STRENGTHENING DISASTER RISK MANAGEMENT THROUGH EARLY WARNING SYSTEMS: A CASE STUDY OF SINDH PAKISTAN [1]

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ABSTRACT
Pakistan, like many other countries, faces various types of disasters, and the severity of these challenges is expected to worsen without proper management strategies. This study examines the monitoring of disasters and the effectiveness of Early Warning Systems (EWS) in Pakistan. Amongst disasters, water-related calamities such as floods, droughts and cyclones pose significant threats to the country. The qualitative data collected through field survey revealed that floods are monitored but highlighted the need for improved communication and dissemination of estimated volumetric rainfall alerts to enable effective planning by authorities and communities. The Provincial Disaster Management Authority (PDMA) sends flood-related information to the respective District Disaster Management Authority (DDMA), which relies on focal persons and field staff to inform people. Communication channels have evolved, with social media becoming a primary source along with field staff, and SMS alerts sent by the National Disaster Management Authority (NDMA) to at-risk communities. Collaboration with NGOs and the use of radio messages further contribute to information dissemination. However, significant challenges and bottle necks exist in pre-disaster planning and post-disaster response. The findings emphasize the importance of effective communication, improved EWS, and coordinated efforts among government agencies to reduce the risk and impact of disasters in Pakistan.

Keywords: Early Warning Systems; disaster risk reduction; vulnerability; Public awareness and sensitization.

INTRODUCTION

Pakistan is currently facing numerous disaster-related challenges, which require immediate attention and appropriate measures to address the increasing severity of these crises (Mukhtar, 2018). The intensity and frequency of water-related disasters, including floods, droughts and cyclones, have increased significantly due to climate change (Rana, Bhatti & Jamshed, 2021). These challenges are posing significant threats to the communities due to increasing vulnerabilities of socio-ecological systems. Failing to manage these situations effectively, will lead to several other humanitarian crises, including food crises (food security and food safety), disease outbursts, and unemployment due to limited capacities to cope with these crises (Pardana et al., 2022).

Under such circumstances, risk management and mitigation need to be the prime focus of the disaster management authorities. Therefore, early warning system (EWS) plays a effective role in risk management and mitigation compared to commonly practiced disaster response strategies (Rana, Bhatti & Jamshed, 2021). An effective and robust EWS equips communities with timely and relevant information gathering through designated institutions, enabling individuals exposed to hazards to take necessary actions to avoid or minimize risks while preparing for an efficient response (Trogrlić, 2022). The EWS entails a comprehensive set of capabilities required to generate and disseminate timely warning information, empowering at-risk individuals, communities, and organizations to adequately prepare and respond to imminent threats, thus mitigating harm and loss (Sufri et al., 2020). The primary objective of EWS is to establish an inclusive system that encompasses all segments of the population, especially the vulnerable groups including women, children and disabled people that are disproportionately exposed to hazards (Pradhan et al., 2016).

Nevertheless, it is worth noting that EWS is not yet widely adopted in Pakistan. To improve preparedness and introduce an effective response mechanism, the disaster management system in Pakistan has been decentralized to the provincial level (Mukhtar, 2018). Several studies have been conducted on risk, vulnerability and community resilience assessment (Rana et al., 2021) as well as the effectiveness of EWS (Rana, Bhatti & Jamshed 2021). Besides all these efforts, the disaster management authorities at the provincial and

local levels failed to introduce effective strategies and policies to cope with disaster in relation to disaster risk reduction (Rana et al., 2021; Shah et al., 2019). The main reason could be the reactive approach where disaster response is the prime focus but the EWS is not yet in place. However, EWS is the key element of risk management and mitigation, being as important as the disaster response itself. Therefore, a robust EWS is essential for disaster risk reduction. Effective EWS mitigate the impacts of disasters through enhancing disaster resilience, and safeguarding lives and livelihoods of the communities. However, to understand the effectiveness and efficiency of EWS in reducing the disaster risk a holistic analytical approach need to be adopted. This could be achieved through the process analysis of EWS and identifying gaps and the bottlenecks regarding the effectiveness of EWS. The amount of work done related to the analysis of key gaps and potential bottlenecks with regards to EWS in Pakistan in general and especially in Sindh province.

Therefore, the objective of this study is to identify the potential bottlenecks with regards to the dissemination of the warning within the existing disaster risk management scheme and to find potential pathways for improvements in the warning mechanisms to make them more inclusive for the population settled in the targeted areas which are prone to multiple hazards, facing frequent disasters focusing on floods and cyclones for establishing the appropriate anticipatory action protocols.

LITERATURE REVIEW

EWS plays a key role in disaster risk reduction. There are three main aspects of EWS that includes the natural, technical and the human/social aspects. Considering all these three aspects, EWS comprises of four interacting elements that include (i) risk knowledge, (ii) monitoring and predicting, (iii) disseminating information and (iv) response capability. These elements have logical sequence and each element has two-way linkages with each of the other elements (Bashir, 2006). Traditionally technical aspects remained the strong focus of EWS, while human dimension received less attention (Hamza and Månsson, 2020). Human aspect includes the policies and practices, institutional framework and the capacities of official and the communities (Fakhruddin & Chivakidakarn 2014). The EWS can be

only be effective and good if the society has the capacity to respond promptly to message received the available technology (Seng, 2012). Without this the best EWS do not necessarily ensure the escape from the devasting disaster (Fakhruddin & Chivakidakarn 2014). So far several models of EWS have been developed but each model has its own strength and weaknesses (Khankeh et al., 2019).

Like other countries in global south, Pakistan is facing climate-related disasters especially the recurring devasting flooding of different nature (Rana, Bhatti and Jamshed, 2020). There are several influencing factors that include ill-planned infrastructural development, population growth, rapid urbanization, physical infrastructural developments in waterways/drains and literacy that increases the intensity of the impacts (Abbas et al., 2015; Membele, Naidu & Mutanga, 2022). The local level disaster-related perception and practices can also contribute toward the disaster risk management and the indigenous knowledge and contribute toward the understanding of the pattern of disasters (Bernatchez et al., 2011). The vulnerabilities associated to climate related disasters are always multi-faceted and complex because it is a function the interaction of physical, social, environmental and economic dimension (Dintwa, Letamo, & Navaneetham, 2019) and therefore a holistic analytical approach is the only option to understand the key gaps in EWS.

RESEARCH METHODOLOGY

This section offers a detailed overview of the methodology employed in conducting this study. The methodological framework is illustrated in Figure 1.
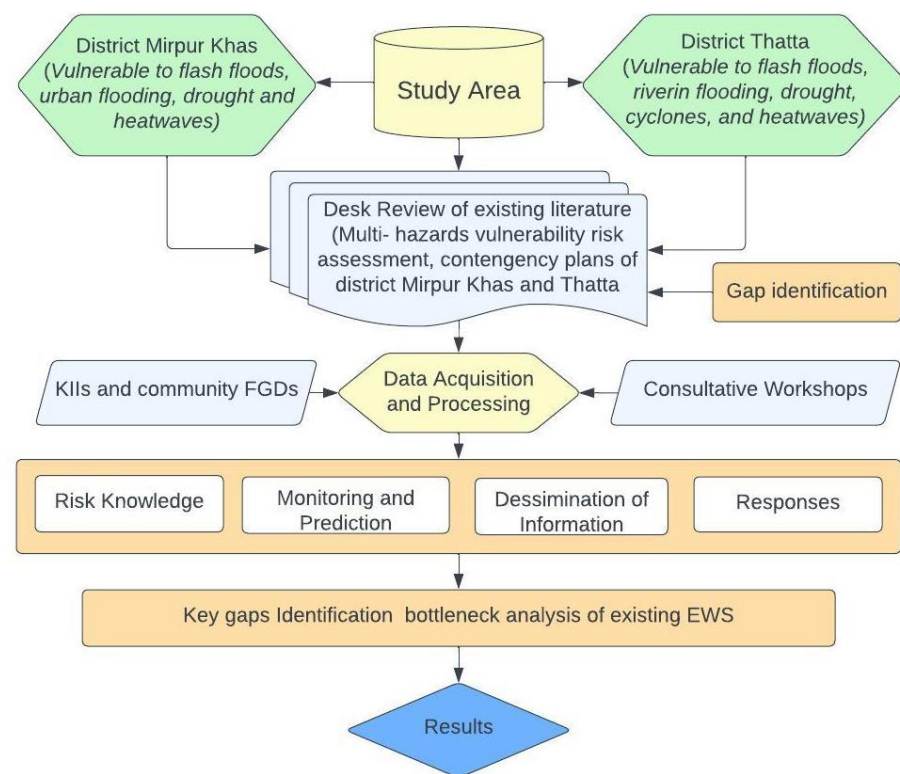
FIGURE-1: METHODOLOGICAL FRAMEWORK OF THE STUDY.

Study Area

This study has been conducted in Mirpur Khas and Thatta districts. Both of these districts are prone to different disasters including riverine floods, flash floods, droughts, cyclones and heat waves. The detailed data collection approach is given in the following sections.

Desk Review

The desk review phase involved a systematic literature search to gather relevant information related to EWS and disaster risk management of the study area. The literature search encompassed government reports and relevant online resources, including the National Disaster Management Plan (2012-2022) and the relevant material from PDMA i.e., Multi-Hazard Vulnerability and Risk Assessments based DRMPs of Thatta and Mirpurkhas, and Multi-

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Hazard Vulnerability and Risk Assessments based DRMP of Sindh Hazard and Risk Atlas, Contingency Plans of Mirpur Khas and Thatta. The review aimed to provide a comprehensive understanding of the current state of the efforts on EWS in Sindh and to identify gaps and areas for improvement.

DATA COLLECTION

To gain in-depth insights into the existing EWS and understand the experiences and perspectives of various stakeholders, qualitative data was collected through key informant interviews (KIIs) and focus group discussions (FGDs). The participants were purposefully selected to ensure a diverse representation of stakeholders.

i) Key Informants Interviews (KIIs): Key respondents included officials from relevant government departments. Total nine KI interviews were conducted individually to obtain a high-level expert view about EWS and its challenges. Besides, two consultative workshops were also organized, where representatives from different organizations, including United Nations (UN) agencies working on disaster in Pakistan, government line departments and representatives from different international and local NGOs have participated.

ii) Focused Group Discussion (FGD): FGDs were organized in the targeted hazard-prone areas to discuss their experiences regarding the effectiveness of the existing EWS. The FGDs also explored the role of local authorities in disseminating warnings and the community's suggestions for improving the early warning mechanisms. Prior to conducting FGDs, efforts were made to identify community members with disabilities in the area to ensure inclusivity and recognize the viewpoints and experiences of marginalized individuals in disaster contexts. By acknowledging and addressing these differences, the FGDs aimed to gather a broader spectrum of perspectives, ultimately enhancing the comprehensiveness and effectiveness of disaster preparedness and anticipatory action strategies. A gender balance was maintained to get the perspectives, experiences of both male and female. Seven FGDs were conducted with 8 to 12 local community members in the selected Districts.

DATA ANALYSIS

The qualitative data collected through literature review, KIIs and FGDs were analyzed using thematic analysis for identifying patterns and themes within the data. At the first step the recorded data from KIIs and FGDs were transcribed verbatim. Following that the transcripts were systematically analyzed, and relevant excerpts were coded to identify recurring themes, issues, and patterns related to the existing EWS and their effectiveness. The coded data were grouped into broader themes that reflected the bottlenecks of the current EWS.

RESULTS AND DISCUSSIONS

This section begins by examining the disaster risk reduction mechanism, followed by exploring the EWS mechanism. Subsequently, an analysis of community preparedness and their comprehension of the current EWS will be presented, drawing insights from data gathered through FGDs and KIIs. These discussions provide a fundamental framework for understanding the challenges encountered by community members and disaster management authorities while facilitating the development of proactive measures.

i) Disaster Risk Reduction Mechanism: In Pakistan, government agencies have primarily focused on disaster response and community rehabilitation, often neglecting the importance of understanding EWS and community preparedness. Nevertheless, community awareness and preparedness play a vital role in mitigating the impact of disasters. The established of a provincial disaster management framework aimed for preparing and rescuing communities during disasters. Within this framework, the District Disaster Management Authority (DDMA) operates under the Provincial Disaster Management Authority (PDMA). The Emergency Operations Center (EOC) is a central command and control facility where coordination and management of emergency response and recovery operations take place. It serves as the primary coordination center for disaster response and recovery activities at the provincial level.

ii) Existing Early Warning Mechanism in Sindh Province: The existing EWS in Sindh Province faces challenges in effectively emphasizing risk knowledge. It relies on resources like the Disaster Management Information System (DMIS), Multi-Hazard Vulnerability

and Risk Assessments (MHVRA), and risk profiling to collect and analyse disaster-related data. However, there is a need for updates and better dissemination of this information, particularly at the district and sub-district (commonly known as Taluk) levels. Situation monitoring and forecasting depend on technology available at the provincial and district levels, including weather radars, satellite imagery, and rain gauge networks. Indigenous knowledge held by local communities also plays a role in predicting disasters, but its scientific documentation is lacking. Information dissemination involves various channels like SMS alerts, radio broadcasts, loudspeakers, and social media platforms to ensure timely and accurate warnings reach at-risk communities.

Community Perception and Evaluation of EWS

The participants of this study reported that they face various disasters and acknowledge that sudden disasters receive more attention than slow-onset ones, affecting vulnerable groups significantly. Lack of physical infrastructure is compensated by community support and information sharing during emergencies. Awareness of EWS and government information varies between genders, and proper EWS is criticized for its role in preventing chaos during disasters.

The community criticized the lack of proper EWS, citing instances where inadequate communication led to chaos during disasters. They mentioned the importance of reliable information sources to prevent people from being trapped in false rumors. However, the communities expressed improvement in dealing with disasters due to EWS and increased awareness in recent years.

Participants were aware of government agencies involved in DRR activities but had limited knowledge of their representatives at the local level. They expressed dissatisfaction with the performance of government agencies in EWS and disaster response, noting that officials often provided limited support during disasters.

Vulnerability to Disasters and EWS

A consensus was observed amongst the responses of all key informants that to mitigate the impact of these disasters, there is a need for training of line departments at the district and sub-district levels regarding the technological advancement in the context of

dissemination of warnings, community and stakeholders' engagement, and trainings of the trainers, establishing control centers in collaboration with NGOs, and coordinating among themselves and district administration. The authority should develop a mechanism to ensure the sustainability of the infrastructure developed by the NGOs. Sohe key informants mentioned that currently, sufficient coordination exists, but others mentioned that the coordination need to strengthened in different area of actions.

The responses of all key informants have an agreement that there is a lack of training regarding technological advancement in the context of disaster, dissemination of the disaster-related information and communities' and stakeholders' engagement for the field staff to ensure an effective EWS and involvement of volunteers to contribute towards the disasters risk reduction. Furthermore, some of the key informants highlighted the need of a system at the district level with robust technical skills and knowledge of disaster risk reduction.

The Existing Approach: Enhancing Disaster Response and Preparedness

Evacuation is always a priority for DDMA to reduce the losses. However, sometime people may refuse to evacuate as they see that they may lose their immovable assets and animals. Besides, due to traditional and social barriers, emotional attachment, or a lack of awareness of disaster damage, people also refuse to evacuate. This challenge can be addressed through an improved EW system.

It was learnt that disaster preparedness is not a priority for the government, and contingency plans are often neglected both by the regulatory and implementing authorities and the community as well. There is lack of capacity at the district level to develop the contingency plans. To achieve successful disaster response, it is crucial to involve all stakeholders, including the government, NGOs, and the community to reduce the disaster risk.

While contingency plans focus on resource mobilization during emergencies, there is a need for community engagement and awareness in disaster preparedness. To bridge the communication gap between the government and the community, it was revealed that the government, with the help of NGOs must build community capacity and keep them engaged. During disasters, the government through the

disaster management authority must ensure the safety of vulnerable groups like children and collaborate with NGOs to confirm the absence of child abuse cases, reported by different key informants approached during this study.

Bottlenecks in the Existing Early Warning Mechanism

It was revealed that, the disaster response and rescue mechanism is the most commonly practiced approach, and disaster preparedness and EWS have not received much attention. During floods, response and rescue activities can be hampered by mobility limitations. However, if communities are trained in DRR, they can effectively rescue their village members. These DRR interventions can save the lives of vulnerable communities, including the elderly, women, and children, and protect their belongings. Through discussions with government officials, it was revealed that government departments would be willing to work with local level committees in preparedness and awareness. This is the most effective and sustainable approaches to coordinate, govern, and take actions during disasters. Nevertheless, in the context of Sindh in general and Mirpur Khas and Thatta districts in particular, the following points represent the key gaps in terms of the effectiveness of early warning systems:

- Non-functional DDMAs: DDMAs are responsible for disaster management at the district level. However, one of the key gaps is that these DDMAs are non-functional, meaning they are not fully operational or effective in carrying out their intended functions. This can be due to various reasons such as limited resources, inadequate coordination, or lack of trained personnel.
- Lack of dedicated staff and technical resources: Another significant gap is the absence of dedicated staff for DDMA at the district level. This means that there is a shortage of personnel specifically assigned to handle disaster management activities within the district. Additionally, there is a lack of technical resources, which may include equipment, tools, and technologies required for effective disaster response and relief operations.
- Insufficient budget for district-level disaster response and relief: While the Provincial Disaster Management Authority (PDMA) in Sindh receives a certain budget for disaster response and relief activities. Nevertheless, there is no dedicated budget at the district

level. This financial gap hinders the ability of the district-level authorities to effectively respond to and provide relief in the event of disasters.

• Lack of capacity on Disaster Risk Reduction and Management (DRR&M): Capacity refers to the knowledge, skills, and resources necessary to perform a particular task or function. At the district level in Sindh, there is a lack of capacity when it comes to DRR&M. This means that the district-level authorities may not have the necessary expertise or understanding of DRR&M principles and practices, which can hinder their ability to mitigate and manage the risks associated with disasters.

• Unawareness of existing MHVRA-informed DMPs and DMIS: MHVRA (Multi-Hazard Vulnerability Risk Assessment) is a comprehensive assessment that identifies vulnerabilities and risks associated with different hazards. However, one of the gaps at the district level is that DDMAs are often unaware of the existing MHVRA-informed District Management Plans (DMPs) and Disaster Management Information Systems (DMIS). This lack of awareness limits their ability to utilize valuable information and data for effective disaster planning and response.

• Lack of awareness of SOPs: SOPs are predefined instructions and guidelines that outline the steps to be taken during specific situations or emergencies. Although SOPs exist for various aspects of disaster management, such as activating District Emergency Operation Centers (DEOCs) and communication during emergencies, the DDMAs are often unaware of these SOPs. This lack of awareness can result in confusion, delays, and inefficiencies during emergency situations.

Recommendations for Effective Disaster Management and EWS
The expert pointed out that effective and efficient management of the disaster, different capacity building initiatives needs to be carried out. Several points highlighted by the key informants are outlined as follows. It consists both of the bottlenecks and the required capacity-building initiatives.

• Lack of institutional memory and dedicated staff at the DDMA and PDMA levels hinders effective disaster management and capacity building.

- Timely dissemination of information and coordination among government departments are lacking, leading to weak EWS and inefficient DRR.
- The current approach is reactive, and a shift to a proactive approach is necessary for effective EWS and DRR.
- EWS should be inclusive, taking into account age, gender, and disability to address the unique perspectives, challenges, and needs of different community members.
- Local village and religious leader scan play a role in educating the public about EWS and DRR, leveraging from their influences.
- Public awareness and sensitization are crucial as people may underestimate EWS and fail to take protective measures. A mechanism should be developed to ensure everyone follows alerts issued by the disaster management authority.
- The DDMA needs to be functional and strengthened as it currently faces challenges due to current administrative framework.
- Improvements in drainage systems are necessary in areas prone to floods to minimize damage.
- Hazard mapping, particularly for urban and flash flooding, should be conducted to provide essential information for disaster management. Additional resources may be required to handle the workload.
- Community-driven initiatives should be introduced to empower communities and involve them in disaster management efforts.

CONCLUSION

The study highlights the importance of addressing disasters in Pakistan, as they have severe impacts on lives, livelihoods, and infrastructure. Communities rely on informal social networks for support and information in the absence of physical infrastructure. The community has a limited access to EWS and reliable information sources. Bridging the gender gap in accessing information and improving communication systems are crucial to enable informed decision-making and prevent misinformation during disaster crises. Technology plays a significant role in disaster management, improving information dissemination. Collaboration between communities, NGOs, and government agencies has shown positive outcomes, but dissatisfaction with government agencies at the local level need

stronger coordination. Enhancing disaster risk reduction efforts requires investing in physical infrastructure, improving access to information, strengthening collaboration, and empowering local-level representatives. By prioritizing these measures, Pakistan in general and disaster-prone districts of the Sindh province in particular can enhance their resilience, reduce impacts on lives and livelihoods, and ensure the well-being of its communities.

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