Critical Evaluation of Mitigation Measures and Disaster Management Practices During Recent Floods

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Abstract:

This study explores the institutionalization of Disaster Mitigation and Management (DM&M) in Pakistan, highlighting the country's vulnerability to natural disasters through statistical evidence. It examines the historical evolution of DM&M institutions, dividing the analysis into pre-2005 and post-2005 periods, with a focus on challenges, gaps, and issues within the institutional framework. The research utilizes both primary (interviews with officials and experts) and secondary (policies, legislation, research literature) data. Findings reveal a lack of proactive DM&M strategies since 1947, with a reactive approach remaining the main challenge. The study identifies overlapping institutional mandates, poor coordination, and capacity issues in financial, technical, and human resources. It offers policy recommendations for a more effective, efficient DM&M framework, especially post-18th amendment, and advocates for institutional reforms at national and provincial levels.

Key words:

Disaster Mitigation, Institutional Framework, Vulnerability, Coordination, Policy Recommendations

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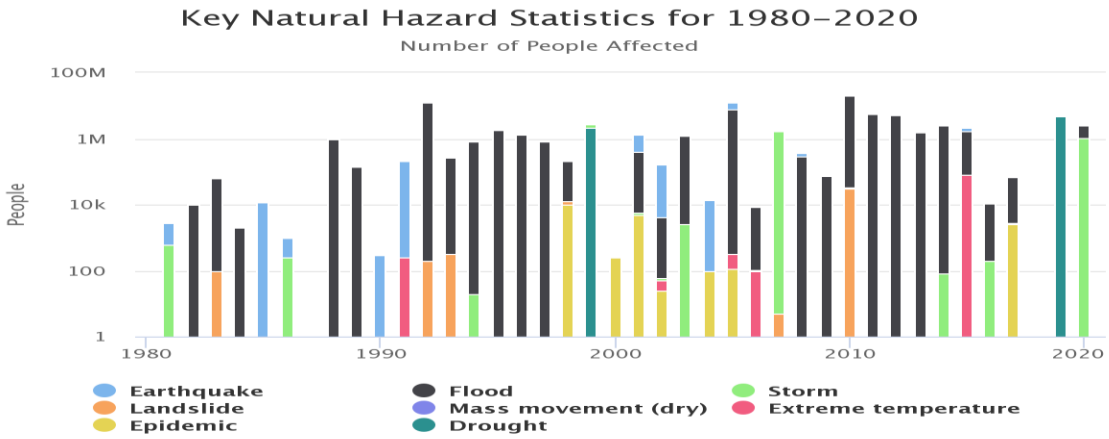
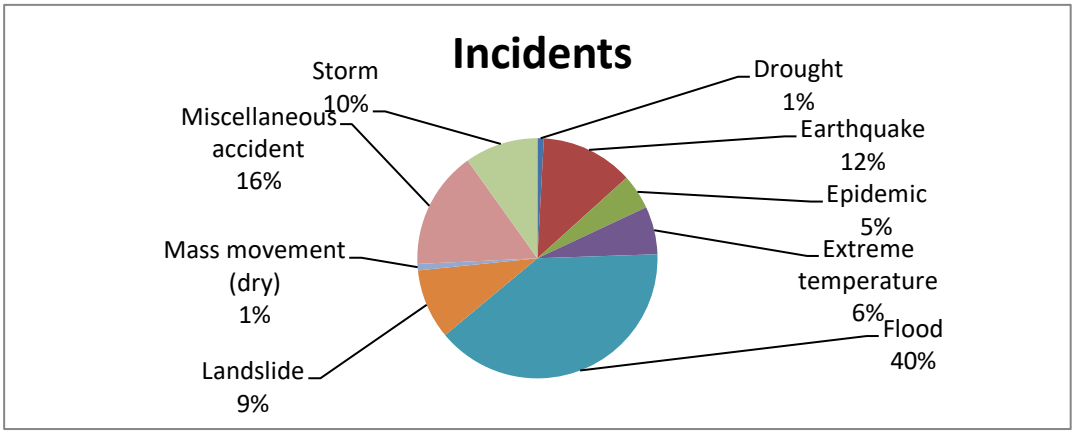
Introduction

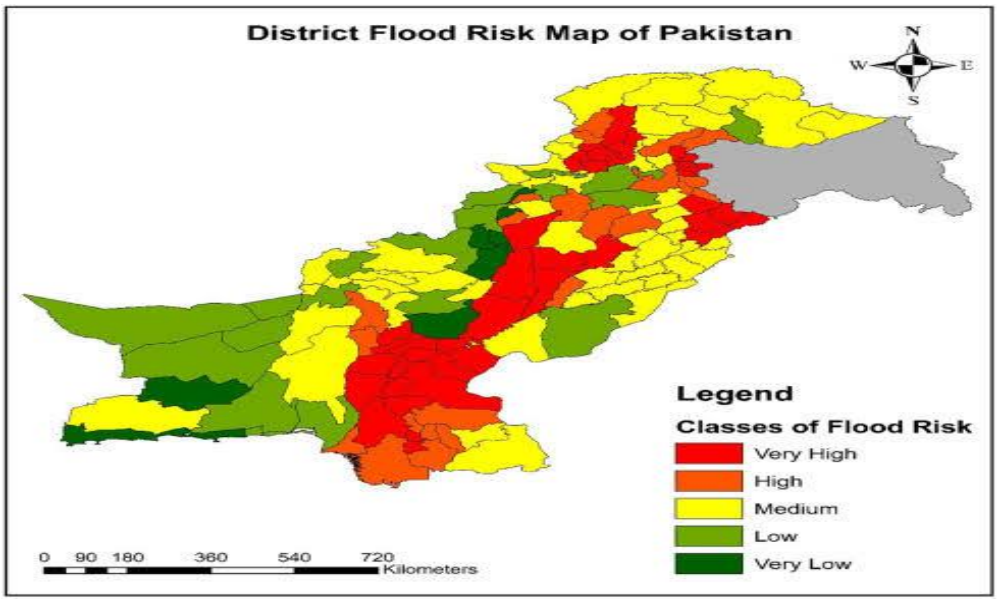
Pakistan is one of the highest disaster-risk countries in the world. The high rate of multidimensional poverty is the main determinant of Pakistan's disaster vulnerability. According to the Inform Risk Index, Pakistan was ranked 18th out of 191 countries in 2019 (World Bank, 2020). The vulnerability risk is particularly determined by the country's exposure to natural calamities like earthquakes and the risk of internal conflicts such as terrorism. Natural hazard statistics from the period 1947 to 2020 outline Pakistan's disaster profile. More than 200 natural disaster events resulted in the loss of 84.6 million human lives. Of these 84.6 million casualties, 67 million were caused by floods. The bar and pie charts below provide a more detailed and clearer picture of the disaster history of Pakistan from 1980 to 2020 (World Bank, 2020).





Flood Vulnerability Profile of Pakistan

For the past 20 years, Pakistan has consistently ranked among the top 10 most vulnerable countries on the Climate Risk Index, with 10,000 fatalities due to climate-related disasters and financial losses amounting to about $4 billion from 173 extreme weather events (Siddiqui, 2022). Pakistan has a long history of floods. Figure 3 shows the map highlighting the flood-vulnerable areas of Pakistan and the track of the flood wave along the Indus River. The country has witnessed almost 19 major flood events, resulting in a cumulative flooding of over 594,700 km², with 166,075 villages affected and total direct cumulative losses amounting to about US $30 billion, which led to the loss of 10,668 precious lives in the past 60 years (Shah et al., 2020).



Recent Floods

Between June and August 2022, torrential rains and a combination of riverine, urban, and flash flooding led to an unprecedented disaster in Pakistan. According to official reports, around 33 million people—that is, one in seven— have been affected by the floods, including nearly 8 million displaced. The floods have taken the lives of more than 1,700 people, one-third of which were children (NDMA, 2022). Rain-induced floods, accelerated glacial melt, and resulting landslides devastated millions of homes and key infrastructure, submerging entire villages and destroying livelihoods. Preliminary estimates suggest that, as a direct consequence of the floods, the national poverty rate will increase by 3.7 to 4.0 percentage points, pushing between 8.4 and 9.1 million people into poverty (World Bank, 2022).

Problem Statement

Flood is a constant phenomenon in various countries including Pakistan. The phenomenon is further aggravated by global warming resulting into melting of glaciers which causes floods in Pakistan frequently. There is an immense need to better understand the sensitivity of the issue at the earliest keeping in view the drastic repercussions as evident by the recent floods in Pakistan. However, despite the lofty claims by the concerned authorities and departments that they were well prepared to tackle the calamity, the loss of life and property could not be iron out successfully. Research is, therefore, required to explore the current imbroglio being faced by Pakistan in the wake of floods and also to recommend a pragmatic way forward for mitigation measures by the concerned departments and disaster management authorities.

Scope of Study

The scope of this research work is limited to the critical evaluation of mitigation measures and floods management practices during recent floods and to conduct the institutional analyses of those institutions which play a role in mitigation of the impacts of floods. It will cover the institutional analysis, financial, administrative and policy matters pertinent to departments working on floods control. The group will also critically evaluate the gaps among the stakeholders and will thereby suggest the way forward overcome those deficiencies observed by the group.

Literature Review

One of the significant reasons for the sluggish industrialization in Pakistan is the prolonged absence of a dedicated industrial policy. Consequently, the roles such a policy would typically fulfill are being managed through other public sector policies related to investment, trade, and monetary matters. The SMEDA Act of 1998 was established to regulate small and medium enterprises (SMEs) by the federal government, followed by Vision 2025 (Burki, 2008). An SME policy was formulated in 2007, which has since been amended and is pending cabinet approval. The 18th Constitutional Amendment devolved Part I of the Federal Legislative List, including the industrial sector, to the provinces, transferring industrial affairs to provincial governments (MOIP, 2021). Frequent changes in government are a major contributor to policy uncertainty in Pakistan. Moreover, past governments have often implemented ad-hoc industrial policies in reaction to crises (Kemal, 2008). The conflict between federal and provincial industrial policies has further complicated the achievement of desired outcomes in the industrial sector (Burki, 2008). The Pakistan Business Council advocates for a "Make-in-Pakistan" initiative to drive industrial growth, leveraging Pakistan's domestic market of over 200 million consumers to develop scale and competitiveness, eventually addressing global demand (PBC, 2018).

Research Methodology

This study is descriptive and analytical in nature. Data has been collected from both Primary and Secondary sources. Secondary sources include disaster related laws and policies and organizations in Pakistan, and research literature published in various national/international journals. In quest of Primary data, semi-structured interviews with government officials and experts were conducted.

Literature Review

According to the study by Lubna Rafiq & Thomas Blaschke, approximately 6% of the total area of Pakistan is in high-risk zones, while 30% is in medium risk zones. Only 27% is considered low risk and 7% very low risk. While, approximately 2% of total population live high risk zones, 18% in moderated risk zones, whereas 38% of the population is in low-risk zones. Only 28% of the population lives in very low risk areas (Rafiq & Blaschke, 2012).

The research community in Pakistan has done lot of work to study various aspects of flood management in Pakistan. This has created a good wealth of knowledge on flood management. Mr. Muhammad Atiq Ur Rehman Tariq and Mr. Nick van de Giesen in their research article title 'Floods and flood management in Pakistan' has thoroughly analyzed the institutional framework of flood management in Pakistan (Tariq & Giesen, 2011). In the present study, various research and technical reports and papers related to flood management studies and published by different academic, research and consulting institutions which were consulted for carrying out the current research work.

INSTITUTIONAL FRAMEWORK

Pakistan has been facing multilateral issues and challenges since independence. Natural calamities are one of them. Before 2005, the institutional framework for disaster management revolved around flood management. No practical steps were taken at the institutional level for flood mitigation measures. At that time, Pakistan was dominated by a mindset that was reactive in nature, and all the preparedness was centered around how to respond.

Institutional Analysis – Pre-2005 Era

Pakistan Meteorological Department

The PMD, established in 1947, is an attached department of the Aviation Division, Cabinet Secretariat. It is a technical and service department and provides services mainly in the fields of meteorology, hydrology, and seismology. In addition, it has various specialized units and centers. FFD is responsible for operational hydrology (flood monitoring/forecasting) in the country and issues all types of flood forecasts and warnings across the country to different stakeholders, government functionaries, and disaster management agencies (PMD, 2000).

Directorate General of Civil Defence

The Directorate General of Civil Defence was established under the Civil Defence Act, 1952, to secure civil defence and regulate all matters related thereto. Realizing the lacunae existing in the Act, it was amended in 1993 so that its jurisdiction was extended to remedial measures against both natural and man-made disasters. The Directorate was the dominant organization responsible for responding to disasters until 1970. Currently, the subject of civil defence is being transferred to E&RS 1122.

West Pakistan National Calamities (Prevention & Relief) Act

The West Pakistan National Calamities (Prevention & Relief) Act was promulgated in 1958 to ensure the restoration and maintenance of areas affected by calamities, both man-made and natural, and to control and provide relief for the same. According to Section 4(1), "The Relief Commissioner shall, with respect to the calamity-affected area, take such steps as he may deem necessary in order to maintain order, prevent, check, or control the calamity, reduce the extent and severity thereof, or provide immediate relief to the victims of the calamity in the affected area."

Water and Power Development Authority

WAPDA was established in 1958 to coordinate and give unified direction to the development of schemes in the water and power sectors. According to Section 8 (2)(iii) of the WAPDA Act 1958, "The Authority may frame a scheme or schemes for a province or any part thereof providing for flood management." Additionally, WAPDA plays a leading role in providing hydrological data from the entire river network in Pakistan. The real-time transmission of data from the telemetry system, which is extremely important for flood warnings, is the responsibility of WAPDA. The operation of major reservoirs, which plays a significant role in mitigating floods, is also WAPDA's responsibility.

Pakistan Commission for Indus Waters

In follow-up to the Indus Water Treaty of 1960, an agreement was signed between India and Pakistan in 1989 through their respective PCIW, which includes provisions to share river flow data considered important for flood forecasting in Pakistan. PCIW receives the Indian data normally once a day. The data is then passed on to the FFD, Lahore, for preparation and issuance of flood forecasts to concerned organizations. The frequency of data reception is increased to every six hours, and even to hourly, in case of a severe flood situation (Awan, 2003).

Emergency Relief Cell

The ERC was established in 1971 with a mandate to support relief and provide compensation to calamity-hit areas. The national disaster plan in 1974, created by the Federal Emergency Relief Cell, was the first plan that envisaged procedures, organizational structures, responding agencies, and monitoring relief operations. Unfortunately, the plan never materialized beyond the paper on which it was written (Zaidi, 2012).

Federal Flood Commission

The FFC was established through a resolution on January 4, 1977, to manage flood-related issues across Pakistan. The Commission was mandated to take only those steps which were necessary for mitigating the effects and impacts of floods. Responsibilities assigned to the Commission included the preparation of National Flood Protection Plans, improvement of the flood forecasting system, standardization of specifications and designs in the field of flood protection, and undertaking research programs for flood control and protection.

Institutional Analysis – Post-2005 Era

All legislations and policies pertaining to disaster management made prior to 2005 could not be proactive and responsive unless they were linked together. Consequently, after the 2005 earthquake, the institutionalization of disaster management and mitigation (DM&M) was completely transformed, resulting in the creation of new entities and the formulation of new plans and policies.

NDMA Act, 2010

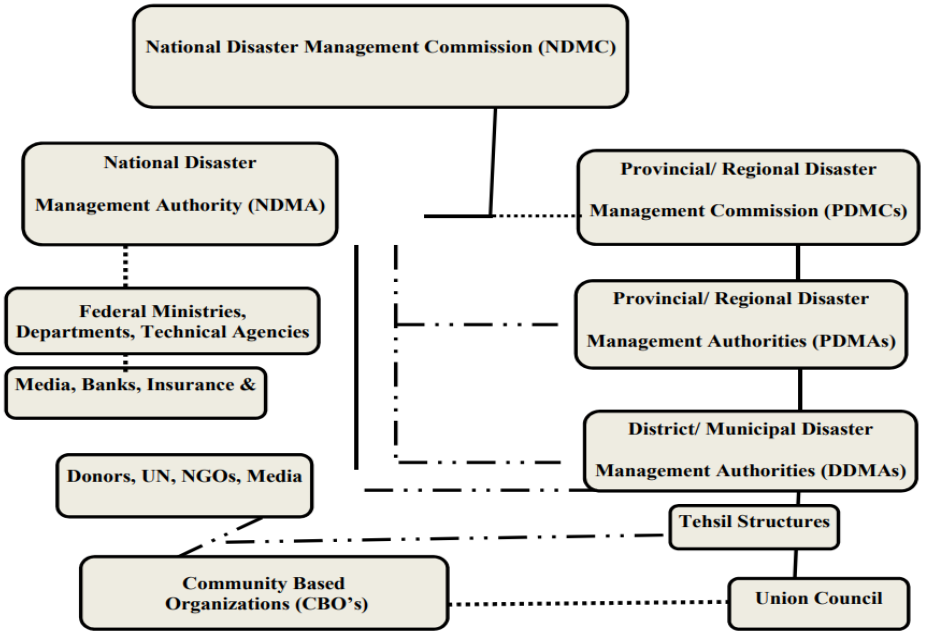
Pakistan's pre-2005 institutional framework was inadequate to deal with the consequences of the massive earthquake of 2005. Therefore, the Government took pragmatic initiatives to establish an effective institutional framework for DM&M in Pakistan. NDMC & NDMA were established in 2006. Initially, NDMA was enacted as a presidential ordinance known as NDMO, 2006 (NDMA, 2010). Later, another massive disaster, the 2010 floods, led to the approval of the same ordinance as an Act of Parliament in 2010. Realizing the expediency of an effective DM&M system after the devastating event of the 2010 floods, the NDMA Act was approved by Parliament on August 11, 2010. It deals with the establishment, functions, and powers of the statutory administrative agency known as NDMA.

National Disaster Management Authority

The legal foundation of the NDMA Act, 2010, lies in the resolution passed by all provincial assemblies under Article 144 of the Constitution of Pakistan, which allows Parliament to regulate NDMA to overcome unforeseen situations (NDRMF, 2010). The table below depicts the hierarchy of the new

framework tasked with mitigating and preventing the devastating impacts of natural disasters:

District & Local Disaster Management Authorities



DDMAs are chaired by the head of district council and comprise of DCO, DPO and EDO (Health) and other district level officers. It is responsible for formulation, implementation and Coordination of national and provincial DM&M polices and plans at district level. Local authorities under DDMA are mandated to ensure the trained human resource, availability of the relevant resources at time of disaster or disaster threat, buildings codes to be followed in the area of their jurisdiction and carry out all other pre and post disaster activities.

National Institute of Disaster Management

NDMA Act also provided for the creation of a NIDM, which was formally established in February 2010. The Institute's mission is to work as a learning center for government officials, the private sector, media, NGOs and community organizations in order to develop policy guidelines and enhance capacity building through research and training. The institute also aims to develop a national database of disaster management policies, prevention mechanisms and mitigation measures.

National Disaster Response Plan

NDRP is a document prepared by the NDMA and approved by the NDMC. It is to be reviewed annually and outlines the measures to be taken for the prevention and mitigation of disasters, for integrating mitigation measures in development plans, and upgrading preparedness for disasters and defining role and responsibilities of line ministries to be implemented throughout the country.

It also defines the roles and responsibilities to different ministries and divisions of the federal government.

NDMF & PDMF

Federal and Provincial Governments shall constitute NDMF & PDMF, which shall be financed by proposed budget allocation, grants, loans, aids and donations etc.

Provincial Irrigation Departments

At present, PIDs are mainly responsible for operation and maintenance of the irrigation system. Since floods in Pakistan follow a 10-year cycle of wet and dry spells, there is almost a memory lapse during dry spells with very little maintenance of flood protection works making them vulnerable when suddenly wet cycle begins. Actually, this is main problem with various flood mitigation and management departments that they don't devise detailed plans during null days before calamity knock at the door. Therefore, the intensity of floods each time hit hard the country due to lack of preparedness.

Comparative Analysis

At the end, keeping in view the whole process of institutionalization of DM&M in Pakistan, a comparison of key disaster related laws has been presented in a table below. This help in a way of understanding the laws by comparing that what are their main focus, how they co-relate with each other and in which way they are overlapping.

Table-1: A Comparison of key Disaster Related Laws

Issue	NDMA Act 2010	West Pakistan National Calamities	Civil Defence Act 1952

		(Prevention and Relief) Act 1958	
Disaster	"disaster means a catastrophe or calamity in an affected area, arising from natural or man – made causes or by accident which results in substantial loss of life or human suffering or damage to, destruction of property"	Whenever the province of … or any part thereof is affected or threatened by flood, famine, locust or any other pest, hailstorm, fire, epidemic or any other calamity which in the opinion of the government warrants action.	Includes following in situation warrants action: Any form of hostile attack by foreign power Natural or man – made disaster in peace time
Disaster Management	Managing the complete disaster spectrum including: Preparedness Response Recovery Reconstruction	Maintenance and restoration of order in area affected by certain calamity and for the prevention and control of and relief against flood, famine, locust or any other pest, hailstorm, fire epidemic or any other calamity.	Defining the civilian population against enemy attack.
Key Institution	NDMA (Prime Minister Secretariat) PDMA, DDMA	Relief Commissioner (Senior Member Board of Revenue) Section 3A	Civil Defence Department working, working under Home Department. At district the responsibility rests with DCO
Government Body	National Disaster Management Council	Provincial Government/ Chief Secretary	Home Department
Field Organization/ Office	District Management Authority	DCO	Civil Defence Department under DCO
DRM Framework	Provides a comprehensive DRM framework encompassing all key areas (Mitigation, Preparation, Response, recovery, Reconstruction)	Focus on relief, multi hazard DM approach. Provides vertical configuration with the little coordination	Capacity building, first aid administration, fire fighting, search and Rescue. An operational discount in Civil Defence operations in the province.
Integration of Disaster Response	Coordinated disaster response through its established inter – tier linkage	-	-
Declaration of Disaster	-	Declaration of Calamity is done by	-

		the provincial government	

SWOT Analysis

Table-2: SWOT Analysis of Institutional Framework	
Strengths	Weaknesses
1. National Disaster Risk Management Framework (NDRMF) 2007 provides legal framework to NDMA to act as Central Coordination Agency. 2. NDRMF 2007 provides legal framework for Strengthening Institutional Arrangements for risk reduction. 3. NDRMF 2007 provides legal framework for awareness and capacity building for reducing vulnerability of communities. 4. NDM Act 2010 provides Legal Framework for establishment of disaster management authorities at three (3) tiers at federal, provincial and district levels. 5. National Disaster Response Plan (NDRP) measure for prevention and mitigation of disaster to be reviewed annually. 6. NDRP defines roles and responsibilities of line ministries and divisions. 7. Properly defined limit for "Lay Off Land" of 200 feet for construction of building on river/tributaries sides in KP River Protection Ordinance 2002. 8. Properly defined limit of 1500 feet for "Provincial Control Area" where no construction or development activities shall be taken in KP River Protection Ordinance 2002.	1. Lack of Comprehensive Flood Policy/Laws by federal and provincial governments. 2. Lack of proper disaster mitigation planning at policy level 3. Lack of effective formulation of flood management strategies 4. Lack of integrated flood management. 5. Lack of inclusion of stakeholders while formulating laws/policies. 6. Lack of interest for construction and development of water reservoirs 7. Lack of decentralization of authority for infrastructure development. 8. Lack of desilting of streams & flood water ways on regular basis. 9. Lack of financial resources. 10. Lack of capacity building and human resource management.
Opportunities	**Threats**
1. Best disaster mitigation practices in the world. 2. Agriculture crop insurance policies 3. Use of latest social media applications.	1. High vulnerability to Climate changes. 2. Lack of vision and seriousness on the part of politician and bureaucracy.

4. Policy formulation for resolving water disputes with regard to infrastructure development. 5. Policy formulation for installation of flood detection system 6. Continuity of afforestation policies and programmers. 7. Sustainable policy for construction of dams and reservoirs. 8. Procurement of modern state of the art technologies. 9. NGO's & Charity Organizations for fund raising. 10. Development of river's sides into public picnic resorts	3. Political uncertainty effecting the continuation of policies. 4. Lack of political will for long term planning for infrastructure development 5. Point scoring game on the part of various political government. 6. Continues decrease in forest cover due to legal and illegal harvesting of forests. 7. Deteriorating national economic indicators.

EETH Analysis

Table-2: EETH Analysis of Institutional Framework	
Strengths	Weaknesses
1. National Disaster Risk Management Framework (NDRMF) 2007 provides legal framework to NDMA to act as Central Coordination Agency. 2. NDRMF 2007 provides legal framework for Strengthening Institutional Arrangements for risk reduction. 3. NDRMF 2007 provides legal framework for awareness and capacity building for reducing vulnerability of communities. 4. NDM Act 2010 provides Legal Framework for establishment of disaster management authorities at three (3) tiers at federal, provincial and district levels. 5. National Disaster Response Plan (NDRP) measure for prevention and mitigation of disaster to be reviewed annually. 6. NDRP defines roles and responsibilities of line ministries and divisions. 7. Properly defined limit for "Lay Off Land" of 200 feet for construction of building on river/tributaries sides in KP River Protection Ordinance 2002.	1. Lack of Comprehensive Flood Policy/Laws by federal and provincial governments. 2. Lack of proper disaster mitigation planning at policy level 3. Lack of effective formulation of flood management strategies 4. Lack of integrated flood management. 5. Lack of inclusion of stakeholders while formulating laws/policies. 6. Lack of interest for construction and development of water reservoirs 7. Lack of decentralization of authority for infrastructure development. 8. Lack of desilting of streams & flood water ways on regular basis. 9. Lack of financial resources. 10. Lack of capacity building and human resource management.

8. Properly defined limit of 1500 feet for "Provincial Control Area" where no construction or development activities shall be taken in KP River Protection Ordinance 2002. 9. Dissemination of Information	
Opportunities	**Threats**
1. Best disaster mitigation practices in the world. 2. Agriculture crop insurance policies 3. Use of latest social media applications. 4. Policy formulation for resolving water disputes with regard to infrastructure development. 5. Policy formulation for installation of flood detection system 6. Continuity of afforestation policies and programmes. 7. Sustainable policy for construction of dams and reservoirs. 8. Procurement of modern state of the art technologies. 9. NGO's & Charity Organizations for fund raising. 10. Development of river's sides into public picnic resorts	1. High vulnerability to Climate changes. 2. Lack of vision and seriousness on the part of politician and bureaucracy. 3. Political uncertainty effecting the continuation of policies. 4. Lack of political will for long term planning for infrastructure development 5. Point scoring game on the part of various political government. 6. Continues decrease in forest cover due to legal and illegal harvesting of forests. 7. Deteriorating national economic indicators.

ISSUES & CHALLENGES

Gap Analysis

The disaster risk management system in Pakistan is facing multiple issues and gaps. One such issue is governance, which includes a multiplicity of institutions with overlapping or conflicting jurisdictions and poor formal linkage and coordination between key line agencies and departments, leading to gaps in the legal framework. There are also issues related to institutional, technological, and human resource capacity.

Reactive Approach

The prime challenge is the reactive mindset at both the policymaking and societal levels. Enforcement of disaster management and mitigation (DM&M) and emergency response must be the principal agenda in Pakistan to deal with disasters. Although a proactive approach has been designed to address

DM&M in the post-2005 era, a reactive approach still exists at the federal, provincial, and district levels, with a primary focus on relief. The situation is even worse at the district level, which is the key point, as it acts as a bridge between the government and the general public. At the district level, the subject is handled by the Assistant Commissioner (AC) Headquarters, who is not a specialized officer to deal with calamities.

Lack of Vulnerability & Risk Assessment

Vulnerability and risk assessments are core tools that combine all scientific data relating to calamities and local vulnerabilities in each geographic location. Pakistan does not have any such arrangements for vulnerability and risk assessment at the federal, provincial, and district levels. Vulnerability and risk assessments for different geographic zones are of utmost importance for policymakers to devise integrated policies, plans, and strategies. There is a lack of a standardized methodology for risk assessments, as well as very limited collaboration among technical agencies. A Vulnerability Atlas of Pakistan needs to be prepared to include hazard maps indicating the location of various hazards with zonation of risk levels (e.g., low, moderate, and severe). The Atlas will also indicate the location of key settlements in hazard-prone areas. The Atlas should be published and disseminated widely to stakeholders at all levels.

Overlapping Mandates

Currently, a number of institutions and organizations with different aspects of managing disasters are functioning. The post-2005 institutional framework has also failed to address the issue of overlapping or conflicting jurisdictions of various DM&M-related organizations. However, it is also an established fact that these organizations are often mandated with overlapping responsibilities and functions, which creates confusion. This overlapping exists at all three levels:

- **National Level**:
    - The National Calamities (Prevention and Relief) Act, 1958, is entrusted with a wide range of responsibilities, such as maintaining, restoring order, preventing and controlling, or providing relief in the affected areas.
    - On the other hand, the Rules of Business, 1973, clearly lay out that disaster relief shall be dealt with by ERC, which was established under the Cabinet Division.
    - Another important legal instrument in this regard is the Civil Defence Act, 1952 (amended in 1993).
    - NCMC is an organization that works under the Ministry of Interior. The cell functions as a control room, operating around

the clock to prepare reports and obtain information on crises/emergencies.

- **Provincial Level**:

  Overlapping organizations also exist at the provincial level, similar to the federal level, creating uncertainty and confusion regarding roles and responsibilities.

- **District Level**:

  Overlapping is also observed at the district level, where DDMUs, District Civil Defence, ERS-1122, and the fire brigade under TMA are working with the same mandate.

Lack of Formal Coordination

Although a national platform has been constituted, disaster management currently suffers from poor communication and duplication issues. The institutional framework does not provide any defined procedure for formal coordination among various organizations. The NDMA Act, 2010, fails to identify and define the relationship between key disaster-related institutions.

The prevailing disaster management law fails to establish tangible linkages for a harmonized response strategy. At the district level, departments like Civil Defence, ERS-1122, and the fire brigade have no direct linkages to coordinate with each other. They coordinate through the Deputy Commissioner (DC), which is a lengthy channel, especially when it comes to emergencies. At the provincial level, the PDMA entails horizontal coordination with the relevant provincial line departments and district administration. However, no such coordination exists at the operational level.

Weak Financial Framework

An advanced and well-established institutional mechanism is a prerequisite for active disaster preparedness and response, where the availability of sufficient financial resources is of paramount importance. Unfortunately, the financial framework for DM&M is very unstable and poorly implemented. NDMF and PDMF have been established, which shall be financed by the federal and provincial governments, grants, aids, loans, and donations.

The key issue with the financial framework is that, as per the Rules of Business, 1973, the Finance Division can only transfer disaster funds to ERC, Cabinet Division, which spends this money on procurement of relief goods in accordance with their relief-oriented mandate, instead of spending on mitigation and preparedness. So, no development funds are given to NDMA,

except for non-development funds. Even at the provincial level, figures show that the relief expenditure in Balochistan, Sindh, and KPK is higher than expenditures on preparedness. This explicitly reveals the practice of the old reactive approach in public financing, despite the establishment of a new institutional framework.

Lack of Institutional Capacity

The deficiency of institutional capacities and expertise is also a major challenge to implementing the policies and plans in letter and spirit, especially at the local level. According to the NDMA Annual Report 2011, many districts still lack DDMUs to steer all disaster management activities across different sectors, despite notifications throughout the country. The existing DDMUs lack human, material, and financial resources to undertake disaster management activities. The local departments' personnel lack the requisite professional knowledge, skills, resources, and equipment to plan or respond to the impending challenges of disaster risks with a scientific approach. DM&M, being a nascent field in Pakistan, therefore, faces a dearth of skilled human resources.

Lack of Comprehensive Flood Policy

Currently, Pakistan does not have an approved national flood policy. Pakistan's draft flood policy seems to consist of a plan rather than a policy. Also, Pakistan's current draft flood policy does not consider glacial lake outburst floods. Pakistan lacks a policy, strategy, and plan specifically dealing with flash floods. A comprehensive flood policy must consider land-use zoning, floodplain management, watershed management, environmental protection, forestation, and water storage development.

Flood Infrastructure Issues

The oldest structures are in poor condition due to a lack of adequate maintenance. Partial implementation of flood works due to delays in approval, funding, and construction, and poor maintenance due to inadequate funds, is common.

There has been no change in the design of embankments for the last few decades. In Pakistan, reservoirs are primarily used for irrigation water storage and hydropower generation, with flood control being only a third consideration.

Conclusion

The recent floods in Pakistan that caused tremendous loss in terms of human lives and property. It established that current flood management mechanism in Pakistan is inadequate and reactive in approach. The present flood mechanism focuses on only flood control and relief measures. It does not concentrate on flood mitigation and management in an integrated manner. The climate change has intensified the vulnerability and flood risks. The situation demands for development of a sound flood mitigation and management system. Though currently, a number of flood management and mitigation measures exist in Pakistan, but these measures have not enhanced the prospects of Pakistan in terms of sound flood management system. Currently, Pakistan faces the challenges of lack of comprehensive flood policy, planning and laws, lack of institutional capacity and coordination, inadequate flood and drainage infrastructure with poor operation and maintenance, lack of improved flood forecasting and early warning system, poor flood preparedness and lack of integrated flood management strategy. Pakistan also lacks in a comprehensive understanding of the Indus Basin hydrology affected by the climate change impacts that include changes in intensities and frequencies of monsoonal rainfall and rapid glacial melting and retreat.

In the aftermath of recent floods, Pakistan can no longer afford to do business as usual. In order to ensure effective and sustainable flood management, Pakistan should improve its flood policy, planning and legislation, enhance institutional capacity, develop new and improve existing flood and drainage infrastructure with improved operation and maintenance, improve watershed management, continue improving flood forecasting and early warning system, improve flood preparedness, enhance community participation, and develop and implement integrated flood management strategy. Pakistan also needs to conduct research to gain an insight into climate change impacts on hydrology of the Indus Basin.

Recommendations

Recommendations have been categorized into short, medium and long term measures:

Short Term Measures

Controlling Global Warming & Climate Change

- Take measures to control the release of carbon dioxide by vehicles, factories etc., through strict implementation of laws and imposing penalties to prevent the excessive smoke producing vehicles to be on road especially diesel consuming vehicles like buses, trucks, rickshas etc. District govt & Traffic department shall come up with stringent laws and their implementation in letter and spirit to detect such vehicles by using modern gadgets and by imposing heavy fines
- Provide electricity and gas to the people living below poverty line by gradual raising the standard of population so that to avoid burning of wood for cooking & heating
- Prevent excessive deforestation. Forest department need to play a very active role in this regard. An App may be developed whereby Forest dept seek permission for cutting a single tree from main Hqd. along with geo-location of forest and replacement of plant with new sapling.

Establishment of Watershed

- Establish Watershed Management Departments/Agencies with the relevant provincial Governments like GB, AJ&K, Baluchistan and KP through necessary legislation. WAPDA has to take the lead since it would require small dams and will produce hydropower too
- Re-forestation, soil conservation and improvement in land use in the watersheds should be promoted. Forest department to take proactive role like billion trees initiative which will not only control soil erosion but also will have positive impact on climate

Revision of SOPs for Operation of Major Reservoirs

- Existing reservoir operational rules (SOPs) for Mangla and Tarbela needs to be further reviewed particularly for Tarbela in the light of 2010 and 2014 floods to ensure efficient control of floods in order to provide maximum relief to downstream areas

Flood Protection Works

- Repairing, strengthening and up-gradation of existing flood protection works need to be carried out on immediate basis through provincial resources to protect the population and infrastructure against flood threat. The need for new flood protection works have been identified along with cost provision and federal agencies/government should arrange funding for their design and construction as per implementation schedule of NFPP-IV.

Forestation Project					
Assumption Risk	**Resource Input**	**Activities**	**Out-put**	**Out-comes**	**Impact**
• Many new saplings go wasted • Protection & care of new saplings • Fight against extreme weather	• Managing financial resources • Acquiring better quality saplings • Trained labor for plantation	• HRM • Acquiring/allocation of land • Plantation process	Forest	Forestation will help to control soil erosion	It will mitigate the negative impacts & severity of climate change

Medium Term Measures

Rehabilitation & Capacity Enhancement of Barrages/Bridges

- Rehabilitation and capacity enhancement of barrages and bridges needs special attention for their immediate execution. Necessary provisions for their studies and implementation have been made in the current NFPP-IV.

Flood Forecasting and Warning Systems

- The real-time simulation method uses forecast data to simulate flooding processes and determine the consequences of heavy rainfall patterns in real-time. Therefore, the hydro-numeric model is fed with forecast rain data to calculate the transient flow processes live and with the maximum possible computing speed. Subsequently the calculated flood hazard variables (water depth and velocity) are processed by the GIS-Model to determine the flood risks in a second step. Therefore, a damage potential analysis is carried out based on existing geodata and with the help of systematic semi-automated GIS process techniques.

Installation of Real-Time Warning System

Assumption Risk	Resource Input	Activities	Out-put	Out-comes	Impact
• Financial constraints • NOC complications • Resistance to change • Import issue	• Lack of technical experts • Financial resources • Approach to market abroad	• Managing HR • Installation of Equipment • Construction facility for the system	Modern & Advanced disaster forecast system	System will provide real time info for early preparedness	It will mitigate the damages caused by the floods

Institutional Capacity Building

Capacity building and training of FFC, PIDs, NDMA, PDMAs, PMD, and WAPDA dealing with floods is recommended on priority basis.

Floodplain Policies and Legislation

'River Act' for the rivers floodplains has been formulated during current NFPP-IV studies keeping relevant stakeholders on board and there is strong need to carry out necessary legislation at provincial as well as well federal level. Provinces may modify it according to their requirements, from river to river. There is strong need to implement the 'River Act' in its real sense and spirit for removing encroachments, permanent settlements and undue developments in the floodplains so that flood damages can be reduced.

Floodplain Mapping and Zoning other than Indus River and its Tributaries

There is strong need to investigate the requirement of Floodplain Mapping and Zoning in the areas other than Indus River and its tributaries. These areas may include floodplains of rivers and major streams/Nullahs in Punjab, Khyber Pakhtunkhwa and Baluchistan. For this purpose, provincial governments should carry out necessary investigations and studies at their own resources.

Community Awareness and Preparedness

PIDs, NDMA, PDMA, DDMA and district management etc., should play active role through workshops, electronic and print media to create awareness in flood prone communities for preparing them to fight against floods and its after affects, awareness about encroachments and un-planned developments in floodplain areas resulting huge damages to their lives and property.

Long Term Measures

Construction of Dams and Storages

- Major reservoirs need to be investigated and constructed on priority basis to preserve the flood water to substantiate irrigation flows and controlled releases to check seawater intrusion. Construction and operation of reservoirs is under WAPDA jurisdictions and need Federal government's attention for necessary approvals, settlement of political and technical issues with the provinces and arrangement of funds.
- Analyses indicate that small damshave substantial potential in mitigating flood peaks from their respective catchments. It is recommended to consider various small dams in KPK, AJ&K, Punjab and Baluchistan for cumulative impact on flood mitigation. The pre-feasibility/feasibility studies on these dams may be taken-up by the provinces at their own resources.

Construction of Dams					
Assumption Risk	**Resource Input**	**Activities**	**Output**	**Out-comes**	**Impact**
• Financial constraints • Time taking process • Political will • Resistance to change • Inter-provincial issues • Donor's issue • Land-acquisition	• Management for execution • Financial resources • Human capital	• Availability of machinery • Placing/Arranging site plans • Construction process • Opening of site office	Functional Dam	Will store extra water & produce hydropower	Mitigate disaster caused by floods & provide green energy

Breaching Sections at Barrages/Bridges and Flood Escape Channels

- It is strongly **recommended that irrigation department** must conduct a comprehensive study of all existing breaching sections to ascertain their effectiveness and possible flow paths, flow depths, velocities and inundation extents of breach flood flows.
- Adequate conveyance capacity within the river and urban channels needs to be restored by removing bottle necks and encroachments which hampers the smooth flow of water and causes floods.

Management of Environmental Problems

- Although rules are made by the concerned departments however, there is a **need of proper implementation through check and balance** by a third party to preserve eco-friendly environment without any of interference, political or otherwise
- **Awareness and trainings to community** to strengthen resilience from gross root at academic institutions to educate and sensitize masses about issues related to disasters in general and floods in particular
- **Institutional framework for environmental issues** to involve all the stakeholders (PIDs, NDMA, PDMA, District Administration) for better planning and execution of plans made for environmental resilience
- **Explore all possible means of gathering the financial resources** required for flood management from commercial activity in the river areas, property tax collected from the flood protected commercial establishments, proceeds of sand excavation leases, proceeds of sale / auction of timber collected from river

Plan Implementation and Third-Party Verification

- The scale and magnitude of proposed investments in flood sector requires **comprehensive monitoring of activities related to funding arrangements, distributions of funds and plan implementation** as per priorities. For this particular objective, a steering committee is proposed which will guide on implementation of priorities based on short term and long term needs in flood management across the country.
- Besides guidelines on priorities, one of the objectives of steering committee would be **monitoring of various projects under plan implementation stage**. To ensure transparency and efficient utilization of funds, third party verification is proposed.
- It will provide important feedback on performance of plan implementation by evaluating activities through certain benchmarks and monitoring indicators.

- It will also assure objectives of integrated flood management through structural and non-structural interventions.

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