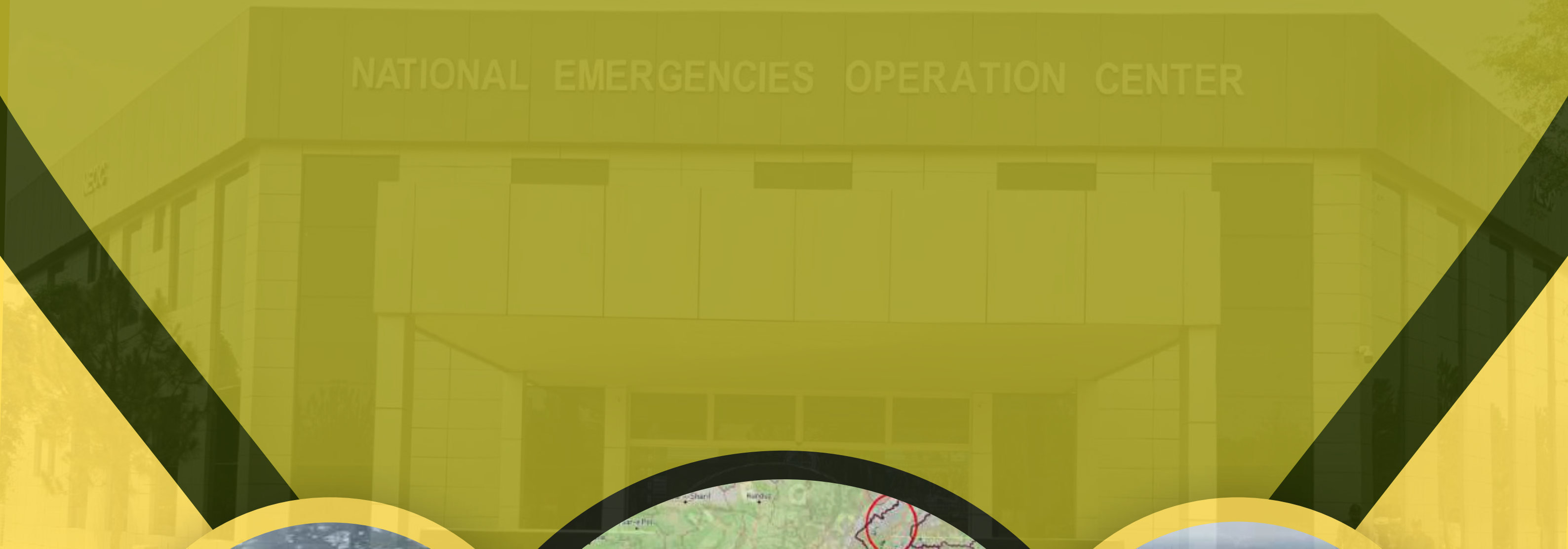
POST MONSOON REVIEW

2025



National Disaster Management Authority

National Institute of Disaster Management

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Table of Contents

ACRONYMS

AJ&K	Azad Jammu and Kashmir
AI	Artificial Intelligence
CBDRM	Community-Based Disaster Risk Management
GB	Gilgit-Baltistan
GLOF	Glacial Lake Outburst Flood
KP	Khyber Pakhtunkhwa
NDC	Nationally Determined Contribution
NDMA	National Disaster Management Authority
NDRC	National Disaster Resilience Council
NFPP-IV	National Flood Protection Plan-IV
SDGs	Sustainable Development Goals

Executive Summary

Pakistan's evolving monsoon regime has become increasingly volatile, with the southwest monsoon responsible for up to 75% of annual rainfall showing erratic onset, shortened duration, and intensified precipitation clusters. Historical flood records from 1950–2025 reveal recurring structural and governance weaknesses, including sedimentation, embankment failures, and unregulated floodplain encroachments. The 2025 monsoon, marked by above-normal rainfall, riverine overflow, and compound flooding, further exposed deficiencies in drainage, forecasting, and adaptive water governance. Comparative analysis of the 2025 floods against the 2010 and 2022 events shows that while improved structural defenses reduced discharge magnitude, spatial inundation expanded due to prolonged rainfall, glacial melt, and urban drainage failures. Persistent issues such as fragmented institutional coordination and asymmetrical data-sharing across provinces hindered anticipatory response, underscoring the need for basin-scale flood forecasting, real-time telemetry, and integrated land–water management frameworks.

Preparedness and response gaps were evident across all ecological zones. In the northern highlands, early warning systems and slope stabilization remained inadequate, leaving remote communities dependent on emergency military assistance. The plains of Punjab continued to suffer from riverine and urban flooding, poor drainage, and delayed recovery measures, while Sindh's coastal and deltaic regions faced compounded challenges from desilting delays, mangrove loss, and overlapping jurisdiction. In Balochistan, the absence of hydro-meteorological infrastructure and logistical capacity prolonged humanitarian isolation. These systemic gaps reflect a lack of localized preparedness mechanisms and the need for community-driven disaster governance.

To address these challenges, a forward-looking resilience framework for 2026 calls for institutional reform through the establishment of a National Disaster Resilience Council and Provincial Resilience Forums to enhance coordination and accountability. It proposes localized AI- and drone-assisted early warning systems, resilient infrastructure such as floating schools and modular desalination units, and ecological restoration through mountain-to-delta corridor management. Livelihood and health resilience should be strengthened via fisherfolk insurance, floating hydroponics, climate-smart agriculture, mobile trauma care units, and community-based disaster training. Technological innovations including digital twin city simulations, crowdsourced mapping, and blockchain-based relief tracking can enhance transparency and predictive decision-making. Financial resilience must be bolstered through instruments like resilience bonds, risk pooling, and diaspora-backed catastrophe bonds, while capacity building should be institutionalized through the establishment of a Pakistan School of Resilience Studies—a consortium dedicated to disaster science, climate resilience, and leadership.

Moving forward, Pakistan must align its Monsoon Preparedness Plan 2026 with global frameworks including the Sendai Framework, Paris Agreement, Sustainable Development Goals, and National Flood Protection Plan-IV. This integration will ensure that resilience building becomes a continuous, institutionalized process rather than a project-based effort. Mobilizing international climate finance through the Green Climate Fund, Adaptation Fund, and Loss and Damage Fund will be essential for sustaining these reforms. By combining engineered defenses with nature-based solutions such as flood basins, canal lining, and watershed restoration—Pakistan can transition from cycles of post-disaster recovery toward anticipatory resilience, securing its people, ecosystems, and economy against future climatic extremes.

Section 1:
Legacy of Monsoon: Past Patterns and Consequences

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1.1 Monsoon Patterns in Pakistan & HKH

1.1.1 Seasonal Structure & Spatial Contrast

The southwest monsoon (June–September) delivers the bulk of Pakistan's summer precipitation. Based on recent NDMA/PMD analyses and climatological datasets, hhistorically, around 60–75% of annual rainfall in much of the country (especially the east/Indus plains) falls in this four-month window. The monsoon's penetration is spatially diverse: the eastern and central Indus Plains (Punjab, parts of Sindh) receive relatively heavier monsoon rainfall, while the western and southwestern arid zones receive much less.

In mountainous northern Pakistan, precipitation is more variable: the Himalaya, Karakoram, and Hindu Kush influence orographic uplift, leading to high rainfall in some catchments, but much greater inter-annual variability. Based on long-term station data and spatial interpolation (e.g., 1961-2020 data from 82 stations), annual rainfall across Pakistan ranges from ~50 mm in arid Balochistan downlands to over 1,700 mm in very wet north Himalayan foothills

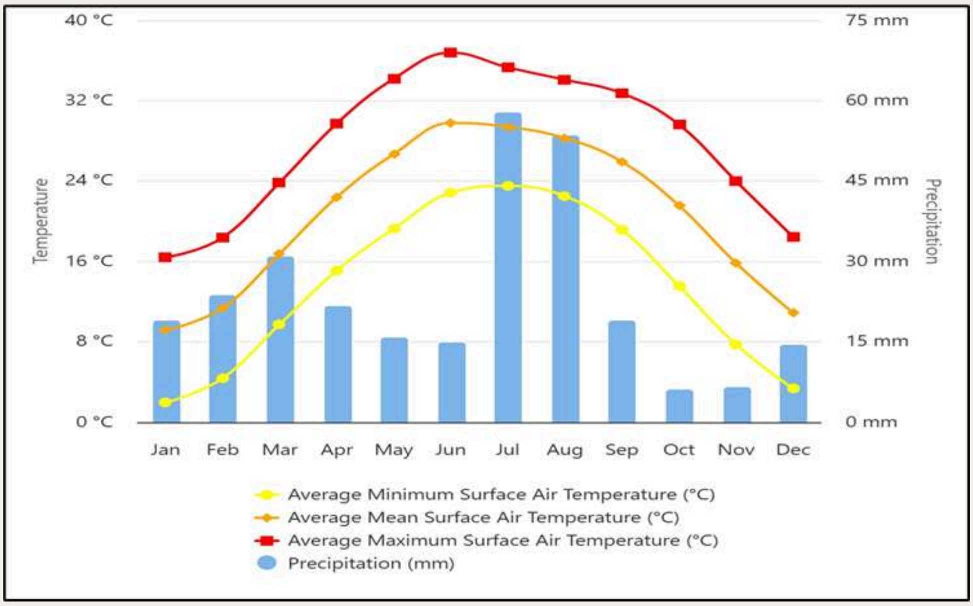


Figure 1: Observed Seasonal Cycle Average Minimum Surface Air Temperature, Average Mean Surface Air Temperature, Average Maximum Air Temperature, Precipitation Pakistan (1961-1990)

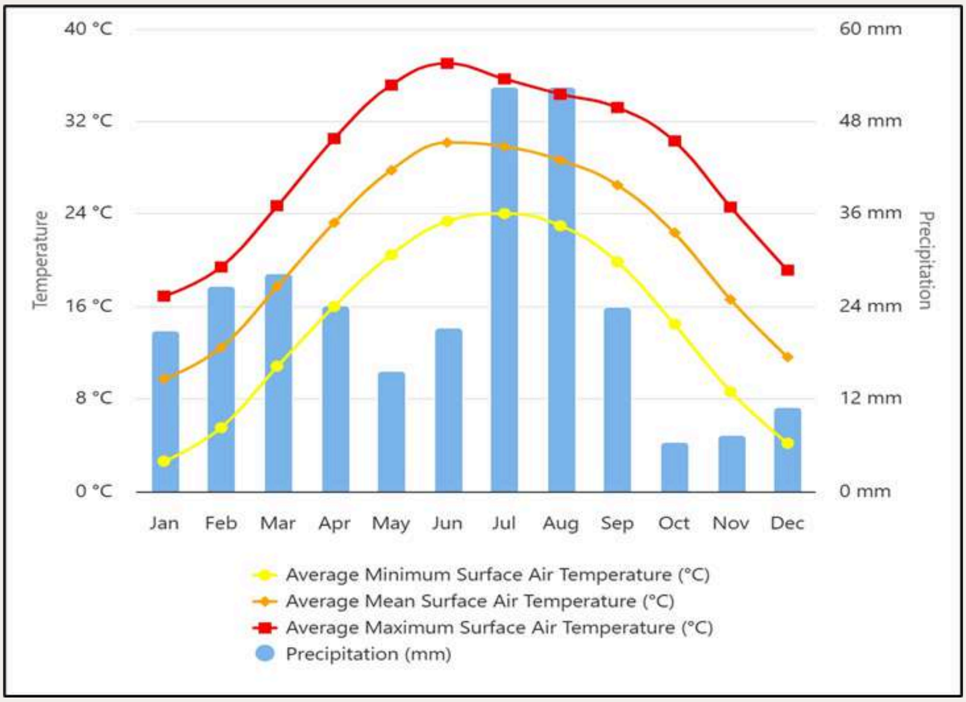


Figure 2: Observed Seasonal Cycle Average Minimum Surface Air Temperature, Average Mean Surface Air Temperature, Average Maximum Air Temperature, Precipitation Pakistan (1991-2020)

1.*1.2 Rainfall Patterns in Pakistan*

- Average annual rainfall Pakistan: 250-300 mm
- Northern Pakistan (HKH & UIB): >1000 MM/year, with winter snowfall (westerlies) and monsoon rainfall (summer) driving glacier-fed river flows.
- Central & Eastern Pakistan (Punjab & KP): 200-800 mm/year, with monsoon contributing 60-70%. Of rainfall in the east (Lahore, Sialkot, Islamabad), while the west gets moderate winter rainfall.
- Western & Southern Pakistan (Balochistan & Sindh): 100-300 mm/year mostly arid, Balochistan sees winter rainfall, while Sindh depends on erratic monsoons and coastal cyclones.
- Deserts (Thar & Cholistan): <150 mm/year, highly erratic rainfall, with occasional heavy monsoon showers but mostly hyper arid conditions

1.1.3 Long-term Trends and Shifts

Multiple observational studies and regional climate products identify a shift in monsoon character over the past two decades: the monsoon is becoming shorter but "flashier" — i.e., more rainfall concentrated in high-intensity, short-duration events with longer dry spells between systems. Trend analyses of daily extreme indices show statistically significant increases in heavy precipitation metrics across many monsoon months and subregions of Pakistan. Ullah et al. (2023) document increasing trends in daily monsoon precipitation extremes and demonstrate links to atmospheric circulation anomalies (subtropical jet variations, Rossby wave patterns) that modulate monsoon surges.

Hussain et al. (2025) and related work also report rising incidence of extreme precipitation events (EPEs) in the principal monsoon zones, with the signal strongest in areas the literature sometimes labels “R-II” (the monsoon-dominated eastern sectors). These observational signals are corroborated by modern reanalysis and satellite products.

At the same time, large-scale natural variability (e.g., Indian Ocean Dipole, ENSO, and teleconnection patterns) remains the dominant driver of year-to-year monsoon strength; however anthropogenic warming amplifies extremes by increasing atmospheric moisture availability (Clausius-Clapeyron scaling) when dynamic forcing is favourable. WMO and regional outlooks therefore characterize the monsoon as a hybrid system: natural modes determine timing and broad intensity, warming increases the probability and intensity of extreme rainfall episodes.

1.1.4 Changing Behaviour: Duration, Intensity, and Frequency of Systems

Three interrelated behavioural changes have emerged since 2000 and are relevant to flood risk management:

1. Shorter, more intense rainfall bursts (cloudbursts and heavy convective events) that produce devastating localized flash floods in steep terrain (mountain valleys) and rapid urban inundation in cities with poor drainage.
2. Higher incidence of successive synoptic systems repeated Bay-of-Bengal lows and monsoon depressions, sometimes interacting with mid-latitude western disturbances that provide compound rainfall totals and prolonged wet spells, increasing the risk of riverine flooding when catchments saturate.
3. Seasonal timing shifts occasional earlier onsets or delayed withdrawals have been observed regionally; forecasts for specific years (e.g., 2025) have correctly signalled earlier onset and above-normal totals in many sectors. Operational seasonal products (SASCOF/ICIMOD/WMO) have therefore become essential key reference tools for contingency planning

1.2 Impacts of Monsoon in Pakistan

Pakistan has experienced several major flood events in its post-independence history. Each has revealed both natural vulnerabilities and gaps in institutional readiness. Below is a concise timeline of the most impactful floods, their consequences, and lessons learned.

Table 1: Impacts of Floods in Pakistan (1950-2025)

Year	Region(s) Affected	Key Impacts	Lessons / Institutional Failures
1950	Punjab, Sindh	First large-scale catastrophic flood post-independence; thousands displaced; crops destroyed.	Earlier floodplain settlements lacked adequate embankments; minimal forecasting and response infrastructure.
1973 & 1976	Punjab, Sindh, NWFP (now Khyber Pakhtunkhwa)	Widespread damage to infrastructure and agriculture; major displacement.	Failure to build resilient infrastructure; lack of long-resting storage reservoirs; poor land use planning.
1992	Northern Punjab (Jhelum, Chenab)	Large flood flows; over 1,000 deaths; long-term displacement.	Weak early warning in tributary basins; riverbank erosion unmanaged.
2010 "Super-Flood"	Extensive swaths of the Indus Plain	~20 million people affected; ~2,000 deaths; breach of Tori Bund levee; major infrastructural destruction.	Importance of maintaining embankments; poor floodplain management; over-reliance on barrages without accounting for sediment buildup.
2011–2014	Sindh, Punjab, KP	Recurring flood damage; agricultural losses; health and sanitation crises in flooded zones.	Delay in relief and rehabilitation; inadequate drainage and floodwater evacuation infrastructure.
2020	Urban centers (Karachi, etc.)	Flash floods from intense monsoon rainfall; severe local damage.	Urban drainage systems overwhelmed; lack of urban planning for flood resilience.
2022 "Climate Catastrophe"	Nationwide, worst in Sindh & Balochistan	~33 million affected; over 1,700 lives lost; economic losses in the tens of billions.	Need for climate-adapted infrastructure; better land-use planning; stronger disaster governance.
2024–2025	KP, Punjab, Ravi/Chenab basins	Ongoing; large-scale displacement; infrastructure and agricultural damage; repeated lapses in rescue, drainage, and forecasting.	Gaps in early warning; infrastructure not durable; insufficient inclusion of vulnerable communities in planning.

Table 2: Major Flood Events Witnessed in Pakistan (FFC)

S.No	Year	Direct Losses (US$ Million) @1US$ = PKR 86	Lives Lost (NO.)	Affected Villages (No)	Flooded Area (Sq. km)
1	1950	488	2,190	10,000	17,920
2	1955	378	679	6,945	20,480
3	1956	318	160	11,609	74,406
4	1957	301	83	4,498	16,003
5	1959	234	88	3,902	10,424
6	1973	5,134	474	9,719	41,472
7	1975	684	126	8,628	34,931
8	1976	3,485	425	18,390	81,920
9	1977	338	848	2,185	4,657
10	1978	2,227	393	9,199	30,597
11	1981	299	82	2,071	4,191
12	1983	135	39	643	1,882
13	1984	75	42	251	1,093
14	1988	858	508	100	6,144
15	1992	3,010	1,008	13,208	38,758
16	1994	843	431	1,622	5,568
17	1995	376	591	6,852	16,686
18	**2010**	**10,056 @1US$ = PKR 86**	**1,985**	**17,553**	**160,000**

19	**2011**	3,730 @1US$ = PKR 94	s516	38,700	27,581
20	**2012**	2,640 @1US$ = PKR 95	571	14,159	4,746
21	**2013**	2000 @1US$ = PKR 98	333	8,297	4,483
22	**2014**	440 @1US$ = PKR 101	367	4,065	9,779
23	**2015**	170 1US$ = PKR 105.00	238	4,634	2,877
24	**2016**	6 1US$ = PKR 104.81	153	43	-
25	**2017**	-	172	-	-
26	**2018**	-	88	-	-
27	**2019**	-	235	-	-
28	**2020**	-	409	-	-
29	**2021**	-	198	-	-
30	**2022**	**30,000* 1US$ = PKR 225**	**1,739**	**6,631^**	**85,000`**
31	**2023**	-	226	-	-
Total		**68,225**	**15,199**	**203,704**	**701,558**

1.3 Impacts of Climate Change

Impacts of climate change on temperature, rainfall patterns, floods, glacial melting, droughts, water scarcity and on agriculture are briefly depicted below:

Table 3: Impacts of Climate Change

Temperature Trends	• Rise in Annual Mean Temperature: Pakistan has experienced a temperature rise of approximately 0.9°C since 1980 (PMD) • Extreme Heat Events: In 2022, Jacobabad and Nawabshah recorded temperatures exceeding 50°C, among the highest globally (WMO)
Rainfall Patterns	• Erratic Monsoon Trends: Monsoon rainfall in Pakistan has become increasingly unpredictable, with 175% above-normal rainfall observed in the 2022 monsoon season, leading to catastrophic floods (ADB) • Regional Variations: Sindh and Balochistan received 300-400% more rainfall than average during the 2022 floods (PMD)
Floods and Glacial Melting	• Flood Impacts: The 2022 floods displaced over 33 million people and caused losses exceeding US$30 billion, severely affecting agriculture and infrastructure (UNDP Report 2022) • Glacial Retreat: Pakistan's glaciers, located in the northern regions, are melting at an accelerated rate, with 2,500 glacial lakes now identified as a risk for Glacial Lake Outburst Floods (GLOFs) (International Centre for Integrated Mountain Development)
Drought and Water Scarcity	• Recurring Droughts: Balochistan and Sindh have experienced prolonged drought periods, with 40% of the country's land area now classified as arid or semi-arid (NDMA) • Declining Water Resources: Pakistan is approaching absolute water scarcity with per capita water availability dropping to 860 cubic meters in 2022, down from 5,200 cubic meters in 1951 (PCRWR)
Agricultural Impacts **i) Yield Reductions** **ii) Flood Induced Losses**	• Wheat yields have declined by 15% in certain areas due to reduced winter rainfall and rising temperatures. • Rice yields in Sindh have dropped by 20% due to water shortages during the growing season. (FAO Report 2023) • Over 4.4 million acres of crops were destroyed during the 2022 floods, including cotton, rice, and sugarcane. (PDNA-2022)
Climate Variability	• Increase in Extreme Events: The frequency of extreme weather events, including heatwaves, floods, and droughts, has increased by over 25% in the last two decades. (Global Climate Risk Index 2023)

1.4 Historical and Contemporary Shifts in River Flows

1.4.1 Indus & Ravi

Rivers are dynamic systems, their beds and channels shift across centuries due to erosion, sedimentation, avulsion (a sudden cutting off of land by flood, currents, or change in course of body of water), , and human interventions. In Pakistan, the Indus and Ravi rivers provide two important case studies: the Indus as a mega-river with catastrophic avulsions, and the Ravi as a smaller, human-modified river with meander shifts. Understanding these dynamics helps agencies such as National Disaster Management Authority (NDMA) plan for floods, manage risks, and align disaster preparedness with historical river behaviour. It aims, “To coordinate and implement comprehensive disaster risk management in Pakistan, ensuring preparedness, timely response, and resilience against natural and man-made hazards.”

The Indus and Ravi rivers highlight how riverbeds shift over time, influenced by both natural dynamics and human interventions. For NDMA, awareness of historical channels, embankment vulnerabilities, and reduced river capacity is essential. The 2010 Indus flood showed the danger of ignoring ancient channels; the Ravi illustrates how treaties and reduced flows reshape river systems. Effective disaster preparedness therefore requires combining history, science, and local knowledge.

1.4.2 Indus and Sutlej

The Sutlej River originates in western Tibet in the Kailas Mountain Range, near the source of the Indus, the Ganges and the Bramaputra Rivers. It travels through the Panjal and Siwalik Mountain Ranges and enters the plains in Punjab State of India. The River flows into Punjab Province in Pakistan near Ferozepur and eventually joins the Chenab River about five km upstream from Panjnad Barrage. It is the longest of the Punjab rivers (NFPP-I, 1978, Supporting Volume-II). and 70% of high floods have occurred in the month of August. Snowmelt in the upper reaches of the basin occurs during March and April, but does not generate substantial flood flows.

Floods in the Sutlej River in Pakistan result from excessive rainfall in the catchment area in India besides excessive releases from Indian reservoirs upstream in India during the monsoon season. Storm depressions generally originate in the Bay of Bengal.

Historically, the Sutlej River has served as a cradle for civilizations, influencing early Indus Valley settlements and continuing to nourish regions through the Vedic, Mughal, and colonial eras. The river's course has been significantly altered by tectonic shifts, originally flowing southeast into the Ghaggar-Hakra system before changing to its current southwest path into the Indus River Basin. Modern history is marked by its extensive use in irrigation through projects like the Bhakra Dam, and the 1960 Indus Waters Treaty, which allocated its waters to India for irrigation and hydropower.

The most significant contemporary factor is climate change, which affects the flow of both the Sutlej and the Indus. Because the Sutlej and other Indus tributaries originate from glaciers, melting of these glaciers and changes in snow patterns can dramatically alter river flows, impacting downstream water supplies. These changes in high and low flows can compromise high-water demand in summer, leading to reduced crop yields and electricity generation in affected regions. The transboundary nature of the Indus and Sutlej rivers, flowing through China, India, and Pakistan, makes changes in their flow a critical factor in regional stability and cooperation, especially in the context of the Indus Waters Treaty. Water availability is crucial for agriculture, which is heavily dependent on these rivers. Shifts in flow also impact water-intensive industries in Pakistan, affecting the national GDP.

1.4.3 Indus and Chenab

The Chenab River originates in Kulu and Kangra Districts of Himachal Pardesh Province of India. The two chief upper streams of the Chenab River - the Chandra and the Bhaga, rise on opposite side of the Baralacha pass at an elevation of about 16,000 ft and join at a place Tandi in Jammu and Kashmir State nearly 9,090 ft above mean sea level (msl). From this junction for a distance of about 170 km , the valley of the river is surrounded by the mountains of the great Himalaya and Pir Panjal Ranges. Then it makes almost a right angle turn and flows through a gorge crossing Pir Panjal and leaves the mountains near Aknhur, after covering a distance of about 500km. The river enters Pakistan territory in Sialkot District near Diawara village.

Historically, the Chenab River was known as Asikni in ancient Sanskrit texts, was a central feature of the Vedic period, and was crossed by Alexander the Great in 325 BCE, who established Alexandria on the Indus near its confluence with the other major rivers. The river's historical course has shifted significantly, most notably before 1245 CE and again by 1397 CE, when it moved west of Multan. Culturally, it serves as a setting for the famous Pakistani folktale of Sohni and Mahiwal and remains a vital resource for irrigation and hydroelectric power in India and Pakistan.

Historically, both the Indus and Chenab rivers underwent significant course shifts over centuries, influencing settlements like the Indus Valley Civilization and the historical city of Multan. Contemporarily, river flow patterns in the Upper Indus Basin are shifting due to climate change, with some areas seeing decreased high flows while others, like the glacier-fed Shigar and Shyok basins, experience increases. Political disputes and the Indus Waters Treaty (IWT) also impact water availability, with recent events showing India reducing flows into the Chenab River. The Indus River has a long history of course changes, particularly from southern Punjab to its delta, moving generally westward. Evidence shows a significant shift westward in northern Sindh of 15-30 km over the last seven centuries. The Chenab's course has also shifted significantly; before 1245, it flowed east of Multan, but by 1397, it had shifted to the west of the city. The ability of rivers like the Indus and its tributaries to shift courses played a role in the rise and fall of settlements. Under the framework of the IWT, India is undertaking construction projects (Ratle Dam) on Chenab, which has led to objections from Pakistan and instances of reduced water discharge by India without prior notice.

1.4.4 Indus and Jhelum

The Jhelum River rises in the Kashmir Valley and passes through the town of Srinagar and Wullar Lake. In this valley the river is navigable for about 140 km. At Baramula, where the elevation is nearly 5,000 ft above mean sea level (msl), the Jhelum is confined to a narroe gorge. After it is joined by its main tributary - the Kishan Ganga, the Jhelum River at Muzaffarabad in AJ&K turns and flows south to Mangla Reservoir. Leaving the Reservoir, the river flows into the Punjab plains until it reaches the Chenab River at Trimmu.

The major portion of the catchment area above Mangla Dam lies below 12,000 ft msl. Snowmelt runoff occurs from February reaching a peak usually in March. The severest floods, however, result from heavy rainfall in the catchment area during the monsoon season of July to September. Nearly 44% of high floods occur in July, 40% in August and 16% in September.

The Jhelum River has played a crucial role in the history of the Indian subcontinent, most notably as the site of the Battle of the Hydaspes 326 BCE between Alexander the Great and Raja Porus, and for its spiritual significance to the local communities of Kashmir. Historically, the Jhelum may have had a different course, possibly flowing southeast into the Chenab valley, and its waters have been vital to the Indus Basin Irrigation System (IBIS), which continues to be a major source of irrigation in the region.

Historical and contemporary river flow shifts in the Indus and Jhelum systems are driven by a complex interplay of climate change, glacier melt, monsoon variability, and by dams and reservoirs. While historically stable, the systems now see increased extreme events, with high flows decreasing in many areas but increasing in others, and low flows becoming more pronounced in summer months due to greater evapotranspiration and reduced summer precipitation. These shifts impact water availability, threatening agricultural output and electricity generation, and require adaptive water management. Historically, the Indus River system, including its tributaries like the Jhelum, provided a relatively stable flow pattern. The construction of Tarbela Dam on Indus and Mangla Dam on Jhelum has significantly impacted river regulation and flow.

1.4.5 Indus River: A Shifting Giant

The Indus River, one of the mightiest and the largest rivers of the world, originates in a spring called Singikabad near Mansarower Lake on the north side of great Himalaya Range in Kailas Parbatin Tibet at an altitude of 18,000 ft. Above mean sea level (msl). In a course of about 1,250 km upto Tarbela there are five right bank and three left bank tributaries.

The Indus transports one of the world's largest sediment loads. Sediment deposition raises riverbeds over time (aggradation), lowering flood-carrying capacity (Gaurav et al., 2011). Multiple barrages (Guddu, Sukkur, Kotri) and embankments restrict natural migration. While these protect farmland and cities, they increase pressure on levees and reduce the river's ability to self-adjust. In August 2010, a breach at the Tori Bund near Guddu Barrage diverted Indus floodwaters into an older paleochannel (an ancient, now inactive, river channel that has been buried by younger sediments. Also known as an ancestral channel, it is a geological feature that provides valuable clues about past environments, can act as a natural aquifer for storing and transmitting groundwater, and may contain mineral deposits) west of the main course. This avulsion inundated about 8,000 km² of Sindh, displacing millions (Brakenridge et al., 2013). Morphological studies show bankline migration, changes between braided and meandering patterns, and sediment buildup reducing flood capacity by ~17.75% .

The Indus River has shaped history as the birthplace of the Indus Valley Civilization (c. 3rd millennium BCE), a Bronze Age society known for its urban planning and sophisticated metallurgy. Later, it became a crucial nexus for migration and trade, witnessed the rise of ancient kingdoms, and facilitated the spread of Islam into the subcontinent. In the 19th and 20th centuries, the British colonial era transformed the river system into the world's largest irrigation network, which was then divided between India and Pakistan, leading to the Indus Waters Treaty and ongoing challenges in water management.

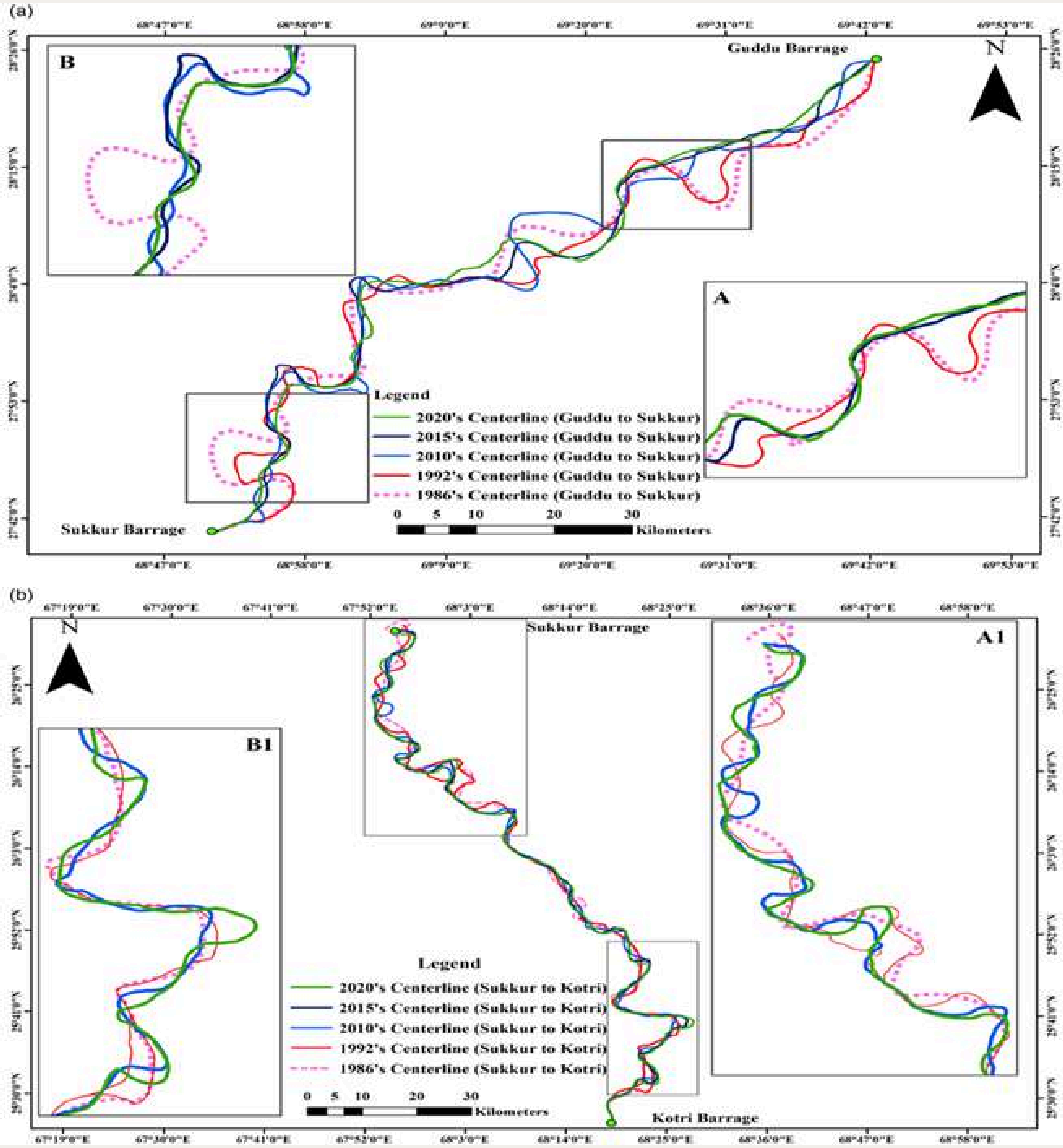


Figure 3: (a) Migration of channel centerline in 1986–2020. (a) is Ghotki reach bending. (b) is Rohri reach bending. (b) Migration of channel centerline in 1986–2020. (A1) bending from Sukkur to Kandiaro reach. (B1) bending from Saidabad to Sekhat reach.

1.4.6 Ravi River: A Smaller but Shifting Channel

The Ravi River is the smallest of the five Rivers that cross the Indus Plain in the Punjab. The upper catchment is hill or mountainous, lying in the Lesser Himalayan Mountains and the Himalayan Piedmont, primarily in India. The total length of the River River is about 780 km. The upper reaches flow through a mountainous basin bounded on the North by the Pir Panjal Range and on the South by Dauladhar Range, with a River slope of 17 per km upto Madhopur Headworks. From the Headworks to the Jassar Railway Bridge, the river slope averages about six ft per km, with the river more-or-less paralleling the India - Pakistan Border from a point about 20 km downstream of Madhopur. The River runs parallel to the border from another about 80km until it enters Pakistan about 30km above Lahore. The River then continues across the plain to its confluence with the Chenab at an average slope of less than one foot per km.

Flooding in the Ravi River Basin generally results from excessive monsoon rainfall, especially in the mountainous part of the catchment in India besides excessive releases from Indian reservoirs upstream in India during the monsoon season. Snowmelt makes no significant contribution to flood peaks on the Ravi River. The flows resulting from melting snow in the basin normally occur in the spring, falling off before the monsoon rains begin in June or July.

The Ravi River, while smaller, also demonstrates significant shifts. Satellite studies comparing 1970s–1990s show the Ravi’s channel migrated significantly, particularly near the India–Pakistan border in Amritsar and Lahore sectors. These shifts result from bank erosion and deposition processes.

1.4.7 Comparisons and Implications of River Flow Shifts

The Indus and Ravi rivers both illustrate that past channels remain highly relevant for contemporary flood management. During extreme floods, rivers may reoccupy abandoned paleo-channels, triggering large-scale inundations. Historical evidence demonstrates that channel migration and avulsion are strongly linked to high sediment loads, poorly maintained levees, and the presence of weak paleo-beds that act as preferential pathways for floodwaters.

In the case of the Indus, repeated episodes of avulsion such as the 2010 Tori Bund breach show how embankment failures can redirect flows into older floodplains, inundating thousands of square kilometres. Similarly, satellite-based analyses of the Ravi highlight significant channel shifts between the 1970s and 1990s, particularly near Amritsar and Lahore, driven by erosion–deposition cycles and reduced flows due to upstream infrastructure.

These dynamics underscore the persistent risks posed by sediment deposition and engineering interventions that restrict natural river migration. Incorporating both geomorphological insights and socio-political realities is essential. Effective flood governance must move beyond structural measures alone, emphasizing adaptive planning, ecological sensitivity, and community engagement.

1.5 Observed Dynamics and Attribution of 2025 Monsoon

1.5.1 General Overview

The 2025 monsoon brought widespread devastation across Pakistan, with the northern regions bearing the brunt of the impacts. Khyber Pakhtunkhwa (KP) was hit the hardest, where cloudbursts, flash floods, and landslides tore through multiple districts. More than 200 lives were lost, many others were injured, and dozens remained missing as homes collapsed or sustained severe damage. In Buner district alone, officials confirmed around 300 fatalities, prompting authorities to declare Buner, Bajaur, Battagram, and Mansehra as disaster-hit areas.

The scale of destruction was unprecedented. Torrential rains, overflowing streams, soil erosion, and landslides not only swept away communities but also blocked roads and disrupted basic connectivity in KP, Gilgit-Baltistan (GB), and Azad Jammu and Kashmir (AJ&K). In August NDMA reported deaths across KP from rains, floods, landslides, and lightning strikes, with Buner, Bajaur, and Battagram among the most severely impacted. Rescue operations were intensified with helicopters dispatched to hard-hit areas, while the provincial government released PKR 500 million in emergency funds for relief, including significant allocations to Buner, Bajaur, Battagram, Mansehra, and Swat.

The intensity of rainfall events created cascading crises. In late June, unusually strong pre-monsoon rains had already triggered flash floods and landslides in northern mountainous regions. By mid-August, back-to-back downpours led to catastrophic flooding and cloudbursts across KP, while on August 19, Karachi faced urban flooding that resulted in multiple casualties and widespread power outages. Toward the end of August, cross-border releases from Indian dams into the Sutlej, Ravi, and Chenab rivers pushed flood levels in Punjab to “exceptionally high limit,” forcing mass evacuations.

By the end of the monsoon, nearly 6.9 million people had been affected across Gilgit-Baltistan, KP, Punjab, and Sindh. (International Medical Corps; WFP). Floodwaters left behind widespread waterlogging, creating ideal breeding grounds for mosquitoes and sparking fears of a severe dengue outbreak in major cities such as Karachi, Lahore, Islamabad, Faisalabad, Sialkot, Rawalpindi, Peshawar, Sukkur, Hyderabad, and Multan, along with other flood-affected districts.

Experts attribute the growing frequency of cloudbursts partly to climate change, while the escalating damage from these events is also linked to unplanned development and fragile infrastructure in high-risk mountain areas.

1.5.2 Observed Behaviour & Anomalies

The 2025 monsoon season was marked by extraordinary climatic activity, characterized by exceptionally heavy rainfall across extensive regions of Pakistan. Multiple episodes of intense downpours occurred from late June through September, resulting in widespread hydrometeorological impacts. Occurrences of cloud bursts and GLOF incidents highlighted prominent visibility of climate change and its impacts. Satellite imagery from NASA and other Earth observation systems showed the extent of the crisis, capturing widespread flooding, shifting river courses, and marked changes in land reflectivity compared to long-term climatological patterns.

By mid-August 2025, relentless monsoon rains swept through Pakistan's northern mountains, unleashing flash floods and landslides that surged downstream with devastating force. Nearly 4 million people in eastern Punjab were affected, with about 2 million evacuated as more than 4,000 villages were submerged. In Lahore, floodwaters from the Ravi River inundated neighbourhoods and major roads, while along the Chenab, over 25,000 people were forced to flee Jalalpur Pirwala as nearby villages disappeared underwater. In eastern Punjab, the flooding was described by humanitarian agencies as the worst in the region's history, reflecting the extraordinary severity of the event. The floods devastated livelihoods, damaging around 12% of Pakistan's farmland and threatening major crops like rice, sugarcane, and cotton—posing serious economic and food security risks for the months ahead. Taken together, these observations highlight that the 2025 monsoon was not only extreme in intensity but also unusual in its spatial spread, impacting the plains, foothills, and mountainous regions alike.

The 2025 floods in Pakistan highlights significant provincial disparities in human losses and injuries as shown in figure 4. Punjab recorded the highest number of affected individuals, with 322 deaths and 665 injuries, followed by Khyber Pakhtunkhwa (KP) with 509 deceased and 218 injured. Sindh reported 90 deaths and 87 injuries, while Balochistan registered comparatively lower figures of 38 deaths and 5 injuries. Azad Jammu and Kashmir (AJ&K) reported 38 deaths and 57 injuries, whereas Islamabad Capital Territory (ICT) faced minimal impact with 9 deaths and 3 injuries. The causes of death indicate that flash floods were the most devastating factor, accounting for 43.2% of fatalities, followed by house collapses (25.2%) and other causes (13.8%). Drowning (7.9%), landslides, electrocution, lightning, and heavy rain contributed smaller proportions, reflecting the multifaceted hazards triggered by the floods. Overall, the 2025 floods resulted in severe human losses across multiple provinces, with Punjab and KP bearing the heaviest toll. Figure 5 shows that as a result of 2025 floods a total of 16,332 livestock and 217,194 houses were damaged.

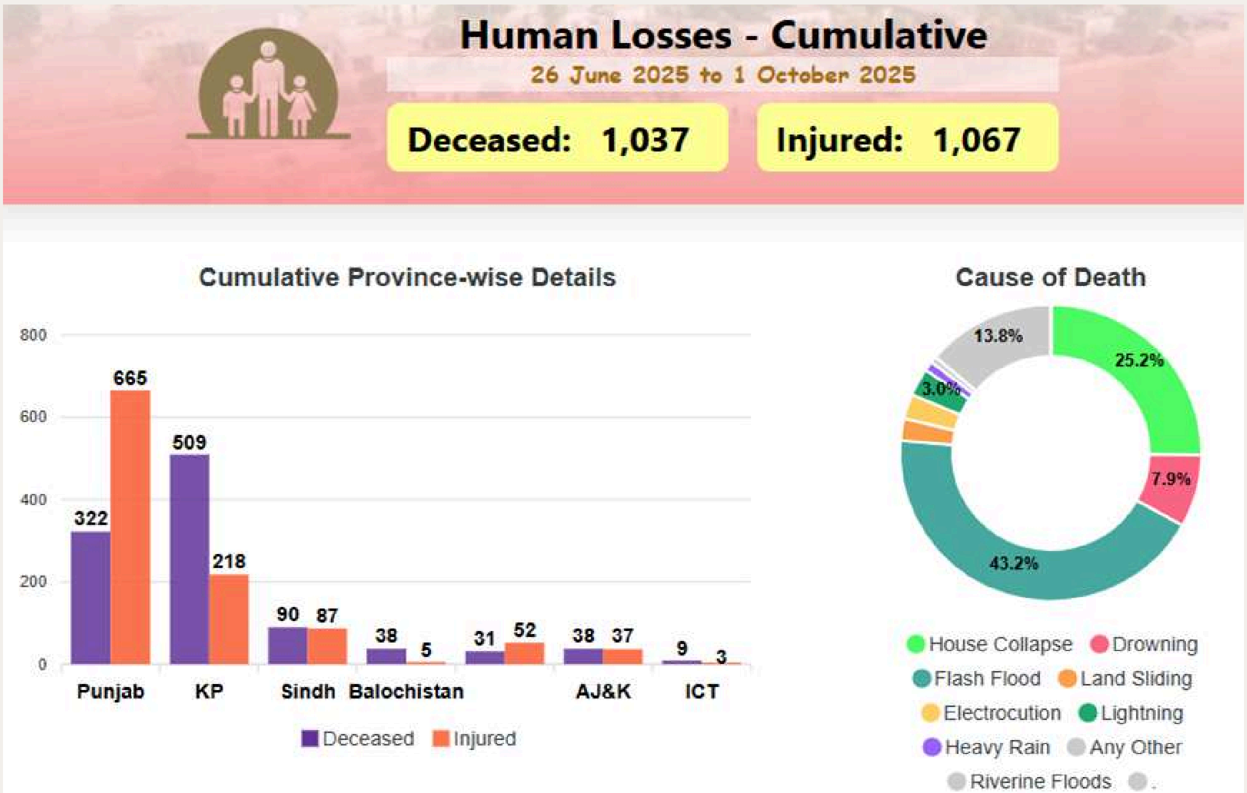


Figure 4: Human Losses and Causes of Death during the 2025 Floods in Pakistan

Damages

1 October 2025

Houses: Livestock:

Province	House Damage			Livestock
	Partial	Full	Total	
Punjab	157,729	55,130	**212,859**	3,871
KP	0	0	**0**	0
Sindh	3,051	0	**3,051**	342
Balochistan	1,284	0	**1,284**	4,205
GB	0	0	**0**	7,914
AJ&K	0	0	**0**	0
ICT	0	0	**0**	0
Grand Total	**162,064**	**55,130**	**217,194**	**16,332**

Damages Zonation

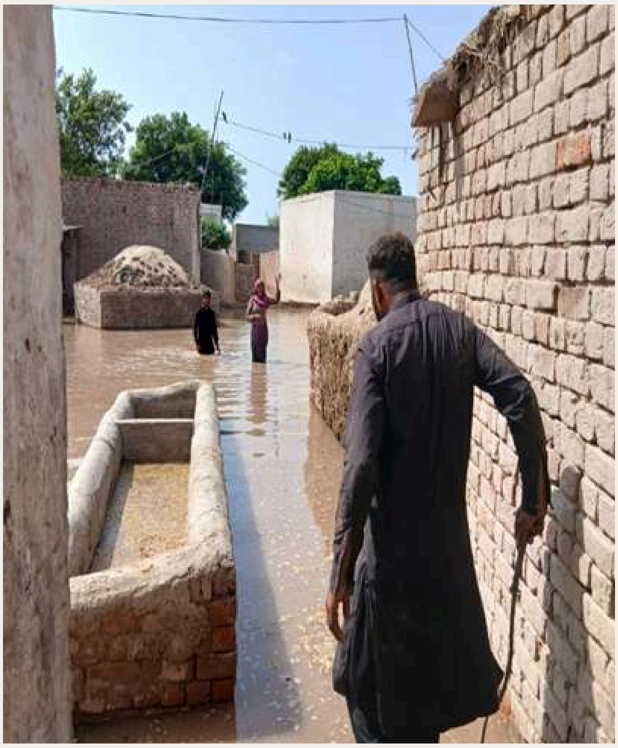
Figure 5: House and livestock damage of Death during the 2025 Floods in Pakistan

1.5.3 Attribution: Role of Climate Change and Natural Variability

Scientific analyses suggest that climate change played a significant role in intensifying the 2025 monsoon rains across Pakistan. According to a joint study by the World Weather Attribution network, extreme rainfall over northern Pakistan including Punjab and Khyber Pakhtunkhwa was made considerably more likely and severe by human-induced warming. The study, which covered key regions such as Islamabad, Rawalpindi, Lahore, and Peshawar, found that increased atmospheric moisture linked to global temperature rise led to heavier rainfall episodes. This aligns with the broader scientific understanding that a warmer atmosphere can hold more moisture, making intense downpours more probable when monsoon dynamics are active. However, experts note that natural variability—such as sea surface temperature shifts in the Indian and Pacific Oceans and other large-scale climate patterns remains a key driver of monsoon surges. In 2025, the interaction of these surges with western disturbances further amplified rainfall, especially in the northern foothills. Additionally, record heat that accelerated glacier melt likely increased river flows and soil saturation, setting the stage for more destructive flooding when the heavy rains arrived.

1.5.4 Spatial Patterns & Hotspots

Rainfall during the 2025 monsoon showed strong regional contrasts across Pakistan. The heaviest accumulation was recorded in northern and central Punjab and southern Khyber Pakhtunkhwa areas that had already been identified as high-risk zones by the NEOC (NDMA) and ICIMOD forecasts.In several districts, sudden cloudbursts and flash floods caused severe, localized damage that went far beyond what average rainfall figures could capture, highlighting the unpredictable and extreme nature of this year's monsoon.



Section 2
Comparative Assessment of Floods 2022 and 2025

Section 2: Comparative Analysis of Floods 2022 & 2025

The 2022 floods were one of the most devastating disasters in Pakistan's history, affecting nearly 33 million people and laying bare major weaknesses in preparedness, coordination, and recovery efforts. In contrast, the 2025 monsoon floods, while again severe and widespread between late June and September, revealed some important changes in how the country responded. This time, contingency planning was stronger, anticipatory action and Early Action Protocols (EAPs) were used more widely, and NGOs together with the IFRC were able to act earlier on the ground. The military also deployed more quickly in several provinces, and humanitarian coordination was more active than before. Still, significant gaps remain, particularly in health services, shelter provision, logistics, and building long-term resilience.

2.1 Preparedness for Monsoon: Institutional Systems and Response Capacity

In 2022, although institutional plans were in place, they were quickly overwhelmed by the sheer scale of the disaster. The Post-Disaster Needs Assessment (PDNA) and later reviews highlighted that while the NDMA and provincial authorities did mobilize, their infrastructure, relief stockpiles, and pre-positioned logistics were nowhere near enough to meet the urgent needs. Entire districts had to be declared calamity-hit, and the demand for large-scale, rapid relief far exceeded the country's available capacity.

By 2025, the NDMA had strengthened its monsoon preparedness through updated contingency planning and improved coordination with provinces and humanitarian partners. The revised National Monsoon Contingency Plan, along with updates to the National Disaster Management Plan (NDMP), and National Disaster Response Plan (NDRP) provided clearer guidance on roles, pre-positioning, and multi-hazard scenarios, giving the country a stronger planning baseline than in 2022. Several provinces acted earlier by declaring contingency measures, while daily situation reports and flash bulletins from NDMA offered more consistent information flow. Ahead of the season, hazard mapping was carried out, priority districts were identified, and stockpiles of shelter kits, WASH supplies, and medical kits were readied.

Despite these steps, the sheer scale and spread of the 2025 floods once again strained national capacity. Evacuations, displacement, and cascading needs grew rapidly from late June through September. Health services, emergency shelter, and logistics for last-mile delivery were especially overstretched, with shortages in surge medical staff and transport assets. The experience underscored that while planning has improved, it must be matched by scalable resources and stronger surge capacity to effectively respond to such widespread disasters.

2.2 Forecasting, Early Warning Mechanisms, and Hydrological Monitoring

In 2022, forecasting from the PMD and river gauge data did provide useful information, but the warnings often didn't reach people in time or in a way they could act on. Lead-times were short and inconsistent, and many communities didn't get clear guidance on what the forecasts actually meant for them. The hydrological monitoring network also had gaps, and data-sharing slowed down during the crisis, making it harder to turn forecasts into timely, practical action on the ground.

Forecast-to-action links were stronger than before, with many river stations in the Indus basin offering 2–5 days of lead time. This window allowed anticipatory actions, such as cash transfers and pre-positioning of supplies, to be activated in several areas. Still, the reliability of these forecasts varied: downstream lowland areas benefited more, while steep upland basins had much shorter warning times. Gaps also remain in the monitoring network, especially in hard-to-reach catchments where sparse gauges and patchy telemetry continue to limit visibility. Addressing these weaknesses is essential for improving flash flood warnings in mountainous regions.

In 2025, flood forecasting and monitoring became more advanced, with greater use of quantitative forecasts, river outflow tracking, and operational Early Action Protocol (EAP) triggers. The International Federation of Red Cross (IFRC), its partners, and national agencies worked together to apply EAP-style thresholds for parts of the Indus and its tributaries, allowing relief stocks and cash assistance to be positioned in advance. Triggers at places like Taunsa and Guddu were actively referenced, and coordination between PMD, the Flood Forecasting Division (FFD), and NDMA was far more dynamic than in 2022. Humanitarian actors, including Pakistan Red Crescent Society (PRCS) and World Food Programme (WFP), were also able to use these forecasts to kickstart early actions. Even so, some communities particularly in remote upper-catchment and mountain areas still reported that warnings reached them late or were not always clear.

2.3 Risk Communication

In 2022, risk communication was patchy and uneven. While national bulletins were being issued, the information often didn't trickle down in ways that communities could easily understand or act on. Localized messaging whether in local languages, through community leaders, radio, or SMS was inconsistent and unreliable. As a result, many people didn't receive clear or timely warnings, which weakened evacuation efforts in the critical early stages.

In 2025, communication around flood risks became more organized and layered. Authorities and humanitarian agencies used a wider mix of channels standardized national bulletins, provincial press briefings, SMS alerts, radio, social media, and community volunteers which gave the system more backup options compared to 2022. NGOs and the PRCS also tied their community-level messaging to Early Action Protocols, helping people understand what to expect and how to prepare.

During the 2025 floods, the National Disaster Management Authority (NDMA) implemented a comprehensive and multi-channel risk communication strategy to ensure timely public awareness and coordinated response. Early warnings and advisories were disseminated through electronic, print, and social media, including radio, digital platforms, and alerts in local languages. NDMA successfully executed an LoA with Jazz and PTA for nationwide SMS and ring-back tone alerts, while coordinating closely with PEMRA, PID, and telecom operators to enhance outreach.

Over 150 press releases, 200 awareness tickers, and 130 expert interviews were broadcasted under the United Disaster Media Support Group (UDMSG) framework. Public service messages, infographics, and field videos from flood-affected regions further strengthened awareness. Joint press briefings with MoCC, MoIB, Chairman NDMA, and DG ISPR, along with extensive media coverage of relief and field operations, showcased NDMA's leadership in proactive, multilingual, and inclusive disaster communication during the 2025 monsoon emergency.

Still, challenges persisted. Technical updates were often available, but not always translated into clear, practical messages in local languages about what steps to take, where to go, or what to bring. In remote or low-literacy communities, this gap was especially noticeable. Access barriers also played a role: power and telecom outages cut off digital channels during peak flooding, and misinformation spread in some places, forcing local NGOs to step in with counter-messaging.

UDMSG Interview

Print Media

News Tickers

Public Service Message

Radio Broadcast in local language

Press Briefings

Alerts Disseminated through Mosques

Infographics

Pak NDMA Disaster Alert App

2.4 National-Level Coordination and Emergency Response in 2025

In 2022, national coordination between NDMA, provincial authorities, and the UN/humanitarian cluster system held together under extreme pressure, but cracks quickly showed. There were delays and overlaps in resource allocation, gaps in conducting timely needs assessments, and difficulties in scaling up key clusters like shelter and health. International assistance eventually played a major role, but it took time to align with national priorities and on-the-ground realities.

In 2025, NDMA took a stronger role in central coordination, issuing regular national sitreps and leading inter-agency meetings with UN OCHA and humanitarian clusters and regular National Monsoon Conference was held with line departments, government agencies, NGOs/INGOs and relevant stakeholders which were activated much earlier than in 2022. The new Inter-Agency Monsoon Contingency Plan helped streamline scenario planning and improve alignment across clusters. On the ground, the WASH, Health, Shelter, and Food clusters moved faster with joint needs assessments and pooled responses in priority districts. Even so, expanding these efforts at scale was still hampered by logistical bottlenecks and access challenges in some areas.

Prime Minister Shehbaz Sharif visited NDMA's National Emergency Operations Centre (NEOC) multiple times during the monsoon season to personally oversee and guide response efforts. In mid-July, as monsoon activity intensified, the Prime Minister directed NDMA and the Ministry of Climate Change to collaborate with provincial governments on a comprehensive disaster management plan, drawing upon lessons from both the ongoing and previous monsoon seasons. On 16 August, he ordered the establishment of a special emergency cell at the Prime Minister's Office to coordinate round-the-clock relief operations through NDMA and provincial authorities, with a particular focus on Khyber Pakhtunkhwa (KP) and Azad Jammu and Kashmir (AJK). He emphasized the urgent distribution of essential relief items tents, food, medicines as well as the expedited evacuation of stranded individuals, including tourists. The Prime Minister also instructed NDMA and provincial administrations to categorize areas into high-, medium-, and low-risk flood zones and to issue timely warnings through media channels and SMS alerts to strengthen public awareness and preparedness.

Meanwhile, the Relief, Rehabilitation & Settlement Department of Khyber Pakhtunkhwa declared an emergency in Swat, Buner, Bajaur, Torghar, Mansehra, Shangla, Lower Dir, Upper Dir, and Battagram districts until 31 August 2025, for the provision of immediate relief to affected communities. A health emergency was also declared in Buner, Swat, Mansehra, Abbottabad, and Bajaur districts. In Buner district, civilian and military teams worked jointly to conduct rescue operations, set up medical camps, provide cooked meals, and clear obstructed roads using heavy machinery.

Simultaneously, the humanitarian community, led by UN agencies, activated sectoral coordination mechanisms to support the government's relief and response efforts. One clear lesson was the value of pre-agreed surge rosters and designated logistical corridors, such as army-led transport and river boat fleets, which helped speed up deliveries in many districts. At the same time, some requests moving from district to national level got bogged down in processing delays, causing overlaps in some places and leaving gaps in others.

2.5 Anticipatory Action

In 2022, most of the response was reactive, with interventions focused on emergency aid after the floods had already struck. Formal systems for risk financing and Early Action Protocols were still in their early stages, so there was little scope for pre-emptive action before the impacts unfolded.

In 2025, anticipatory action in Pakistan transitioned from concept to tangible practice, becoming increasingly visible across disaster-prone areas. Humanitarian partners including the IFRC network, PRCS, WFP standby teams, and several NGOs activated Early Action Protocols and pre-positioned cash and relief supplies in high-risk riverine zones of Sindh and parts of Punjab based on forecast triggers. These steps reduced preventable impacts by enabling earlier evacuations and faster relief delivery. For instance, once forecast thresholds were reached, the Pakistan Red Crescent Society and IFRC carried out anticipatory distributions of cash, WASH items, and evacuation support, facilitated through rapid funding from mechanisms like the Disaster Response Emergency Fund (DREF). Among NGOs, the Start Network played a pivotal role through its Disaster Risk Financing (DRF) program, a multinational initiative integrating both ex-ante (pre-disaster) and ex-post (post-disaster) financing instruments. During the 2025 flash floods in Khyber Pakhtunkhwa and the subsequent riverine floods in Punjab and Sindh, these instruments yielded highly impactful outcomes. The Start Network's ex-ante financing mechanism, the Ready Fund, operates as a pooled fund linked with crisis anticipation models for floods, heatwaves, and droughts, monitored according to a hazard calendar. Since 2023, these models have shown remarkable precision in forecasting seasonal risks, enabling timely allocation of funds for anticipatory actions nationwide. Complementing these NGO-led initiatives, the National Disaster Management Authority (NDMA) mainstreamed anticipatory disaster risk reduction (DRR) actions into the 2025 national response.

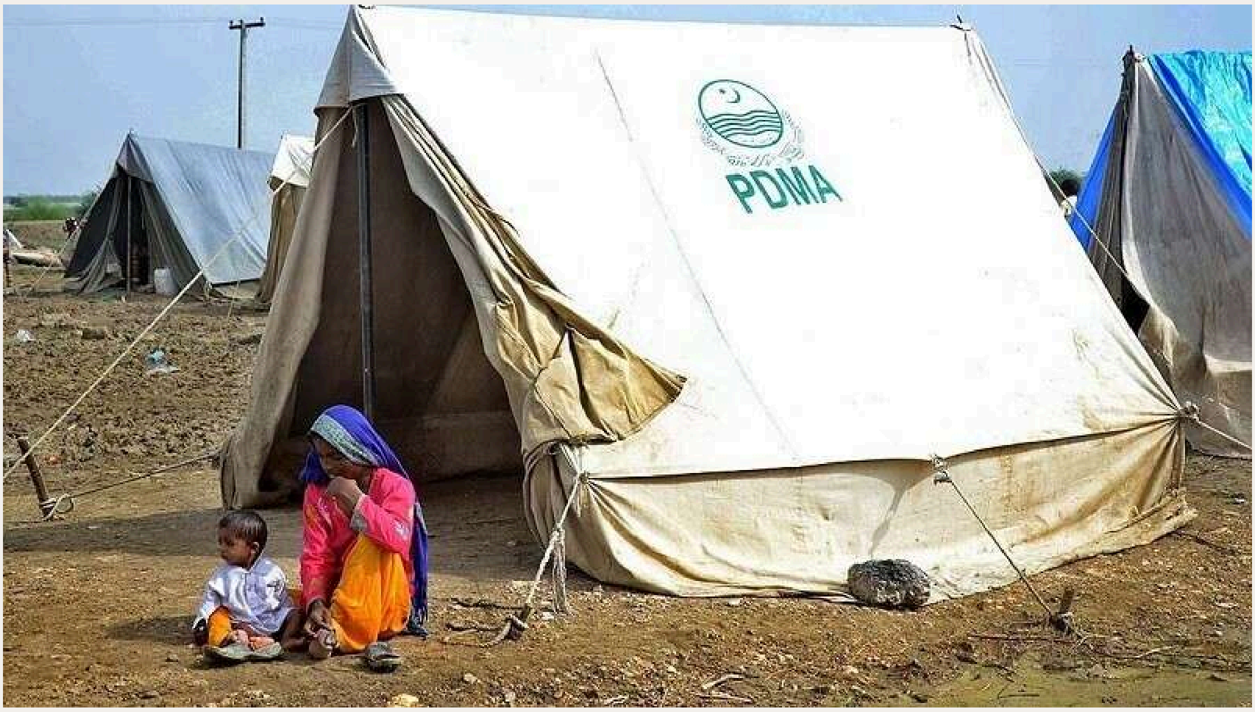
The Monsoon Contingency Plan and Monsoon SimEx 2025 guided systematic preparedness, including pre-positioning of relief stockpiles in high-risk districts, empowering district authorities to implement early evacuations and shelter plans based on improved forecasts. Coordination meetings between the UN system, NGOs, and provincial DMAs enhanced humanitarian synergy, while anticipatory medical teams and Community Emergency Rescue Teams (CERTs) mitigated health risks and strengthened local response capacities. Collectively, these anticipatory measures made a tangible difference for tens of thousands of people, though the scale of implementation remained limited compared to the national impact. The 2025 experience reaffirmed that anticipatory action is both feasible and effective but must be expanded and better integrated within national financing systems to achieve sustainable, nationwide resilience.

2.6 Deployment of Armed Forces and Rescue Agencies

In 2022, the armed forces played a central role in the response, providing rescue operations, transport, and engineering support. Their logistical strength was one of the country's biggest assets during the crisis, but even with their wide reach, the sheer demand especially in hard-to-access and remote areas went beyond what they could fully cover.

In 2025, the military once again took on a rapid and large-scale role in the flood response. Army units, Civil Defense, and Rescue 1122 teams were quickly deployed across affected districts, carrying out mass evacuations, boat rescues, engineering works, and logistical support. In some phases, reports noted that hundreds of thousands of people were evacuated, with helicopters, boats, and even drones being used for search and rescue in the hardest-hit areas.

Coordination between civil authorities and security forces was noticeably stronger than in 2022, with clearer division of roles: the military concentrated on heavy logistics and reaching inaccessible areas, while civil authorities and NGOs focused on providing shelter, health, and WASH services at transit sites. Even so, at the sub-district level, coordination was not always seamless, sometimes leading to duplication of effort and leaving gaps in ensuring that services were delivered in a protection-sensitive way.



2.7 Evacuation and Relief Operations

In 2022, large-scale evacuations became unavoidable, but the support systems in place couldn't keep up. Many camps lacked adequate shelter, clean water, and health services, which quickly led to secondary public health problems. Relief supplies eventually reached affected communities, but the distributions were slow to scale, leaving many families struggling in the early weeks.

In 2025, authorities and humanitarian partners once again oversaw mass evacuations, with NDMA and UN OCHA reporting figures in the hundreds of thousands—at times reaching over 900,000 people. Evacuations were carried out by boats, helicopters, and road convoys, driven both by heavy rains and controlled water releases from barrages. While the scale and speed of these evacuations were notable, many displaced people did not end up in formal relief camps. Instead, large numbers sought shelter informally, making it harder to track needs and ensure consistent support.

On the relief side, prepositioned stocks of shelter materials and WASH supplies allowed faster distributions in some provinces, and cash assistance was introduced where markets were still operating. Even so, damaged roads and bridges quickly became bottlenecks, slowing the resupply of essential goods.

Health challenges soon emerged as overcrowded shelters and standing water created fertile ground for outbreaks of cholera, dengue, and malaria. Despite the deployment of of mobile clinics and targeted health interventions, the demand for surge medical support quickly outpaced local capacity, requiring urgent reinforcements from both national and international actors.

2.8 Civil Society Contributions and Humanitarian Partnerships

In 2022, local NGOs, community groups, and provincial volunteers were on the frontlines of the response, often stepping in as the first source of help for flood-affected families. Their efforts were vital, but the sheer scale of the disaster stretched their capacity far beyond limits. To keep relief moving, international partners provided much-needed funding and technical support, helping local responders continue their work under extremely challenging conditions.

In 2025, civil society groups and local NGOs played a far stronger role, moving beyond just response to also shaping anticipatory actions. Their close ties on the ground meant they could mobilize people quickly and deliver support where it was most needed. International partners, including the Red Cross/Red Crescent, UN agencies (WHO, UNICEF, IOM), and INGOs (Alkhidmat Foundation, Minhaj Welfare Foundation, HHRD, FGRF, Muslim Hands, Islamic Relief Pakistan, PRCS, AKAH, Muslim Aid, Human Appeal), backed these efforts with funding, technical expertise, and supply chains. Support from donors, such as the German Red Cross for PRCS's early actions, made it possible to act earlier and more effectively than in 2022, with partnerships running smoother and faster overall.

2.9 National Resource Mobilization (Industry and Private sector)

In 2022, Pakistan's private sector and philanthropists stepped up with generous donations to support flood-affected communities. However, the country's financial systems especially national funding and insurance mechanisms were not equipped to provide the kind of rapid, large-scale financing needed to sustain recovery and rebuilding efforts.

In 2025, Pakistan's private sector demonstrated a faster and more coordinated response to the floods than in previous years. Many corporations activated their CSR programs and swiftly mobilized logistics assets, including transport fleets, warehouse spaces, fuel supplies, and in-kind donations, to support relief operations across multiple provinces. Multinational companies and donors also played a vital role by providing emergency goods and technical assistance, creating a more collaborative flow of private support that complemented government and humanitarian efforts.

The National Resource and Relief Financing Facility (NR2F), operating under the coordination framework of the National Disaster Management Authority (NDMA), effectively mobilized contributions from diverse sectors during the monsoon response. A total of 3,396 tons of in-kind assistance valued at approximately Rs. 1,999 million was delivered or remained under distribution, alongside Rs. 50 million in direct financial contributions. The government corporate sector emerged as the largest contributor, providing 2,147 tons of relief items worth Rs. 1,458 million and additional financial assistance of Rs. 50 million. The private sector contributed 422 tons of essential goods valued at Rs. 222 million, while the industrial sector provided 546 tons worth Rs. 167 million, and philanthropic organizations delivered 281 tons valued at Rs. 151 million.

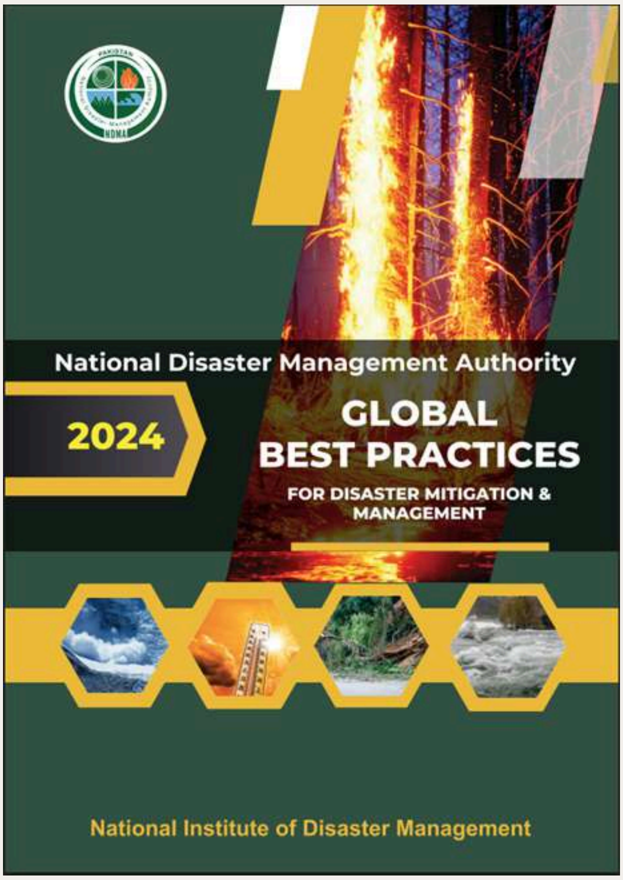
These combined efforts reflected growing collaboration among government, private, industrial, and philanthropic partners in strengthening Pakistan's disaster response capacity. However, despite these commendable contributions, significant financing gaps persisted. Long-term investments required for recovery—such as rebuilding damaged infrastructure, restoring crops, and rehabilitating roads and irrigation systems—remained severely underfunded compared to the magnitude of losses reported. This underscored the urgent need for establishing sustainable and resilient financing mechanisms to ensure comprehensive post-disaster recovery in Pakistan.

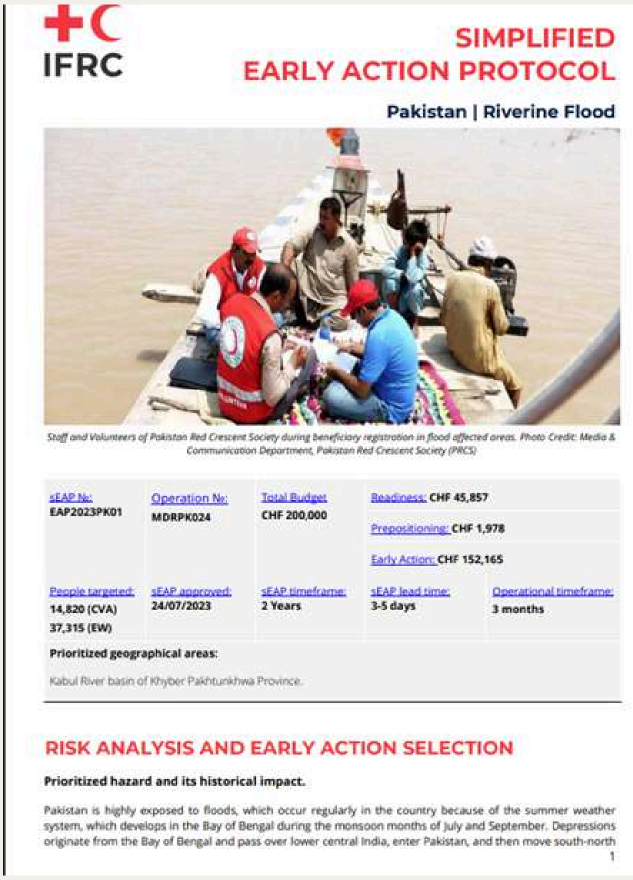
2.10 Application of Global Best Practices in Response

During the 2022 floods, Pakistan's disaster response revealed major gaps in the adoption of international best practices such as early warning systems, anticipatory action, and forecast-based financing. Although national and provincial authorities issued timely alerts and mobilized relief operations, mechanisms to turn forecasts into proactive measures were still in their early stages. According to documentation from the Pakistan Red Crescent Society (PRCS), simplified Early Action Protocols were in place in certain riverine areas, but they covered only a small portion of at-risk communities. As a result, most responses were reactive relief efforts began only after the floods had already caused significant damage. Coordination among humanitarian clusters, NGOs, and government agencies also faced delays, while financing systems for rapid, large-scale action or long-term resilient infrastructure were limited. Despite awareness of global models—like anticipatory cash transfers, community-led preparedness, and risk-informed early warning—Pakistan's practical implementation of these tools remained uneven and underdeveloped.

By 2025, Pakistan's disaster management system showed far greater alignment with international best practices, especially in the areas of anticipatory action, early warning, and community-driven preparedness. The Pakistan Red Crescent Society (PRCS), in partnership with the Anticipation Hub, expanded its forecast-based financing mechanisms and Early Action Protocols (EAPs) across several riverine basins. These initiatives trained local responders to take pre-defined actions once specific flood triggers were met, embedding early action into provincial and national disaster risk management frameworks. A key shift was the growing emphasis on community empowerment, local committees were increasingly involved in monitoring, communication, and response, reflecting the global standard that stresses localized ownership and context-specific solutions.

The National Disaster Management Authority (NDMA) also evolved notably between 2022 and 2025. Building on lessons from past floods, it enhanced coordination with provincial disaster management authorities (PDMAs), integrated satellite-based early warning systems, and improved multi-sectoral collaboration with humanitarian agencies and private partners. NDMA's early warning alerts became more targeted and accessible, using mobile platforms and social media for real-time dissemination. Private sector engagement through prepositioned logistics, supply chains, and CSR-based funding further strengthened operational readiness. Despite these advancements, however, challenges persist. Many remote and marginalized areas still lack full coverage under anticipatory frameworks, and long-term investment in resilient infrastructure such as drainage systems, embankments, and flood defenses remain below the level seen in global best practice models. Nonetheless, Pakistan's progress in institutionalizing early action and integrating community-led systems marks a significant evolution toward a more proactive and adaptive disaster management approach.




IFRC

SIMPLIFIED EARLY ACTION PROTOCOL

Pakistan | Riverine Flood

Staff and Volunteers of Pakistan Red Crescent Society during beneficiary registration in flood affected areas. Photo Credit: Media & Communication Department, Pakistan Red Crescent Society (PRCS)

sEAP No: EAP2023PK01	Operation No: MDRPK024	Total Budget: CHF 200,000	Readiness: CHF 45,857 Prepositioning: CHF 1,978 Early Action: CHF 152,165	
People targeted: 14,820 (CVA) 37,315 (EW)	sEAP approved: 24/07/2023	sEAP timeframe: 2 Years	sEAP lead time: 3-5 days	Operational timeframe: 3 months
Prioritized geographical areas: Kabul River basin of Khyber Pakhtunkhwa Province.				

RISK ANALYSIS AND EARLY ACTION SELECTION

Prioritized hazard and its historical impact.

Pakistan is highly exposed to floods, which occur regularly in the country because of the summer weather system, which develops in the Bay of Bengal during the monsoon months of July and September. Depressions originate from the Bay of Bengal and pass over lower central India, enter Pakistan, and then move south-north

1

2.11 Engagement of Academia

In 2022, universities and research institutions across Pakistan played an important role in conducting post-disaster assessments and documenting the localized impacts of floods. Academic teams collected valuable field data, analyzed damage patterns, and

and produced studies that helped policymakers and humanitarian agencies better understand the social and environmental dimensions of the crisis. However, their engagement was mostly reactive focused on research and evaluation after the floods had already occurred. Direct participation in real-time forecasting, early warning systems, or preparedness planning was still limited. Most academic contributions were project-based or linked to short-term collaborations, rather than being fully integrated into the national disaster management framework. As a result, the wealth of technical expertise within academia was not fully leveraged for operational forecasting, risk modeling, or community preparedness areas where sustained partnerships could have significantly improved early action and resilience.

By 2025, the role of academic institutions in disaster management had become far more proactive and structured. Universities and research centers across Pakistan were not only conducting post-flood studies but were now actively contributing to hydrological modeling, risk mapping, and early warning analysis. Many academic teams worked in coordination with the National Disaster Management Authority (NDMA), participating in technical working groups and contributing to real-time decision support. Their expertise helped refine flood forecasts, identify high-risk zones, and guide more targeted response and recovery planning.

The National Institute of Disaster Management (NIDM) played an instrumental role in bridging academia, policy, and practice. A dedicated communication system, including WhatsApp groups, facilitated real-time exchange of advisories and situational updates among universities, officials, and responders. Academic institutions conducted rapid assessments in flood-prone districts, providing evidence-based insights that informed NDMA's decision-making. Community Emergency Rescue Teams (CERTs) and DRR societies were mobilized to provide first aid, evacuation support, and relief logistics at the local level. Moreover, pre-monsoon workshops for district administrations improved readiness, while urban mock drills helped strengthen flood management capacities. NIDM also organized debrief sessions with provincial DMAs, where lessons were compiled, including long-term issues such as the resurgence of Sutlej water after three decades.

During the floods of 2025 in Pakistan, several universities, under the guidance of NIDM, NDMA actively contributed to relief, assessment, and recovery efforts. AWK University Mardan, through its Department of Psychology, conducted a post-flood assessment with a team of psychologists to evaluate the mental health impacts on affected communities.

The University of Peshawar mobilized volunteers for search, rescue, and response operations, while also carrying out a rapid assessment of the floods and identifying cases of Post-Traumatic Stress Disorder (PTSD) among survivors. The Social Work Department of Islamia University Bahawalpur (IUB) engaged its volunteers in collaboration with Rescue 1122 to participate in rescue and evacuation activities across flood-hit areas of Bahawalpur District. Similarly, the University of Sargodha organized flood relief activities to provide essential support to affected communities. These efforts, coordinated under NIDM's guidance, demonstrate the critical role of academia in disaster response, resilience-building, and community support.

AWKU-First Aid Psychological services to the Local Community

Uni of Sargodha/Islamia Uni BWP/Uni of Peshawar- Post Flood Campaigns at Flood Affected Areas

Brief- NEOC exposure visit


Volunteer- Relief Operation




Damage Assessment with Volunteers

2.12 Community Preparedness and Mobilization

In 2022, communities played a vital role in coping with the floods, often relying on their own experience and social networks to survive and recover. However, local preparedness systems such as evacuation planning, designated safe shelters, and community-level early warning mechanisms were inconsistent and, in many places, insufficient. Many vulnerable areas lacked properly equipped shelters or organized evacuation routes, leaving residents dependent on last-minute warnings or informal support networks. While traditional community solidarity helped save lives, the absence of structured preparedness plans and limited access to official early-warning channels meant that response efforts were mostly reactive rather than preventive.

By 2025, community preparedness across Pakistan showed clear progress, due to stronger coordination led by the National Disaster Management Authority (NDMA) and its partners. NDMA worked closely with provincial disaster management authorities, the Pakistan Red Crescent Society (PRCS), and local NGOs to strengthen community-level disaster readiness. In several high-risk districts, local volunteer networks were trained and equipped to conduct evacuation drills, manage small community stockpiles of relief supplies, and disseminate early warnings. These efforts meant that during the 2025 floods, many villages were able to evacuate more quickly and organize locally before official rescue teams arrived.

NDMA's guidance on community contingency planning also helped standardize preparedness activities, linking early warning systems with ground-level response. However, challenges persisted particularly in remote valleys and low-income rural areas where access to durable shelters, real-time alerts, and livelihood protection mechanisms like crop insurance remained limited. While 2025 demonstrated tangible progress toward community resilience, it also highlighted the ongoing need for NDMA to expand local preparedness programs and ensure that even the most isolated communities are part of Pakistan's disaster readiness network.

2.13 National Self Reliance

In 2022, the massive scale of flooding exposed Pakistan's heavy reliance on international assistance for emergency relief and recovery. While the government, armed forces, and humanitarian agencies mobilized rapidly, it became clear that national systems alone were not fully equipped to manage such a widespread disaster. Shortfalls in emergency financing, logistics storage, and surge health capacity meant that external aid from the UN, international NGOs, and donor countries was essential to fill critical gaps. Many local institutions did their best with available resources, but limited national stockpiles, inadequate pre-positioned relief materials, and insufficient funding mechanisms slowed the initial response. The 2022 floods ultimately underscored the urgent need to strengthen Pakistan's internal disaster management capacity so the country could respond more independently and efficiently in future crises.

By 2025, Pakistan showed noticeable progress toward national self-reliance in disaster management, with stronger domestic planning, improved institutional coordination, and quicker mobilization of internal resources. The National Disaster Management Authority (NDMA) played a far more active and strategic role compared to 2022 updating the National Monsoon Contingency Plan 2025, enhancing early warning dissemination, and working closely with provincial disaster authorities, the armed forces, and humanitarian

The country's improved use of domestic assets ranging from military logistics and provincial relief stocks to corporate sector contributions signaled a tangible step toward self-reliance. However, Pakistan is still in transition. Key gaps remain in areas such as surge health capacity, long-term reconstruction financing, and resilient infrastructure development. While national coordination and planning improved, the scale of flooding in 2025 again highlighted the importance of international technical expertise, particularly in hydrological modeling and large-scale disease management. Overall, the shift between 2022 and 2025 reflects a more confident and capable NDMA-led response system, though continued external partnerships remain essential for sustaining recovery and resilience-building.

2.14 Global Partnerships

In 2022, the floods revealed deep limitations in how Pakistan connected with the world on disaster response. The international community rallied governments, UN agencies, and NGOs provided generous aid but much of it arrived after the worst damage had already been done. Despite being the focal point for coordination, NDMA's role was often reactive, focusing on logistics: clearing customs for aid shipments, tracking relief supplies, and working alongside UNOCHA in coordination clusters.

Structured international cooperation and real-time disaster simulations were scarce. Pakistan's involvement in large-scale simulation exercises such as those that test cross-border coordination, real-time information sharing, or scenario-driven preparedness was minimal or largely observational. Diplomatic efforts were centred around donor appeals, fundraising, and showing global solidarity rather than establishing or activating technical frameworks for anticipatory action or early warning.

As a result, while the generosity and solidarity of the global community were evident, the capacity to reduce harm before it struck through simulation, predictive planning, or anticipatory coordination was underdeveloped. Losses that might have been mitigated were not, because many structures for readiness were not yet in place or had not been tested.

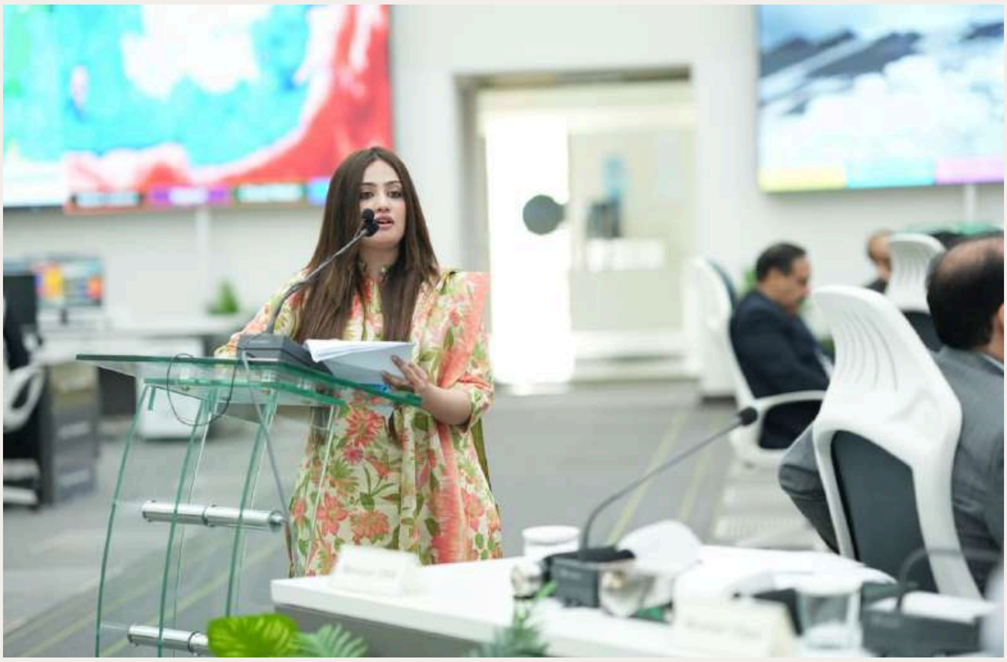
By 2025, NDMA's role in global disaster preparedness had shifted in very noticeable ways. Building on the hard lessons of 2022, Pakistan was no longer just waiting for aid when disaster strikes it was increasingly shaping how that aid is anticipated, coordinated, and operationalized. A concrete sign of this change was NDMA's active participation in the Comprehensive International Simulation Exercise (CISE). For example, the CISE 1/2025 held at NDMA's National Emergency Operations Centre (NEOC) brought together disaster management authorities from countries like the USA, France, Malaysia, and others. The exercise simulated scenarios such as a cyclone and forest fire to test both readiness and collaborative response. Similarly, CISE 3/2025 involved multiple nations from South Asia and beyond and focused on flood contingency, helping Pakistan strengthen cross-border coordination and response protocols.

NDMA also used these simulation exercises to test and refine important aspects of disaster diplomacy and technical readiness: protocols for mobilizing resources across borders, aligning international search-and-rescue operations, improving rapid post-disaster needs assessments, and synchronizing early warning systems with global standards. On the diplomatic front, NDMA's engagement matured as well undertaking pre-monsoon coordination meetings with international partners and embedding anticipatory planning. For example, on 20–21 May 2025, NDMA organized a National Simulation Exercise (SimEx) at its headquarters to simulate large-scale flood and GLOF (Glacial Lake Outburst Flood) scenarios, bringing together federal, provincial, and humanitarian stakeholders. There was also a deliberate push by NDMA, through conferences like the Humanitarian Conference 2025 in Islamabad, to foster enhanced coordination among UN agencies, NGOs, INGOs, and development partners. These gatherings emphasized the importance of early warning, local data tools, and preparing in advance rather than just reacting.

Together, these advances show NDMA transforming from coordinating after disasters to helping lead preparedness, diplomacy, and technical collaboration on a regional and global scale. While there's always more to do especially ensuring that remote areas are included and that the gains are sustained this evolution marks real progress.


NATIO
STANDARDIZIN
TRAINING C


Provincial Level
Multi-Hazard
Emergency Response
Simulation Exercise
1st - 3rd July, 2025
Karachi - Sindh
Risk Knowledge
Think Tank : National Institute of Di
Universities of global cold zones (US, Canada, EU, China)
Zone A : High Mountains
GB, AJ&K,
North Bln
Earthquakes
GLOF, Floods
Landslides
Dams, Tourism
GBDMA
SDMA
PDMA KP
NIDM
PDMA Pb
Universities of desert, coastal zones (M.E, US, Aus, China)
Zone C : Desert, Indus
South Punjab
Sindh
Drought, Heat
Flooding
Desert storms
PDMA Sindh



Section 3
Gap Assessment: Preparedness & Response

Section 3: Gap Assessment: Preparedness & Response

3.1 Mountainous Areas (GB, AJ&K, KP)

3.1.1 Preparedness Gaps

Pakistan's northern and hilly regions, including Gilgit Baltistan (GB), Azad Jammu and Kashmir (AJ&K), and Khyber Pakhtunkhwa (KP), remain poorly prepared for recurring disasters such as flash floods, landslides, and Glacial Lake Outburst Floods (GLOF). In GB, early warning and monitoring systems are still limited, with pilot community-based initiatives under the UNDP's GLOF II Project covering only a few valleys, leaving many vulnerable areas without timely alerts. AJ&K lacks proper landslide hazard mapping, slope stabilization programs, and enforcement of building codes, allowing unsafe construction on fragile slopes. KP faces coordination challenges among departments and lacks real-time river monitoring infrastructure, with provincial irrigation departments unable to provide reliable upstream flood forecasts. Across these regions, disaster preparedness remains fragmented and underfunded, with little integration between scientific data and local knowledge. Evacuation plans, relief stockpiles, and community drills are mostly missing, while weak land use enforcement continues to expose communities to high-risk zones.

3.1.2 Response Gaps

During Monsoon 2025, the response in GB, AJ&K, and KP was hindered by logistical delays, poor coordination, and dependence on military assistance rather than civilian led systems. In GB, landslides blocked the Karakoram Highway for days, delaying humanitarian access, while the lack of pre positioned relief stocks forced affected communities to rely on local coping strategies. AJ&K's response was similarly slow, as road blockages and outdated communication networks hampered aid delivery, and hospitals in Muzaffarabad reported shortages of medicines and diagnostic kits. In KP, despite PDMA coordination, limited availability of helicopters delayed relief drops, camps were overcrowded with inadequate WASH facilities, and women's needs were often overlooked. Health centers across all three regions struggled to manage injuries and outbreaks of waterborne and vector borne diseases, while damaged bridges, micro hydropower units, and roads prolonged isolation and recovery. The reliance on the Pakistan Army's engineering and air support once again highlighted the lack of robust civilian disaster management capacity and the continued focus on response over preparedness .

3.2 Plains (Punjab)

3.2.1 Preparedness Gaps

Punjab's preparedness for Monsoon 2025 once again revealed deep-rooted weaknesses despite its long history of major flood disasters in 2010, 2014, and 2022.

Although the Flood Forecasting Division (FFD) of the Pakistan Meteorological Department (PMD) issued timely warnings, local governments lacked the institutional and logistical capacity to act on them. Evacuation orders were poorly implemented, transport arrangements were insufficient, and shelters were not pre-positioned, leaving vulnerable riverine communities in districts such as Jhang and Multan struggling with last-minute evacuations. Urban preparedness was also inadequate. In Lahore, prolonged waterlogging in Johar Town, Mozang, and Garden Town continued for over 48 hours after heavy rainfall, despite recent drainage upgrades under the Punjab Intermediate Cities Improvement Program. These failures highlighted persistent problems of poor drainage maintenance, illegal encroachments on stormwater nullahs, and limited pumping capacity. Similarly, Rawalpindi's Nullah Leh overflowed once again, exposing the repeated gap between planning and actual infrastructure execution .

3.2.2 Response Gaps in Plain Areas (Punjab)

Punjab's flood response during Monsoon 2025 exposed major weaknesses in relief operations, health services, and recovery mechanisms. Although the Provincial Disaster Management Authority (PDMA Punjab) mobilized emergency relief efforts, temporary shelters in some districts (Muzaffargarh, Kasur, and Jhang) were overcrowded, lacked privacy and gender-sensitive spaces, and provided poor access to clean water and sanitation facilities. Health systems in flood-affected rural areas were severely strained, as many basic health units ran short of essential medicines and lacked proper referral systems for treating waterborne diseases. Agricultural losses were extensive, particularly in southern Punjab, where cotton and sugarcane crops were destroyed. However, compensation and livelihood recovery schemes were delayed, leaving farming families without timely assistance. Urban areas also struggled, agencies such as the Water and Sanitation Agency (WASA) responded slowly, with limited pre-flood preparedness and minimal citizen engagement. In Lahore, Faisalabad, and Rawalpindi, repeated flooding disrupted daily life, mobility, and power supply, fuelling public frustration. Weak crisis communication and overlapping responsibilities among municipal institutions further slowed coordinated response efforts.

3.3 Coastal Areas — Sindh Coast (Indus Delta, Karachi)

3.3.1 Preparedness Gaps along Sindh Coast (Indus Delta, Karachi)

Sindh's coastline and major cities such as Karachi and Hyderabad faced overlapping hazards during the 2025 monsoon, as inland river flows coincided with high Arabian Sea levels and intermittent storm surges. Civil society and environmental groups had long warned about the growing risks from mangrove loss and reduced freshwater inflows in the Indus Delta, which weakened natural coastal defences and made the region more vulnerable to saline intrusion and surge impacts. Despite these repeated warnings, ecological restoration projects remained scattered and underfunded, lacking a unified long-term plan to restore mangroves and regulate freshwater flows critical for delta resilience. Governance and institutional weaknesses further deepened these vulnerabilities. Coastal hazard mapping and community evacuation planning were incomplete, especially in fishing villages and informal peri-urban settlements that depend on shallow harbors and small-scale fish processing. Evacuation routes and shelters on higher ground were either poorly marked or missing altogether, and marine search and rescue protocols were not tested before the 2025 monsoon. During the surge events of July and August 2025, coordination issues among PDMA Sindh, the Karachi Metropolitan Corporation (KMC), and port authorities caused delays in evacuation efforts across several coastal communities. In Karachi, stormwater drains such as Gujjar and Orangi nullahs remained blocked due to encroachments and insufficient desilting, resulting in prolonged flooding in major residential areas.

3.3.2 Response Gaps along the Sindh Coast (Indus Delta, Karachi)

The 2025 monsoon season exposed major weaknesses in Sindh's response systems across both urban and rural coastal areas. In Karachi, emergency operations were slowed by overlapping institutional responsibilities and poor coordination among key agencies. Drainage clearance duties were divided between the Karachi Metropolitan Corporation (KMC), cantonment boards, and the provincial irrigation department, causing delays in dewatering and recovery efforts. Extended power outages further disrupted pumping operations and essential services, including hospital operations in inundated areas. In the Indus Delta, fishing communities bore the brunt of the disaster. Many lost boats, nets, and mangrove nursery grounds that sustain local fisheries, yet relief packages from government and humanitarian agencies failed to adequately address these livelihood losses. As a result, many families depended on temporary or ad hoc cash and in-kind assistance. Relief camps established in urban outskirts and rural coastal areas lacked protection-sensitive facilities such as gender-segregated sanitation, safe sleeping spaces for women, and child-friendly areas, exposing vulnerable groups to further hardship. Health crises intensified as stagnant floodwaters and damaged sanitation systems led to widespread outbreaks of gastroenteritis and dengue, overwhelming hospitals in Hyderabad and Karachi. These combined preparedness and response failures highlight the need for urgent reform. Strengthened municipal governance of drainage, dedicated financing for mangrove rehabilitation, and clear evacuation Standard Operating Procedures (SOPs) coordinated between PDMA, KMC, and port authorities are essential if Sindh's coastal belt is to withstand future compound flood and storm surge events.

3.4 Coastal Areas — Balochistan (Makran Coast, Gwadar, Coastal Districts)

3.4.1 Preparedness Gaps in Balochistan (Makran Coast, Gawadar, Coastal Districts)

The Makran coast and adjoining districts of Balochistan remain among the least prepared coastal zones in Pakistan, despite increasing exposure to Arabian Sea surges, heavy monsoon rains, and cyclonic events. During 2025, episodic surge incidents combined with intense rainfall caused flooding in low-lying estuaries, damaged coastal roads, and destroyed small fishing jetties and settlements. However, preparedness efforts in the region remained minimal and fragmented. Hydro-meteorological monitoring infrastructure was extremely limited, with few tide gauges or real-time sensors installed along the Makran coast. This restricted accurate surge forecasting and coastal inundation modelling, resulting in delayed or insufficient community alerts. In coastal towns such as Gwadar, Pasni, Ormara, and Jiwani, residents often took shelter in informal structures like mosques, as designated higher-ground evacuation sites had not been developed. Road connectivity was also poor, and many evacuation routes in remote fishing villages became impassable during heavy rains. Institutional capacity at the district level remained weak. Most disaster management functions were centralized in Quetta, leaving local District Disaster Management Authorities under-resourced and unable to lead timely evacuations or relief operations. Pre-positioned relief supplies were lacking in most coastal towns, forcing authorities to rely on emergency deliveries from distant cities such as Quetta or Karachi. The province's dependence on small-scale fisheries further added to its vulnerability. When storms or surges damaged boats, nets, or cold storage facilities, repair and replacement support was slow to arrive, and livelihood recovery assistance was rarely included in formal disaster programs. As a result, fishing communities faced long recovery periods and growing economic insecurity after each disaster.

3.4.2 Response Gaps in Balochistan (Makran Coast, Gawadar & Coastal Districts)

The response to Monsoon 2025 in Balochistan's coastal belt was severely constrained by poor access, weak governance, and limited livelihood support. Washed-out coastal tracks delayed relief convoys to remote settlements in Gwadar and Pasni, leaving many communities stranded for days without assistance. Power and telecommunications restoration was slow, further isolating affected populations and complicating coordination. Many households reported waiting several days before receiving basic food and non-food supplies, reflecting the limited presence of humanitarian organizations and weaker logistics networks compared to Sindh and Punjab. Recovery efforts also failed to adequately address livelihood needs. Reports from UN and NGO clusters noted that emergency aid packages did not include fishing gear replacement, jetty repairs, or cold-chain support for small-scale fish processors—essential for sustaining coastal livelihoods. Coastal pastoralist communities were similarly neglected, receiving minimal assistance despite losing livestock and fodder due to flooding and saline intrusion. The combination of sparse population density, limited governance reach, and a weak humanitarian footprint has consistently prolonged recovery timelines in Balochistan's coastal districts. These gaps underscore the long-standing neglect of coastal resilience in the province and highlight the urgentt need for decentralized preparedness systems, improved logistics infrastructure, and livelihood-centered recovery mechanism.

Section 4
National Resilience: Recommendations and Way Forward for 2026

Section 4: National Resilience: Recommendations and Way Forward for 2026

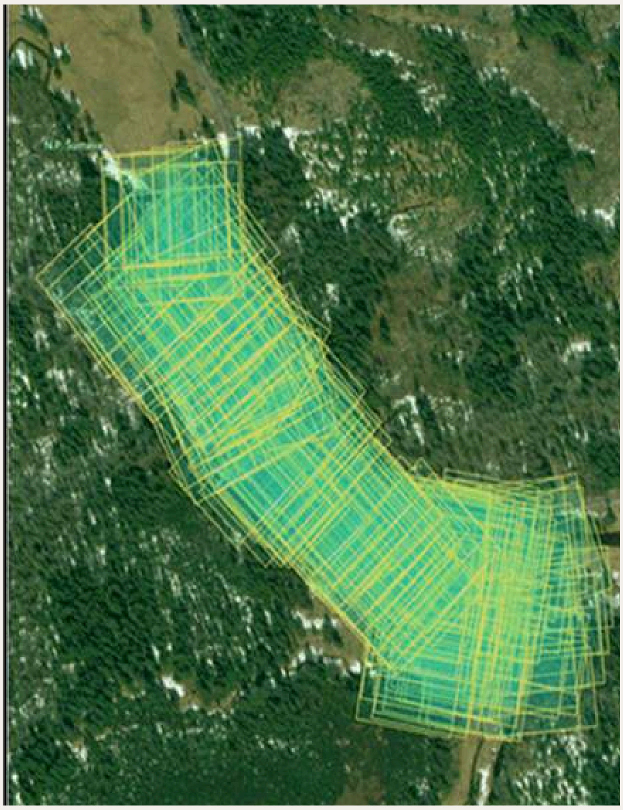
4.1 Implementing Sectoral Best Practices

4.1.1 Governance and Coordination Mechanisms

- NDMA and PDMAs provide the main framework for disaster management at the national and provincial levels, but still lacks a truly connected system where government institutions, private organizations, and communities work together effectively.
- It is important to establish a permanent National Disaster Resilience Council (NDRC), led by the Prime Minister but also including experts from universities, the private sector, and civil society. This council would help ensure that decisions are based on real evidence and that the voices of affected communities are heard in national planning, instead of policies being made only from the top.
- Similarly, provinces should form Provincial Resilience Forums, where district representatives regularly share local issues and experiences. Such a system would help close the coordination gaps between provincial and municipal agencies that became evident during the 2025 monsoon response.

4.1.2 Forecasting and Early Warning Systems

- Pakistan's weather forecasting system is still too broad and not specific enough for local conditions, which means that many districts receive warnings that are either delayed or not relevant to their area.
- One of the key goals should be to develop localized, impact-based forecasting systems. These systems should use artificial intelligence (AI) and machine learning (ML) to combine data on rainfall, rivers, soil conditions, and sea tides. This approach would help generate more accurate and timely local forecasts that communities can act on immediately.
- At the same time, drone (UAV)-based flood mapping should be carried out during each monsoon season to update floodplain maps in real time.
- Another major gap is the absence of a marine surge modelling centre in Pakistan. Establishing such a unit at Gwadar University could fill this need and help predict coastal flooding and sea-level changes more accurately. This would be especially valuable for communities along the Makran coast, where storm surges and rising sea levels continue to threaten local fishing livelihoods.

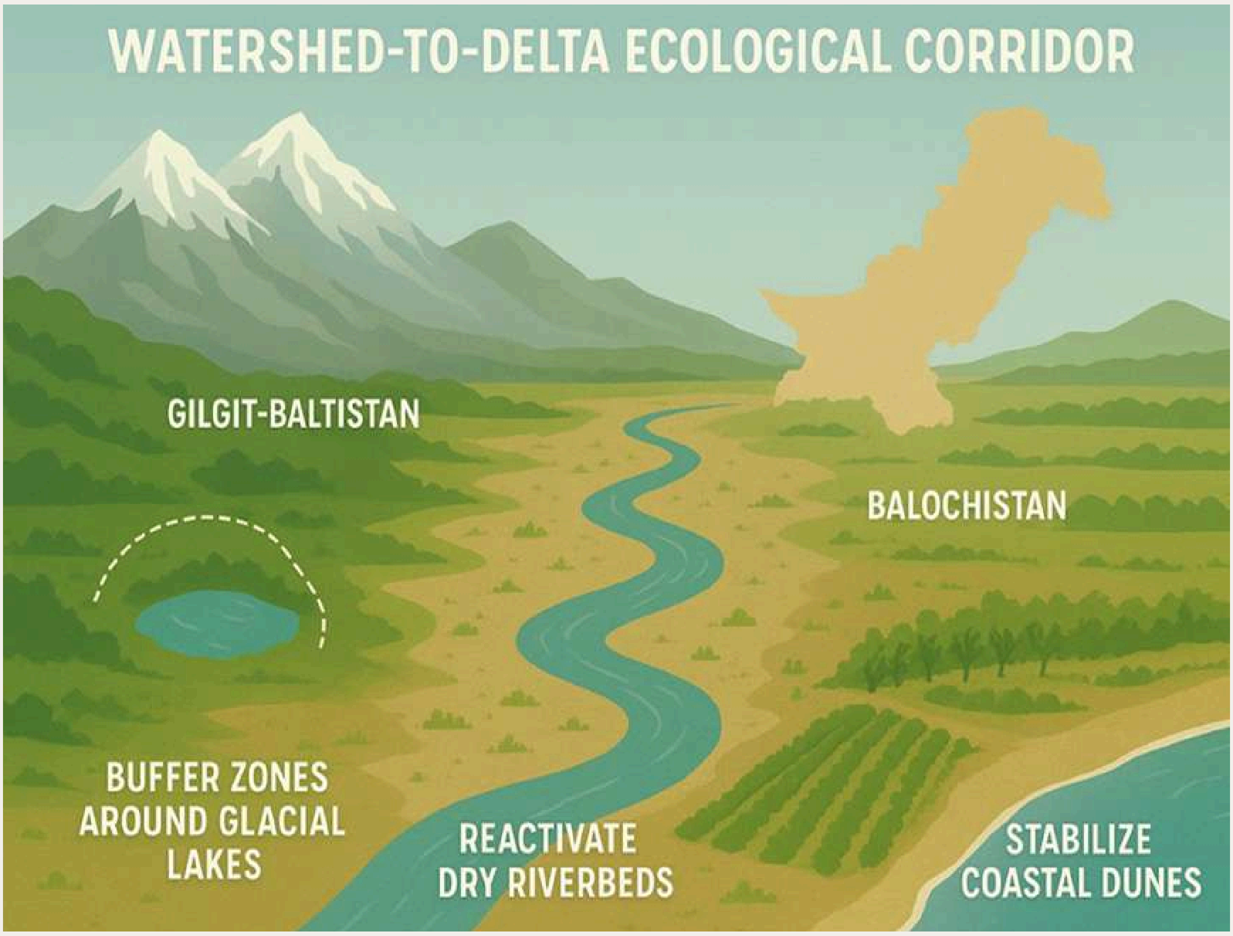


4.1.3 Resilient Infrastructure Development

- Infrastructure failures during Monsoon 2025 showed that Pakistan must shift from simple repair work to building resilience through smarter design.
- The government should pilot floating modular schools and clinics in Sindh's floodplains and the Indus Delta, ensuring that education and healthcare continue even when floodwaters rise.
- In Punjab's low-lying districts, submersible roads could be constructed to endure seasonal flooding rather than being destroyed by it a design already proven effective in other flood-prone regions around the world.
- Along the coast, emergency modular desalination and water storage ponds should be developed to provide safe drinking water when floods or storm surges contaminate regular supplies.

4.1.4 Ecosystem-Based Solutions for Flood Management

- Pakistan has made progress in mangrove afforestation, but the broader adoption of ecosystem-based disaster solutions remains fragmented and limited in scale.
- The country should adopt a “watershed-to-delta ecological corridor” strategy that connects mountain, plain, and coastal ecosystems within a unified resilience framework.
- The above approach would include establishing buffer zones around glacial lakes in Gilgit-Baltistan and Khyber Pakhtunkhwa to regulate meltwater flow, reactivating dry riverbeds in the Cholistan and Thar deserts to channel monsoon runoff into underground recharge zones, and stabilizing coastal dunes in Balochistan through hybrid vegetative belts that combine native species with engineered barriers.
- These integrated ecological measures would strengthen natural water regulation, enhance storm surge buffering, and build long-term drought resilience.
- By aligning development with natural systems, Pakistan can create a sustainable and climate-resilient future



4.1.5 Agriculture and Livelihood Resilience

- Agriculture and fishing communities faced severe losses during the 2025 monsoon season, yet livelihood protection continues to receive little attention in disaster management frameworks.
- Pakistan should establish a National Fisherfolk Insurance Scheme to safeguard against the loss of boats, nets, and fish-processing infrastructure—assets that are vital to coastal economies but currently excluded from standard relief programs.
- In Sindh’s floodplains, floating hydroponic farms could be introduced to ensure continuous food production during prolonged inundation, minimizing crop losses and enhancing local food security.
- Similarly, Climate-Resilient Pastoral Corridors in arid regions such as Thar, Cholistan, and Kharan should be developed, equipped with fodder banks and water points to sustain livestock during droughts and disrupted grazing seasons.

4.1.6 Health Systems and Social Protection

- Pakistan's health system continues to operate reactively, struggling to meet the specific health challenges that emerge during disasters.
- Specialized mobile health units should be introduced during the monsoon season to address region-specific risks such as waterborne and vector-borne diseases in Punjab and Sindh, injuries and hypothermia in flood-affected areas of KP and Balochistan, and altitude-related complications during monsoon rains in Gilgit-Baltistan.
- Above units would ensure timely medical response and reduce preventable mortality in high-risk zones.
- In addition, post-disaster trauma and mental health clinics should be established within district hospitals to support individuals coping with stress, loss, and displacement—an area long overlooked in Pakistan's emergency health planning.
- To improve living standards for disaster-affected populations, climate-smart portable shelters should be deployed. These shelters (solar powered, foldable, and equipped with rainwater harvesting systems) would offer safe, hygienic, and sustainable temporary accommodation for displaced communities in desert and coastal regions.

4.1.7 Technology and Data-Driven Systems

- Data-driven tools are transforming disaster management worldwide, yet Pakistan has only begun to tap into their potential.
- A crowdsourced flood reporting mobile application should be developed in Urdu and regional languages, enabling citizens to upload photos and geotag locations of blocked drains, inundated roads, and damaged infrastructure to alert and prompt timely response from local authorities (ADB, 2024; PDMA Sindh, 2025).
- To enhance transparency and accountability, blockchain technology could be introduced to track relief distribution, ensuring aid reaches intended beneficiaries while reducing corruption and duplication.
- Additionally, digital twin simulations of major cities such as Karachi, Lahore, and Gwadar should be created to virtually model disaster scenarios, allowing planners to test infrastructure resilience, evacuation strategies, and climate adaptation measures before crises occur.

4.1.8 Disaster Risk Financing and Risk Transfer Mechanisms

- Pakistan's disaster financing remains heavily reactive, with most funds mobilized only after crises occur.
- The country should adopt innovative financial instruments that promote proactive resilience-building. Resilience bonds, which link investor returns to the success of disaster prevention projects, could attract private sector participation in financing flood defenses, drainage systems, and coastal protection.
- In high-risk rural areas, community savings and credit resilience groups could be established to create locally managed funds that release pooled resources automatically based on rainfall or flood indices, helping households recover quickly without waiting for external aid.
- Additionally, diaspora-backed catastrophe bonds could be launched to enable overseas Pakistanis to directly contribute to national climate resilience efforts, expanding the financial base beyond government and donor support.

4.1.9 Education, Training and Capacity Building

- Capacity building in Pakistan continues to be fragmented and project-based rather than institutionalized.
- Establishing a Pakistan School of Resilience Studies a consortium of universities dedicated to disaster science, climate resilience, and leadership would provide a permanent platform for advanced training and research.
- Local government officials in hazard-prone districts should be required to obtain certification in community-based disaster risk management (CBDRM), ensuring that preparedness and response decisions are rooted in practical field knowledge.
- Vocational resilience programs should be introduced to train youth in critical life-saving skills such as solar system repair, boat operation, drone-based mapping, and emergency medical response. Prioritizing these skills in coastal, desert, and mountainous regions would empower local populations to become first responders and active contributors to disaster resilience rather than passive recipients of aid.

4.1.10 Strengthening Community-Based Resilience

- While community-based disaster risk management (CBDRM) initiatives do exist in some pilot projects, they remain limited in scale and lack the innovation needed to truly empower communities. These efforts often reach only a small number of people and struggle to move beyond traditional awareness activities missing the chance to build genuine local ownership and long-term resilience.

- Women’s Resilience Brigades should be formally established in high-risk union councils, granting them legal authority to lead evacuations, manage relief distribution, and conduct awareness campaigns. Empowering women at the frontline not only enhances disaster response but also strengthens social cohesion and trust within communities.
- Side by side, community-owned micro-energy grids powered by solar and wind in regions such as Makran and Thar should be prioritized. These decentralized energy systems would ensure uninterrupted communication, lighting, and essential services during disasters making communities less dependent on fragile national power networks.
- Finally, the creation of Village Resilience Micro-Centres would transform the local landscape of preparedness. These multipurpose spaces could serve as community halls during normal times and as emergency shelters when disasters strike equipped with solar power, rescue gear, first aid supplies, and food reserves. Anchoring resilience within daily community life, rather than leaving it to distant authorities, would mark a decisive shift toward people centred disaster management in Pakistan.

4.1.11 Revamping the Canal System of Pakistan

- The Indus Basin canal system one of the world’s largest irrigation networks has become both a lifeline for agriculture and a major flood risk. Much of it is outdated, silted, and poorly maintained, turning canals into unregulated flood channels during the 2025 monsoon.
- A national revamp plan is essential. This should include large-scale desilting, installation of digital flow sensors and automated gates, canal lining in high-seepage areas, and creation of flood basins to store excess water
- Embankments must be rebuilt with flood-resilient designs and strict action taken against encroachments. By redesigning canals to also manage floodwaters, Pakistan can turn its aging irrigation network from a recurring liability into a key defence against climate-induced disasters.

4.2 Broader Water & Flood Management Measures (In addition to the Sectoral Best Practices)

- Removal of encroachments from all the rivers and restore Right of Way (R.O.W) of the rivers (Ravi, Sutlej, Chenab, Jhelum, Indus)
- Immediate enactment of River Act by Balochistan, GB and AJ&K
- Removal of encroachments from the tributary, secondary and tertiary rivers, nullahs, streams by all the four provinces, GB, AJ&K from within their respective areas of jurisdiction.
- Selected dredging of Rivers Ravi, Sutlej to cater for future very high releases from India
- Multi Hazard Vulnerability & Risk Assessment of Priority-I most flood vulnerabile districts of Pakistan
- Installation of of flood telemetry gauges: i) GB, ii) AJ&K, iii) KP under Short Term measures
- 100% operationalization of District Disaster Management Authorities on priority: i) GB, ii) AJ&K, iii) KP under Short Term measures
- Based on the experience of 2022 and 2025 urban rains and floods construction of underground storm water tanks/ponds in selected major cities prone to the risk of pluvial flooding for the beneficial use of water

- Approve and Launch draft National Water Conservation Strategy
- Launch rainwater harvesting and public awareness campaigns
- Formulate National Watershed Management Plan
- On the pattern of Leh Nullah Flood Forecasting & Warning System develop early warning systems for floods and storm water management for cities most vulnerable to urban flooding and drainage issues
- Formulate SOPs for urban flood management through conjunctive use of storm water including city nullahs/streams,
- Formulate guidelines for incorporating legal, environmental, social/gender and climate change aspects in flood protection project planning and preparation,
- Study for revision of flood limits for eastern and western rivers and flood classification of all rivers
- With the accelerated decline in snow cover and its ramifications on water security begetting even more significant implications for the Indus Basin, following actions need to be taken:
    - Increase density of snow observation stations with the integration of remote sensing techniques for improving accuracy in snow cover monitoring.
    - Upgrade existing high-resolution snow models to better predict seasonal and long-term snow cover changes and their hydrological impacts.
    - Integrate snow cover inputs to hydrological models used by water management agencies for more accurate predictions for river flow and water availability.
    - Strengthen Glacier Monitoring Research Centre (GMRC) by:
    - Enhancing technical capacity for glacier monitoring & data collection
    - Installing remote sensing and GIS-based monitoring tools in key glacier regions, such as the Neelum Valley, linking data to national climate repositories.
    - Establishing regional glacier monitoring stations in collaboration with organizations like the Pakistan Meteorological Department (PMD).
    - Deploying automated weather stations (AWS) and GPS-based monitoring in critical glacial areas to enhance data accuracy.
    - Integrating GMRC's efforts into national hydro-meteorological networks for a coordinated response to glacial hazards.

5. Way Forward

In line with 4.1 and 4.2:

- The road to resilience requires more than emergency relief.
- It demands a paradigm shift from reactive disaster management to proactive risk reduction.
- Implementing sectoral best practices in governance, infrastructure, health, livelihoods, and technology will require sustained financing, political will, and community ownership.
- International climate finance through the Green Climate Fund (GCF), Adaptation Fund (AF) and the Loss and Damage Fund must be accessed strategically to support resilience-building.
- By aligning the Monsoon Preparedness Plan 2026 with the Sendai Framework for Disaster Risk Reduction (SFDRR, the Paris Agreement, Sustainable Development Goals (SDGs), National Flood Protection Plan -IV (NFPP-IV), National Master Plan for Flood Telemetry Network in Pakistan, Pakistan's National Adaptation Plan and Nationally Determined Contributions -3.0 (NDC 3.0), the country can safeguard lives, livelihoods, and development gains by adopting hybrid disaster management strategies including in particular the nature based solutions
- If above recommendations are systematically operationalized, Pakistan can move from a cycle of devastation and recovery to one of anticipation, adaptation, and sustainable resilience.

6. References

1. World Bank. Climate Change Knowledge Portal: Pakistan historical climate and climatology (1961–2020). https://climateknowledgeportal.worldbank.org/country/pakistan/climate-data-historical

2. Ullah, S., Iqbal, M. F., Ashraf, M., & Ijaz, M. W. (2023). An increasing trend in daily monsoon precipitation extreme indices over Pakistan and its relationship with atmospheric circulations. Frontiers in Environmental Science, 11, 1228817. https://www.frontiersin.org/articles/10.3389/fenvs.2023.1228817/full

3. Hussain, D., Ahmed, K., Ullah, S., & Zhang, Q. (2025). Classification of extreme precipitation events in Pakistan and their multiscale interaction mechanisms. Atmospheric Research, 308, 107612. https://doi.org/10.1016/j.atmosres.2025.107612

4. ICIMOD (2025). HKH Monsoon Outlook 2025. International Centre for Integrated Mountain Development (ICIMOD).

5. Houze, R. A., Rasmussen, K. L., Medina, S., Brodzik, S. R., & Romatschke, U. (2011). Anomalous atmospheric events leading to the summer 2010 floods in Pakistan. Bulletin of the American Meteorological Society, 92(3), 291–298. https://doi.org/10.1175/2010BAMS3173.1

6. Nie, J., Boos, W. R., & Kuang, Z. (2016). Forcings and feedbacks on convection in the 2010 Pakistan flood: Modeling extreme precipitation with interactive large-scale ascent. Journal of the Atmospheric Sciences, 73(10), 4093–4114. https://doi.org/10.1175/JAS-D-15-0232.1

7. Alam, A. (2014). Understanding the Changes in the River Ravi Basin. Cornell University. https://ecommons.cornell.edu/handle/1813/38901

8. Boota, M. W., Yan, C., Idrees, M. B., Li, Z., Soomro, S. E. H., Dou, M., Zohaib, M., & Yousaf, A. (2021). Assessment of the morphological trends and sediment dynamics in the Indus River, Pakistan. Journal of Water and Climate Change, 12(7), 3082–3098. https://doi.org/10.2166/wcc.2021.125

9. Brakenridge, G. R., Syvitski, J. P. M., Niebuhr, E., Overeem, I., Higgins, S. A., Kettner, A. J., & Prades, L. (2013). Causation and avoidance of catastrophic flooding along the Indus River: The 2010 Tori Bund avulsion. GSA Today, 23(1), 4–10. https://doi.org/10.1130/GSATG165A.1

10. Gaurav, K., Sinha, R., & Panda, P. K. (2011). The Indus flood of 2010 in Pakistan: A perspective analysis using remote sensing data. Natural Hazards, 59(3), 1815–1826. https://doi.org/10.1007/s11069-011-9869-6

11. PreventionWeb. (2022). Q&A: Pakistan will have to adapt to floods as new normal. https://www.preventionweb.net/news/qa-pakistan-will-have-adapt-floods-new-normal

12. Associated Press. (2025, September 17). Flood survivors begin to return home in Pakistan's eastern Punjab as water recedes. AP News. https://apnews.com/article/c5daf47c5fbed329cc5b8c5a8816c250

13. Associated Press. (2025, July). Heavy monsoon rains in Pakistan kill 54 people in 24 hours. AP News. https://apnews.com/article/708baaf43d0d3b530f4507e8c116c754

14. Dawn. (2024, March 1). Heavy rains cause deadly floods in Pakistan; state of emergency declared in Sindh and Balochistan. Dawn. https://www.dawn.com/news/1811222

15. NDMA (2024, March). Daily Situation Report: Floods in Sindh and Balochistan. Islamabad: Government of Pakistan.

16. PDMA- Balochistan (2024, March). Flood Situation Updates. Quetta: Government of Balochistan.
17. Reuters. (2025, September 12). Boat capsizes in Pakistan floods, killing nine, authorities say. Reuters. https://www.reuters.com/business/environment/boat-capsizes-pakistan-floods-killing-nine-authorities-say-2025-09-12
18. The Guardian. (2025, August). Pakistan floods: Dozens killed in Swat as flash floods devastate valley. The Guardian. https://www.theguardian.com/world/2025/aug/27/pakistan-floods-dozens-killed-swat
19. The Times of India. (2025, September). Pakistan floods: Buner district worst-hit in Khyber Pakhtunkhwa. Times of India. https://timesofindia.indiatimes.com/world/pakistan/pakistan-floods-buner-district-worst-hit-in-khyber-pakhtunkhwa/articleshow/112233445.cms
20. United Nations Office for the Coordination of Humanitarian Affairs (OCHA). (2025, September 10). Pakistan: Floods Situation Report No. 5. ReliefWeb. https://reliefweb.int/report/pakistan/pakistan-floods-situation-report-no-5-10-september-2025
21. Imdad, Z., Baber, H., Bacha, U., Khaliq, F., Hayat, A., Taj, I. A., Naqash, T., & Nagri, J. (2025, July 22). Over 200 killed as flash flooding devastates country's northern areas. Dawn News. https://www.dawn.com/news/1931033
22. Ali, F., Hassan, L., Naveed, A., Khursheed, M., Komal, I., & Usman, Z. (2025, July 23). Death toll from floods, cloudburst in KP crosses 300. Aaj News. https://english.aaj.tv/news/330429574/death-toll-from-floods-cloudburst-in-kp-crosses-300
23. Alkhidmat Foundation (2025). Pakistan floods emergency appeal 2025.https://alkhidmat.org/floods-in-pakistan.
24. NDMA (2025, September 2). NDMA monsoon 2025 daily situation report No. 69 [PDF].https://www.ndma.gov.pk/storage/sitreps/September2025/PJ9nrdwBZkY5yYaAW1B5.pdf
25. NDMA (2025). NDMA monsoon contingency plan 2025 [PDF]. https://www.ndma.gov.pk/storage/plans/June2025/yMhAUWuWvqAWSzGyIlbY.pdf
26. PRCS (2025). Early action protocol summary 2025. International Federation of Red Cross and Red Crescent Societies (IFRC).
27. National Disaster Management Authority. (2025, March). National Disaster Management Plan, 2025 [PDF]. https://www.ndma.gov.pk/storage/plans/March2025/sps3g997GvbYIOEpwvKw.pdf
28. Anticipation Hub (2025). The Pakistan Red Crescent Society implements anticipatory actions for floods along the Indus River and its tributaries. https://www.anticipation-hub.org/news/the-pakistan-red-crescent-society-activates-early-actions-for-flooding-at-the-chenab-river
29. Associated Press (2025, September 1). Pakistani rescuers use drones to help evacuate thousands as floods devastate Punjab. AP News. https://apnews.com/article/pakistan-flood-drones-evacuations-punjab f128d5629f50c5d75020fcee3b8fcce4
30. United Nations Office for the Coordination of Humanitarian Affairs (2025). Pakistan: Inter-Agency Monsoon Contingency Plan 2025. https://www.unocha.org/publications/report/pakistan/pakistan-inter-agency-monsoon-contingency-plan-2025
31. Associated Press (2025). Pakistan evacuates 25,000 people from eastern city as rivers threaten flooding. AP News. https://apnews.com/article/pakistan-floods-threaten-punjab-city-evacuations-6e73e1eccfda4fce157a13e8a19f380b

32. Associated Press (2025, October 1). Crowded camps, stagnant water and not enough doctors: first the floods, now disease stalks millions in Pakistan. The Guardian. https://www.theguardian.com/global-development/2025/oct/01/floods-now-disease-cholera-dengue-malaria-stalks-millions-in-pakistan

33. NASA Earth Observatory (2023, September 9). Monsoon rains flood Pakistan. https://earthobservatory.nasa.gov/images/154781/monsoon-rains-flood-pakistan

34. Zachariah, M., Saeed, F., Clarke, B., Kimutai, J., Ijaz, S., Irfan, K., Ullah, A., Sadad, A., Ahmad, I., Rashid, I. U., Singh, R., Vahlberg, M., Scholz, C., Baumgart, N. J., Raju, E., & Otto, F. (2025). Climate change intensified heavy monsoon rain in Pakistan, exacerbating urban floods that impacted highly exposed communities. Imperial College London. https://spiral.imperial.ac.uk/server/api/core/bitstreams/a0162fc8-0ed7-4d2e-944a-9ec76bf7666d/content

35. Ashfaq, M., Johnson, N., Kucharski, F., Diffenbaugh, N. S., Abid, M. A., Horan, M. F., Singh, D., Mahajan, S., Ghosh, S., Ganguly, A. R., Evans, K. J., & Islam, S. (2023). The influence of natural variability on extreme monsoons in Pakistan. npj Climate and Atmospheric Science, 6(1), Article 148. https://doi.org/10.1038/s41612-023-00462-836. Ibrahim, M., & Khan, H. A. (2025, August 27). Pakistan says 210,000 evacuated as army expands flood relief operations in Punjab. Arab News. https://www.arabnews.com/node/2613204/pakistan arabnews.com

37. Associated Press (2025). Pakistan evacuates 25,000 people from eastern city as rivers threaten flooding. AP News. https://apnews.com/article/pakistan-floods-threaten-punjab-city-evacuations-6e73e1eccfda4fce157a13e8a19f380b

38. Anticipation Hub. (2025). Early action and community preparedness case studies – Pakistan. Anticipation Hub.

39. NDMA (2025). International Simulation Exercise (CISE 1/2025) at NEOC. https://ndma.gov.pk/pages/single-news/international-simulation-exercise-cise-1-2025-at-neoc

40. NDMA (2025). CISE 3/2025 | Global preparedness in action. Retrieved from https://www.ndma.gov.pk/public/pages/single-news/cise-3-2025-global-preparedness-in-action

41. The Nation (2025, May 21). NDMA conducts national simulation exercise focused on flood, GLOF hazards. The Nation. https://www.nation.com.pk/21-May-2025/ndma-conducts-national-simulation-exercise-focused-on-flood-glof-hazard

42. NDMA (2025). Humanitarian Conference 2025 on enhanced coordination for early warning & preparedness for monsoon 2025. https://www.ndma.gov.pk/pages/single-news/humanitarian-conference-2025-on-enhanced-coordination-for-early-warning-and-preparedness-for-monsoon-2025

43. Asian Development Bank. (2025). Punjab intermediate cities improvement investment program: Drainage and flood resilience assessment. Manila: ADB. https://www.adb.org

44. Azad Jammu and Kashmir State Disaster Management Authority (AJK-SDMA). (2025). Situation report: Floods and landslides in AJK (August 2025). Muzaffarabad, Pakistan.

45. Dawn. (2025, September 20). Karachi losing mangrove cover due to land allotment, Senate panel told. Dawn News. https://www.dawn.com/news/1780530

46. Food and Agriculture Organization (2025). Fisheries and coastal livelihoods in Pakistan: Resilience and vulnerabilities. FAO Regional Office for Asia-Pacific. https://www.fao.org/documents

47. NDMA (2025, August 27). Situation Report #63 (Monsoon 2025). Islamabad, Government of Pakistan. https://www.ndma.gov.pk/storage/sitreps/August2025/sbcOhLH3UIfcZbRGtrq3.pdf
48. NDMA (2025). Monsoon 2025 situation reports. https://www.ndma.gov.pk/sitrepm
49. Pakistan Meteorological Department (PMD). (2025). Seasonal and event-based flood updates 2025. Government of Pakistan. https://www.pmd.gov.pk
50. Provincial Disaster Management Authority (PDMA) Balochistan. (2025). Monsoon 2025 situation reports. Government of Balochistan. https://pdma.gob.pk
51. Provincial Disaster Management Authority (PDMA) Khyber Pakhtunkhwa. (2025). Summer hazards contingency plan 2025. Peshawar: Government of Khyber Pakhtunkhwa. https://www.pdma.gov.pk/public/storage/downloads/files//DtdsirUd6HIva2QHhLcx8abhyQOEWVVrj4clDMlV.pdf
52. Provincial Disaster Management Authority (PDMA) Punjab. (2025). Monsoon situation report: Flood impacts and response in Punjab (August–September 2025). Lahore: PDMA Punjab.
53. Provincial Disaster Management Authority (PDMA) Sindh. (2025). Monsoon 2025 situation reports and advisories. Government of Sindh. https://pdma.gos.pk/monsoon-2025-situation-reports/
54. ReliefWeb / United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA). (2025). Pakistan: Monsoon floods 2025 – Situation reports and flash updates. ReliefWeb. https://reliefweb.int
55. United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA). (2025). Pakistan humanitarian update: Floods and coastal surge 2025. ReliefWeb. https://reliefweb.int
56. World Health Organization (WHO). (2025, August 29). Health emergency and response updates: Pakistan floods 2025. WHO Pakistan Office. https://www.emro.who.int
57. World Wide Fund for Nature (WWF) Pakistan. (2025). Substantial rehabilitation of mangrove forests along the Indus Delta. Journal of Environmental Management. https://www.sciencedirect.com/science/article/pii/S1470160X25007678
58. Ali, S., Hussain, A., & Khan, N. (2024). Bridging the gap between local knowledge and institutional practices: Flood preparedness in northern Pakistan. International Journal of Disaster Risk Reduction, 101, 103210. https://doi.org/10.1016/j.ijdrr.2024.103210
59. Hasnain, S., Khan, M. A., & Qureshi, S. (2024). Coastal vulnerability and disaster risk reduction along the Makran coast of Pakistan. Journal of Coastal Research, 39(2), 233–245. https://doi.org/10.2112/JCOASTRES-D-22-00045.1
60. World Wide Fund for Nature (WWF). (2024, March). Effective partnerships urged to improve mangroves in the Indus Delta. WWF Pakistan. https://www.wwfpak.org/?392236
61. Qureshi, M. S., Batool, Z., & Mehmood, R. (2023). Urban flood management challenges in Pakistan: The case of Rawalpindi's Nullah Leh. Journal of Urban Management, 13(1), 45–57. https://doi.org/10.1016/j.jum.2023.09.004
62. United Nations Development Programme (UNDP). (2023). Scaling-up of Glacial Lake Outburst Flood (GLOF-II) risk reduction in northern Pakistan. https://www.pk.undp.org
63. World Bank. (2023). Strengthening flood early warning and community preparedness in Punjab: Policy review. Washington, DC: World Bank. https://documents.worldbank.org

64. World Bank. (2023). Pakistan: Building disaster resilience in mountainous areas (Policy Review). Washington, DC: World Bank. https://documents.worldbank.org
65. Hasson, S. U., et al. (2022). Glacial hazards and climate adaptation in the Hindu Kush Himalaya. Sustainability, 14(12), 7551. https://doi.org/10.3390/su14127551
66. National Flood Protection Plan I, 1978, Supporting Volume II.
67. FFC, 2023. Annual Flood Report 2023. Federal Flood Commission. https://ffc.gov.pk/wp-content/uploads/2024/07/Annual-Report-2023.pdf
68. Global Climate Change Impact Studies Center (GCCISC).

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