihoods, and support long-term national survival. Where they are degraded, risk intensifies. Where they are protected and restored, resilience grows.

This report will therefore play a critical role in shaping discourse on why flood management is now central to Pakistan's national security. It is a call to decision-makers to prioritise much stronger disaster management, with the urgency, seriousness, and coordination normally reserved for national emergencies, and to reduce risk through building resilience before the next crisis strikes. The practical question running through the report is clear: how can Pakistan move from repeated disaster to more intelligent flood-risk governance? The answer it offers is not a single solution, but a more integrated one that links science, policy, planning, institutions, ecosystems, and communities in a more durable framework for resilience.

## The Cycle of Recurring Flood Loss and Systemic Failure



### Without systemic response, each flood reinforces the next

Figure 1. Cycle of Recurring Flood Loss and Systemic Failure in Pakistan

This figure illustrates how flood risk is reinforced through interacting systemic pressures, where climate change, institutional fragmentation, and reactive responses combine to reproduce vulnerability and economic loss over time.

