

From Reactive Response to Proactive Resilience: Reforming Pakistan's Disaster Management System: An Assessment of Institutional Coordination, Early Warning Systems, Community Resilience and Disaster Risk Reduction

Muhammad Haroon Khalid

Business Administration, Allama Iqbal Open University, Islamabad, Pakistan

Email: muhammadharoonjutt8@gmail.com

Abstract

Pakistan faces a complex and increasingly interconnected disaster-risk environment involving floods, droughts, earthquakes, heatwaves, landslides, glacial lake outburst floods, storms, urban hazards, and other human-induced emergencies. Although the country has developed a formal disaster-management architecture since the 2005 earthquake, including the National Disaster Management Act 2010 and a multi-level system of national, provincial, and district institutions, recurring disasters reveal persistent implementation and governance gaps. This paper examines how Pakistan can shift from a predominantly reactive disaster-response model toward proactive disaster risk reduction and national resilience. Using secondary data from government strategies, international assessments, and peer-reviewed literature, the study evaluates four interrelated dimensions: institutional coordination, early warning and anticipatory action, local/community capacity, and risk-informed recovery and financing. Evidence indicates that Pakistan's principal challenge is not the complete absence of institutions or policies; rather, it is the uneven translation of policy into coordinated, adequately financed, and locally actionable risk reduction. The 2022 floods illustrate the economic and social consequences of weak preparedness, fragmented coordination, and insufficient investment in resilience. The paper proposes a Proactive Disaster Resilience Framework that links hazard identification, risk assessment, early warning, anticipatory action, preparedness, resilient recovery, learning, and risk financing. It recommends clearer federal–provincial–district roles, stronger district capacities, interoperable data and GIS systems, people-centred early warning, pre-arranged financing, risk-informed land-use planning, regular simulation exercises and systematic community participation. The paper concludes that disaster management reform should be treated not only as an emergency-management issue but as a national development, climate-adaptation and governance priority.

Keywords: Pakistan; disaster risk reduction; disaster management; resilience; early warning systems; climate change; institutional coordination; community resilience; anticipatory action.

Introduction:

Disasters increasingly constitute a governance and development challenge rather than an isolated emergency-response problem. A hazard becomes a disaster when exposure and vulnerability interact with insufficient coping capacity. For Pakistan, this interaction matters because the country combines high exposure to floods, earthquakes, droughts, heatwaves, and other hazards with substantial socioeconomic vulnerability and uneven institutional capacity.

The World Bank's country risk profile identifies flooding, earthquakes, drought, and other hazards as major components of Pakistan's disaster-risk profile (World Bank, 2021).

Pakistan's experience also demonstrates the high cost of repeated shocks. The 2022 floods produced estimated damages exceeding US\$14.9 billion and economic losses of about US\$15.2 billion, while resilient rehabilitation and reconstruction needs were estimated at least US\$16.3 billion (World Bank, 2022). These figures demonstrate that the cost of prevention and preparedness must be considered against the much greater cost of post-disaster recovery.

The institutional evolution of Pakistan's disaster-management system accelerated after the 2005 earthquake. The National Disaster Management Ordinance 2006 and subsequently the National Disaster Management Act 2010 established a formal architecture involving national, provincial and district structures. Nevertheless, research has identified jurisdictional overlap, duplication of responsibilities, resource constraints and coordination weaknesses as persistent problems (Khan et al., 2020). More recent international assessments likewise identify weak federal–provincial coordination, unclear roles, limited stakeholder capacity, insufficient integrated risk-reduction investment and inadequate disaster-risk financing as major constraints (IMF, 2025).

The policy environment has nevertheless evolved. Pakistan's National Disaster Risk Reduction Strategy 2025–2030 explicitly promotes proactive planning, inclusive governance, technological innovation, institutional capacity, early warning, local empowerment, and resilience (NDMA, 2025). This creates an important policy window for shifting the research question from whether Pakistan needs a disaster-management system to how the existing system can be transformed into a more anticipatory, decentralized, and resilience-oriented system.

Accordingly, this paper addresses the following research problem: despite the existence of laws, institutions, and disaster plans, why does Pakistan continue to experience substantial disaster losses, and what reforms can improve the conversion of risk information into preparedness and resilience?

Research Objectives:

- i. To assess the strengths and weaknesses of Pakistan's disaster-management architecture using secondary evidence.
- ii. To examine institutional coordination between national, provincial, and local levels.
- iii. To evaluate the role of early warning systems, technology, and anticipatory action in disaster-risk reduction.
- iv. To assess the importance of community participation and local institutional capacity.
- v. To propose a practical framework for moving Pakistan from reactive response toward proactive resilience.
- vi. To develop policy recommendations that can be implemented through existing institutions and the National DRR Strategy 2025–2030.

Research Questions:

- i. How effective is Pakistan's existing disaster-management system in reducing disaster risk?
- ii. What institutional and coordination gaps constrain preparedness and response?

- iii. To what extent can early warning, GIS, data systems and anticipatory action reduce disaster losses?
- iv. What role should district authorities and communities play in disaster-risk reduction?
- v. What reforms are required to integrate disaster risk reduction into development planning, financing and recovery?

Literature Review:

The literature on disaster governance has progressively moved from emergency response toward disaster risk reduction, resilience, and anticipatory governance. The Sendai Framework for Disaster Risk Reduction 2015–2030 emphasizes understanding disaster risk, strengthening risk governance, investing in resilience, and enhancing preparedness for effective response and recovery. This shift is particularly relevant for developing states where repeated disasters can reverse development gains.

In Pakistan, Khan et al. (2020) found that disaster-management authorities experienced jurisdictional overlap, duplication of responsibilities, insufficient resources, and coordination problems across institutional tiers. Their findings suggest that institutional creation alone does not guarantee effective disaster-risk governance. Capacity, accountability, resources, and clarity of mandates are equally important. Research on inter-agency collaboration after the 2005 earthquake demonstrates the benefits of coordination among government agencies, NGOs, relief organizations and communities. Shah et al. (2022) argue that coordinated interventions helped reduce duplication and improve the delivery of relief and rehabilitation, while the establishment of ERRA provided an institutional mechanism for reconstruction and coordination.

Early warning research also indicates that technical forecasting is insufficient when warnings do not reach vulnerable populations in usable form. Studies of the Indus River Basin emphasize the importance of linking hydrometeorological early warning to multilevel governance and community knowledge rather than relying solely on centralized, technocratic systems (Maskrey et al., 2016). Research on flood early warning in urban Pakistan similarly highlights the importance of communication, trust, local interpretation, and community response capacity (Rana et al., 2021). Recent scholarship further emphasizes that Pakistan's flood risk is multidimensional. The state-of-the-art review by Rana et al. (2023) shows that Pakistan flood research spans hazards, vulnerability, land use, health, infrastructure, gender, communication, and institutional capacity, but also identifies continuing gaps in integrating these dimensions into a coherent risk-governance system. The implication is that Pakistan needs a whole-of-government and whole-of-society approach rather than separate hazard-specific interventions.

The literature therefore points to four recurring reform requirements: first, clearer institutional mandates and vertical coordination; second, stronger local capacity; third, people-centred early warning and anticipatory action; and fourth, integration of risk reduction into development, infrastructure and public finance. These themes form the analytical basis of this paper.

Methodology:

The study uses a qualitative, policy-oriented secondary-data research design. No primary survey or interview data were collected. Evidence was drawn from Pakistan government documents, the National Disaster Management Authority (NDMA), World Bank assessments,

IMF country reports, peer-reviewed journal articles, and international disaster-risk frameworks. The literature was selected for relevance to Pakistan’s disaster governance, institutional coordination, early warning, community resilience, climate risk, and disaster financing.

The analysis uses thematic synthesis. Four analytical dimensions were coded across the literature: (1) institutional governance and coordination; (2) early warning, technology and anticipatory action; (3) local and community capacity; and (4) risk-informed recovery and financing. The findings are then compared with the direction of the National Disaster Risk Reduction Strategy 2025–2030.

A limitation is that secondary evidence can reflect differences in measurement, institutional perspective, and publication date. The paper therefore does not claim to estimate a causal effect of individual policies. Instead, it identifies converging evidence and translates it into an institutional reform framework.

Pakistan’s Disaster Management Architecture:

Pakistan’s formal disaster-management structure is based on the National Disaster Management Act 2010 and subsequent institutional and policy developments. At the national level, NDMA functions as the federal lead agency and supports national coordination. Provincial disaster-management authorities operate under provincial arrangements, while district structures provide the critical interface with local administration and communities. The system is therefore intended to be decentralized while retaining national policy and coordination functions.

The core institutional challenge is the gap between formal decentralization and actual operational capacity. The literature indicates that local institutions may lack technical expertise, equipment, stable financing, and sufficient authority. This creates a dependency pattern in which lower tiers wait for provincial or federal support rather than acting rapidly on locally identified risks (Khan et al., 2020). The 2025–2030 National DRR Strategy responds to this issue by calling for capacity building of NDMA, PDMAs and DDMA, improved funding and equipment, GIS and early warning technology, local disaster command centres and stronger community coordination (NDMA, 2025).

Table 1: Institutions, their Principal Functions, Strengths and Vulnerabilities¹

Institutional level	Principal function	Key strength	Key vulnerability
National	Policy, standards, national coordination, forecasting/alerts, resource mobilization	National mandate and technical networks	Coordination complexity; dependence on provincial implementation
Provincial	Planning, coordination, preparedness, emergency response, resource allocation	Closer to operational realities than federal level	Uneven capacity and resources across provinces
District/local	Risk assessment, local preparedness, evacuation, first response, community interface	Direct access to communities and local knowledge	Limited staff, finance, equipment and technical capacity
Community/civil society	Preparedness, local warning dissemination, mutual aid, response and recovery	Local knowledge and social networks	Unequal participation, limited formal integration and resources

¹ Authors’ curtsy

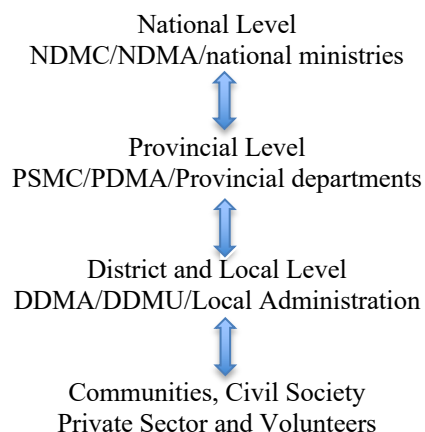


Figure 1: Multi-level Disaster Governance Model²

Evidence of Systemic Gaps:

The evidence does not suggest that Pakistan lacks policies. Rather, the central issue is implementation capacity and institutional integration. Four gaps repeatedly emerge in the literature and policy assessments.

- i. **Institutional Coordination:** Disaster management involves multiple departments: meteorology, water resources, irrigation, health, local government, rescue services, police, armed forces, civil administration, social protection agencies, and development departments. Fragmentation becomes costly when agencies use separate information systems, plans, and operational procedures. The 2022 flood experience exposed shortcomings in federal–provincial coordination and role clarity, while the IMF’s 2025 assessment specifically identified these as reform priorities (IMF, 2025).
- ii. **Early Warning and Anticipatory Action:** Pakistan possesses substantial forecasting and monitoring capabilities, but the value of an early warning depends on the complete chain from detection to decision to public action. A technically accurate warning that reaches communities too late, in inaccessible language, or without a defined evacuation or assistance mechanism cannot produce the intended reduction in losses. Research on Pakistan and the Indus Basin emphasizes the need for people-centred and multilevel warning systems (Maskrey et al., 2016; Rana et al., 2021).
- iii. **Local Capacity and Community Resilience:** Communities are usually the first affected and often the first responders. Yet disaster governance can remain institutionally top-down. Community organizations, local governments, schools, health workers, farmers, volunteers, and civil society organizations should be incorporated into preparedness planning, warning dissemination, and simulation exercises. Local participation is especially important where formal communications are disrupted or where geographic and social conditions make centralized response difficult.

² Source: Author’s synthesis based on NDMA (2025) and Khan et al. (2020).

The literature also shows that vulnerability is multidimensional. Gender, poverty, disability, livelihood dependence, location, and access to transport or communications can influence disaster outcomes. Therefore, resilience planning should identify who is likely to receive warnings, who can evacuate, who needs assistance, and who may be excluded from formal communication channels.

- iv. **Risk-Informed Recovery and Financing:** Post-disaster spending frequently dominates public attention, while risk reduction competes with immediate relief requirements. This creates a cycle in which damaged infrastructure is repaired without sufficiently changing the underlying risk. The 2022 PDNA’s call to “build back better” illustrates the need to use reconstruction as an opportunity to improve resilience rather than simply restore pre-disaster conditions (World Bank, 2022). Risk financing should also be increasingly pre-arranged so that funds are available before and immediately after a disaster instead of relying predominantly on ex-post reallocations and external assistance.

The 2022 Floods as a Stress Test:

The 2022 floods provide a useful case for evaluating Pakistan’s disaster-management system because they combined extreme rainfall, river flooding, flash flooding, and widespread socioeconomic disruption. The post-disaster assessment estimated damages above US\$14.9 billion, economic losses of approximately US\$15.2 billion, and resilient reconstruction needs of at least US\$16.3 billion (World Bank, 2022). Housing, agriculture and livestock, and transport and communications were among the sectors with the largest damages.

The case demonstrates three lessons. First, disaster risk is inseparable from development planning because infrastructure, housing, agriculture, and transport determine exposure and recovery capacity. Second, preparedness must operate before the hazard peak; once roads, bridges, and communications are disrupted, conventional response becomes more expensive and slower. Third, recovery should be used to reduce future vulnerability through resilient standards, land-use management and stronger local institutions.

The floods therefore should not be interpreted simply as a failure of emergency response. They should be understood as a stress test of the entire risk-governance chain: risk identification, land use, infrastructure design, forecasting, warning dissemination, evacuation, local response, financing, recovery and learning.

Table 2: Indicators of Disasters in Pakistan

Indicator / finding	Evidence	Management implication
2022 flood damages	> US\$14.9 billion	Prevention and resilient infrastructure can protect development assets.
2022 economic losses	~ US\$15.2 billion	Disaster risk is a macroeconomic and fiscal issue, not only an emergency issue.
Resilient reconstruction needs	≥ US\$16.3 billion	Recovery should incorporate risk reduction and climate resilience.
Major affected sectors	Housing; agriculture/livestock; transport/communications	Risk reduction must be cross-sectoral.
Institutional weaknesses	Coordination, role clarity, capacity and financing identified as constraints	Governance reform should accompany technical investments.

Proposed Proactive Disaster Resilience Framework:

This paper proposes a Proactive Disaster Resilience Framework designed around a continuous risk-governance chain. The model begins before a disaster with hazard identification and risk assessment, converts information into early warning and anticipatory action, builds local preparedness, and continues through resilient recovery and institutional learning. The framework is designed to complement rather than replace Pakistan’s existing disaster-management architecture.

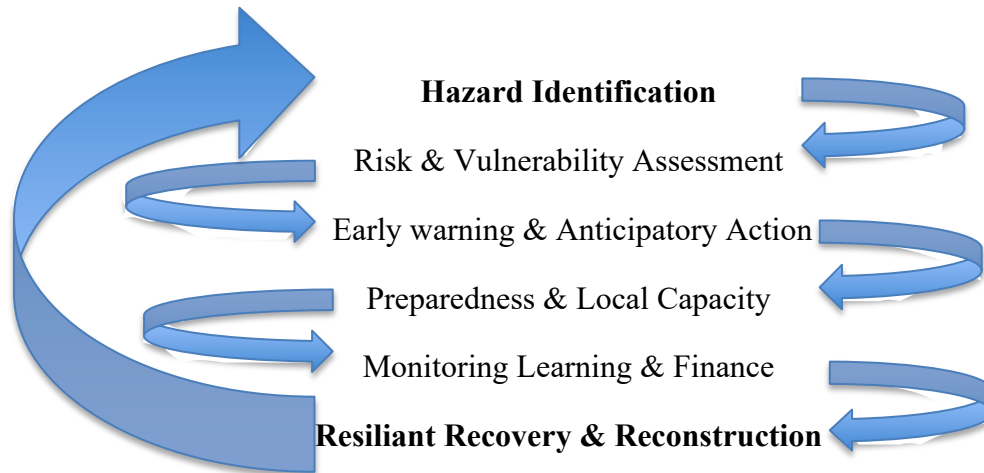


Figure 2: Proposed Proactive Disaster Resilience Framework for Pakistan³

Table 3: Suggested Secondary-Data Indicators

Dimension	Indicator	Possible source
Hazard	Number and spatial distribution of major hazard events	NDMA, EM-DAT, PMD
Exposure	Population/infrastructure in high-risk areas	PBS, NDMA, GIS datasets
Early warning	Warning lead time and geographic coverage	PMD, NDMA, PDMAAs
Preparedness	District plans, drills, shelters and stockpiles	PDMAAs/DDMAAs
Response	Response time and resource availability	Rescue/emergency agencies
Recovery	Recovery cost and proportion rebuilt to resilient standards	Planning/finance bodies, PDNA
Finance	Pre-arranged vs ex-post disaster financing	Finance Division, NDRMF, IMF
Community resilience	Training, volunteer coverage and local preparedness	PDMAAs, NGOs, local government

Conceptual Proposition:

The paper advances the following conceptual proposition for future empirical testing: stronger institutional coordination + stronger local capacity + actionable early warning +

³ Source: Author’s synthesis

anticipatory financing + risk-informed development should increase preparedness and reduce avoidable disaster losses. Future research could operationalize these variables and test the relationship quantitatively across provinces or high-risk districts.

Table 4: Stages and relevant actions, leaders and output

Stage	Key actions	Lead actors	Expected output
Risk identification	Hazard mapping; exposure databases; climate-risk assessment	NDMA, PMD, provincial departments, universities	Updated national/provincial/district risk profiles
Risk assessment	Vulnerability analysis; critical infrastructure mapping; scenario planning	PDMA, DDMA, planning departments	Prioritized risk register
Warning & anticipation	Forecasting; impact-based warnings; triggers; pre-positioning	PMD, NDMA, PDMA, local administration	Timely and actionable warnings
Preparedness	Exercises; evacuation plans; shelters; stockpiles; community training	DDMA, local government, communities	Preparedness and response readiness
Response	Incident command; search and rescue; health; logistics; protection	Civil administration, rescue services, health, security institutions	Rapid, coordinated response
Resilient recovery	Build-back-better standards; resilient infrastructure; livelihood recovery	Planning/finance departments, line ministries, provinces	Reduced future vulnerability
Learning & finance	After-action reviews; risk financing; data sharing; accountability	NDMA, finance/planning bodies, audit and oversight institutions	Continuous improvement

Technology and Digital Transformation:

Technology should be treated as an enabling layer rather than a substitute for institutions. GIS can integrate hazard, exposure, infrastructure, and demographic information. Remote sensing can support flood mapping and damage assessment. Mobile communication can disseminate warnings rapidly. Data dashboards can help decision-makers track rainfall, river levels, road closures, shelter capacity and emergency resources. Artificial intelligence and machine learning may support forecasting and pattern recognition where adequate data and validation exist.

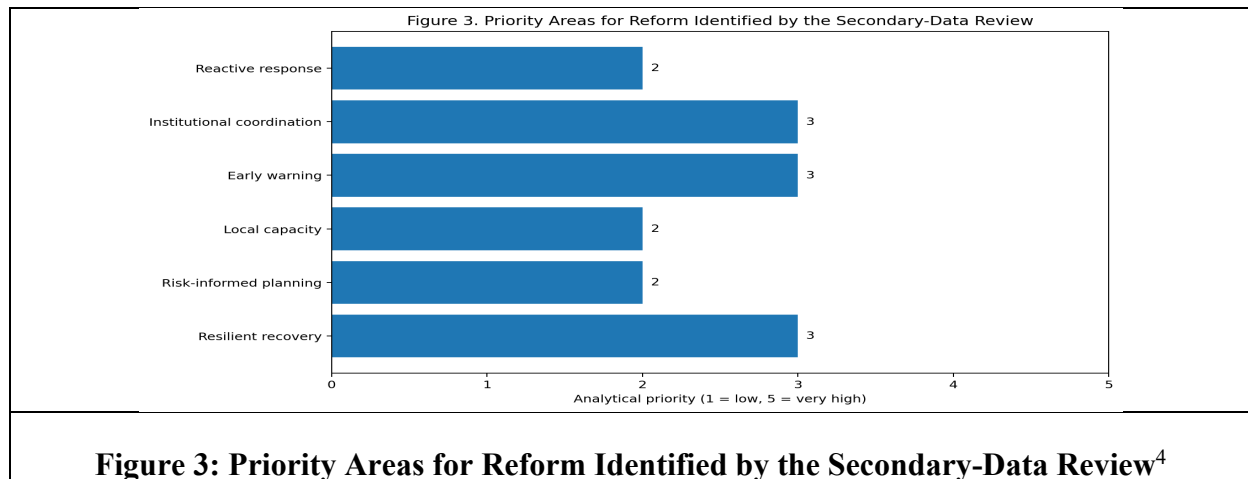
The National DRR Strategy 2025–2030 explicitly calls for GIS and early warning technologies, real-time data-sharing capabilities and local disaster command centres (NDMA, 2025). The reform priority should therefore be interoperability: national, provincial and district systems should be capable of exchanging standardized information rather than operating as isolated platforms. Technology investments should also include redundancy, cybersecurity, offline procedures and human training so that systems remain useful during power or communications failures.

Community-Centered Disaster Risk Reduction:

A proactive system must treat communities as partners rather than passive recipients of relief. Community-based disaster risk reduction can include local hazard mapping, volunteer response teams, school safety programs, household evacuation planning, first-aid training, identification of vulnerable persons, and community-level warning protocols. Local knowledge can complement scientific forecasting, particularly in mountainous, riverine and remote areas.

Community participation also improves trust. Warnings are more likely to result in protective action when people understand the source, timing, likely impact and recommended behaviour. Messages should therefore be specific, accessible and action-oriented. Local languages, trusted community institutions and multiple communication channels should be used, with special arrangements for persons who may face barriers to receiving or acting upon warnings.

Risk Financing and Resilient Development:



Disaster risk financing should move toward a layered approach. Frequent, low-cost events can be managed through contingency reserves and local budgets; medium-scale shocks can use dedicated national or provincial instruments; and catastrophic events can be supported through insurance, catastrophe risk transfer, international financing, and contingent credit. The objective is to reduce the fiscal shock created by disasters and make resources available quickly.

Table 5: Priority-wise Recommended Reforms

Priority	Recommended reform	Time horizon	Performance indicator
1.	Clarify federal–provincial–district roles and establish enforceable coordination protocols	0–2 years	Published RACI/role matrix and annual coordination exercises
2.	Strengthen DDMA/local capacity with dedicated staff, equipment and contingency resources	1–3 years	District preparedness score and response-time improvement
3.	Develop impact-based, people-centred early warning and anticipatory-action triggers	1–3 years	Warning lead time and percentage of exposed population reached
4.	Integrate GIS, risk registers and interoperable disaster information systems	1–4 years	Share of districts using standardized digital risk profiles
5.	Institutionalize community and school preparedness programs	1–4 years	Coverage of high-risk communities and annual drills
6.	Mainstream disaster-risk screening into public investment and land-use planning	2–5 years	Percentage of major projects risk-screened
7.	Expand pre-arranged disaster-risk financing	2–5 years	Share of projected emergency needs available through pre-arranged instruments
8.	Create systematic post-event learning and	Immediate/continuous	After-action reviews completed and

⁴ Note: scores are analytical priority ratings constructed by the author from the convergence of the reviewed evidence; they are not survey measurements.

accountability mechanisms	reforms tracked
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Risk reduction should also be embedded into public investment decisions. New roads, bridges, schools, hospitals, housing schemes and water infrastructure should be screened for hazard exposure and designed against relevant risk standards. Land-use planning should discourage new development in high-risk flood channels, unstable slopes and other hazardous areas where feasible. The economic rationale is straightforward: protecting an asset before a disaster is generally less expensive than repeatedly repairing it afterward.

Discussion:

The evidence supports a central proposition: Pakistan’s disaster-management challenge is primarily a problem of converting institutional capacity into coordinated risk reduction. The country has a legal framework, specialized agencies, forecasting capabilities, and increasingly explicit policy commitments to resilience. However, the benefits of these assets are reduced when responsibilities overlap, local institutions lack resources, warnings are not translated into community action, and recovery spending does not adequately reduce future risk.

The proposed framework also changes the meaning of preparedness. Preparedness should not be measured only by the existence of contingency plans. It should be evaluated through operational indicators: whether district authorities can activate plans, whether shelters are mapped and accessible, whether communications work under failure conditions, whether vulnerable households are identified, whether supplies are pre-positioned, and whether decision-makers have clear triggers for anticipatory action. A second implication is that resilience is cross-sectoral. Disaster-management authorities cannot reduce disaster risk alone. Planning, finance, agriculture, irrigation, housing, transport, health, education, local government and environmental institutions all shape exposure and vulnerability. Disaster risk reduction should therefore become a routine component of development planning and public investment appraisal.

Finally, decentralization must be accompanied by capacity. Assigning responsibility to provinces and districts without sufficient finance, personnel, equipment and technical authority can create nominal rather than effective decentralization. Pakistan’s next phase of disaster governance should therefore focus on empowering the lowest competent level while retaining national standards, technical support, coordination, and surge capacity.

Policy Recommendations:

- i. Adopt a national disaster-risk governance protocol that clearly defines responsibilities, decision authority, information flows, and escalation procedures among NDMA, PDMA, district authorities, and line departments.
- ii. Make district-level capacity a measurable national priority through minimum staffing, equipment, contingency funds, GIS capability, and annual preparedness assessments.
- iii. Shift from hazard-only warnings toward impact-based early warning that identifies expected consequences, exposed populations and required protective action.
- iv. Develop anticipatory-action protocols with predefined triggers for floods, heatwaves, droughts and other predictable hazards, linked to pre-arranged funds.
- v. Establish interoperable national and provincial disaster information systems with standardized risk registers, critical infrastructure databases and geospatial layers.

- vi. Conduct annual multi-agency and community-level simulation exercises in high-risk districts and use after-action reviews to track corrective measures.
- vii. Integrate disaster-risk screening into major public investment, urban development, housing, transport and water projects.
- viii. Strengthen community-based disaster risk reduction through local volunteers, schools, health workers, civil society organizations and trusted communication networks.
- ix. Expand disaster-risk financing through contingency reserves, insurance/risk-transfer instruments and other pre-arranged mechanisms appropriate to different layers of risk.
- x. Use post-disaster reconstruction to reduce underlying vulnerability rather than simply restoring damaged assets to their pre-disaster condition.
- xi. Develop a national resilience dashboard with a small set of indicators covering warning reach, district readiness, infrastructure resilience, financing and recovery performance.
- xii. Promote research partnerships among government agencies, universities and technical institutions to improve hazard modelling, vulnerability assessment and evidence-based policy.

Conclusion:

Pakistan's disaster-management system has evolved significantly since the 2005 earthquake, and the country now possesses a formal legal and institutional architecture for disaster risk management. The National Disaster Risk Reduction Strategy 2025–2030 provides an important policy opportunity because it explicitly recognizes proactive planning, technological innovation, institutional capacity, early warning, and local empowerment. However, repeated disasters—most dramatically the 2022 floods—demonstrate that institutional existence does not automatically produce resilience. The central reform requirement is to connect the different stages of disaster risk governance into a functioning chain: identify risk, assess vulnerability, warn early, act before impact, prepare locally, respond in a coordinated manner, recover resiliently, and learn systematically. Institutional coordination, district capacity, community participation, interoperable data, early warning and risk financing are therefore not separate reforms; they are mutually reinforcing components of one national resilience system.

Pakistan should consequently move from a relief-centred model toward a prevention- and resilience-centred model in which disaster risk is integrated into national development, climate adaptation, infrastructure investment and fiscal planning. Such a transformation would not eliminate disasters, but it can substantially reduce avoidable losses, accelerate recovery and protect development gains. The strategic objective should be a disaster-management system that anticipates risk before it becomes an emergency and treats resilience as a permanent function of governance.

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