

Article

Gender Perspective of Flood Early Warning Systems: People-Centered Approach

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Abstract: Natural hazards early warning systems (EWS) are built on a solid technical and scientific foundation. However, a significant focus must be on those at risk and a systems approach that considers all the key risk factors. A people-centered flood EWS has proved to be more successful at conveying risk messages and protecting lives during times of crisis. The present study intends to analyze the gender perspective of flood early warning systems in Pakistan by using four components of a people-centered approach. The data acquired from the different sources in this study (including institutional key informant interviews = 30 and community focus groups = 32) is analyzed using a paradigm of gender analysis. The findings regarding gender analysis revealed that there was a lack of participation from women in the risk assessment process, and the institutions did not pay enough attention to the conventional knowledge and views of women and men. In most cases, women were not given hazard alerts since they only receive information about possible risks from men. Women were still reluctant to participate in the planning process for disaster response and capacity building because of societal norms and impediments. In addition, the study revealed that the EWS did not satisfy most of the requirements specified in a people-centered gender-sensitive EWS owing to the bureaucratic approach, lack of residents' engagement, communication breakdown between people (at risk), and official risk messages.

Keywords: people-centered flood early warning systems; gender analysis; risk messages; bureaucratic approach; institutional hurdles; Pakistan



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1. Introduction

Of the various natural hazards in terms of economic and social consequences, flood disasters are perhaps the most prevalent cause of death and destruction in society [1]. Floods are responsible for more than 30% of all-natural hazards in the last century [2]. Besides the impact of climate change, water-related catastrophic events are becoming more frequent in Pakistan. According to the Climate Risk Index (CRI), Pakistan is the world's seventh most vulnerable country to climate change, while it comes in at 18th (out of 191) on the Global Risk Index (IRI) [3]. Pakistan was hit by 21 significant floods between 1950 and 2011 (with one flood occurring every three years on average) [4]. Approximately USD 19 billion have been lost in indirect economic losses due to these 21 floods that have

killed 8887 people and affected more than 100,000 villages [5]. Yet, Pakistan saw its worst flooding in history in 2010, affecting nearly all four provinces simultaneously. The 2010 flood resulted in a total economic loss of USD 9.7 billion, claimed the lives of 1985 people, and affected about 20 million people across the country [6–10]. The scale of the impact of the 2010 flood ranks it as a significant event, similar to Katrina, Haiti, Nargis, etc. [11]. These hazards profoundly affected the overall community perception and attitude toward risk [12,13].

Risk communications and perceptions remain established areas in hazard research; however, most of the hazard literature and studies focus on the Global North. In the context of the Global South, risk assessments and perceptions frequently boil down to hazard early warnings. The context and cultural differences must be factored into the equation when communicating risk in a specific location using literature from northern contexts [14]. The term “gender” refers to the unique set of advantages and disadvantages that come with being a man or woman in a particular society or culture and the underlying power systems that regulate their interactions [14]. Gender is perhaps one of the most important and misused ideas in the sphere of social sciences and hazards. Natural hazards have varying effects on men and women; thus, early warning systems must be tailored to their specific needs. Over the past couple of decades, natural hazard records suggest that women are more likely to die than men [15] because they lack information, mobility, decision-making authority, and the resources and training they need to survive in addition to the burden of gender-based social/cultural norms and restrictions, traditional gender responsibilities, and high male outmigration rates [16]. There has been extensive research carried out on conflict early warning systems since the 1980s. Yet, the inequalities between men and women have received less consideration regarding conditions and requirements, perceptions of risk, vulnerabilities, or personal experience [17]. Modern technology has brought various early warning ICT technologies that allow for swift and effective responses to threats.

Despite various projects and programs targeted at gender inclusion over the last several decades, gender concerns and the poor engagement of women in early warning systems have yet to be addressed [18]. This lack of acknowledgment of gender imbalances is also evident in mitigating natural disasters [18]. Women’s inequities in early warning system access and control arise from society’s stereotypical view of technology (e.g., male-centric) that permeates many facets of daily life. For instance, it is common for men to be the ones who are familiar with and skilled at operating technological tools in the agriculture sector. The way women use and engage with technology reflects their primary occupations (e.g., receptionists and operators), whereas men are more likely to be involved in technology repair [19]. Early on, computers were viewed as scientific and male activities due to the obvious strong link between science, men, and technology [17]. Computers are now eroding traditional distinctions between men and women. Likewise, several researchers have discovered that women’s social networks and support systems have been strengthened by mobile phone access. For example, the use of mobile phones has been shown to lessen women’s information poverty and allow them access to a wider, non-traditional leisure space, which demonstrates choices and power [20].

A good early warning system necessitates last-mile connectivity. “The last mile” refers to the most susceptible group, particularly those who have been excluded from the development phase, such as underprivileged children and women (information is frequently passed down through men) [21]. Thus, considering the gender perspective in disaster risk reduction (DRR) planning underscores the need for gender sensitivity in early warning and response. Gender analysis aids in finding disparities in accordance with men’s and women’s activities, circumstances, requirements, possession of available resources, access to the benefits of development, and the ability to make decisions [14,18]. It is possible to achieve gender mainstreaming when men’s and women’s perspectives are considered equally during developing, executing, monitoring, and assessing policies and programs [22]. The women size, shape, endurance, their main obligation of caring for

newborns and the elderly, and, in some cases, their outerwear could all conspire to delay them down at a crucial stage in a crisis. Although women and men have a wide range of disparities in their skills and understanding, their positions in society, preferred modes of communication, and cultural and social norms also significantly impact men and women. These distinctions must be considered when designing and implementing early warning systems [23]. Incorporating a gender viewpoint into early warning systems can increase their effectiveness since it allows for the collection of more precise and distinct data and the ability to conduct more exact and detailed analyses, which results in better readiness and prevention measures, and more precise and quantifiable responses, resulting in a lower potential loss [14,18].

The role of gender in natural resource management (especially in the face of climate change) has been extensively examined in numerous studies [14,24,25] little attention has been devoted to how gender identities are (re)negotiated or (re)produced in the context of natural hazards [26,27]. This is especially true in floodplains, where water plays an important role in providing, supporting, and destroying life and livelihood. Critical sociological and geographical studies provide a deeper comprehension of how people from various social groups perceive, interpret, and negotiate hazardous waterscapes in their daily lives. Recognition of the need for gender-sensitive early warning systems is important in the country since women are more vulnerable to disasters due to their low adaptive capacity in Pakistan. Disasters have a greater effect on women due to various social and capacity-building impediments for women. This implies that when managing and reducing flood risk, women and men require distinct methods and techniques [28]). The concerned agencies have failed to address gender-specific vulnerabilities to disasters [26]. Moreover, women's linkages with local and civil society organizations in KP are also missing. Through gender recognition, disaster impacts can be mitigated, especially in low-income countries such as Pakistan, and particularly for the most vulnerable group [29].

Therefore, using the example of flood EWS in the KP province of Pakistan, we strive to raise awareness about the lack of recognition given to gender-sensitive flood early warning systems. Hazard research has a long history of exploring risk communication and perceptions, although much of the literature is concentrated in the Global North. While in the Global South, risk assessment and perceptions generally come down to hazard early warning, policy, and humanitarian settings. To be successful, the risk communication strategy must be adapted to the specific setting in which it is being utilized and sensitive to cultural diversity. So, instead of focusing exclusively on women, in this paper, we provide a specific example of EWS in Khyber Pakhtunkhwa Province, Pakistan, to show (1) how gendered sensitivities could help risk messages reach more people and facilitate life-saving actions and (2) institutional challenges and gaps for integration of gender aspects into early warning systems in Khyber Pakhtunkhwa province, Pakistan.

2. Coupling Risk Knowledge with Early Warning Systems: Special Reference to Pakistan

Research on risk communication (in the context of flood hazards) has helped shift the perspective from engineering flood defense to better comprehensive hazard management during the last few decades [30]. Such a paradigm change has revealed the considerable implication of risk perceptions, behavioral reactions, and institutional management, which raises doubts about the efficacy of top-down approaches. Several scholars have emphasized the usefulness of vernacular knowledge and proposed a comprehensive perspective in which official knowledge is supplemented by local risk mechanisms [31]. The social augmentation of risk [32] and the democratization of risk [33] assist us in understanding the depth of biophysical and social elements of hazard (risk) messages. Risk is communicated in various ways and then comprehended in different social contexts based on various actors, such as the receivers' social standing, educational attainment, preexisting frameworks of knowledge, personal history, and gender [32]. The nexus between societal risk attenuation and gender susceptibility to risks culminates in the formation of vulnerable geographical

regions and consequently serves as the primary entrance point for all policy initiatives. Gender influences our vulnerability to environmental stresses and our ability to anticipate, adapt, and recover from these stressors. Gender influences control over resources and decision-making in information, health, education, financial services/credit, transport, legal systems, and entitlements, which can also exacerbate poverty and susceptibility.

In a country like Pakistan, the ideology of purdah (purdah refers to the act of covering women from public view by dressing them in head-to-toe concealing garments and maintaining high walls, drapes, and screens well within the home (https://departments.kings.edu/womens_history/purdah.html (accessed on 20 June 2022)), and the corresponding honor code that assigns social value to authority over women's bodies exists to differing extents in the social sphere, and still hinder women's movement and information exchange as well as their involvement in the workforce; the marketplace; health services; and education [34]. Similarly, it establishes a sense of patriarchal supremacy and standards for whatever is required to be a good man. For decades, women have been denied the right to inherit land because of their role in farming, which has left them with a structural dependency on their male family members. Judicial precedent in Pakistan does not explicitly prejudice women, but customary law governs succession and inheritance, which results in the general deprivation of women from land entitlements. However, even women who want to stand up for their rights may run into obstacles because they are neither listed on revenue records as tenants nor have any legal processes to recognize their work as agricultural laborers [35]. Since the establishment of Pakistan's National Commission on the State of Women, several formal initiatives have been taken. For instance, in 1996, Pakistan ratified the Convention on the Elimination of All Forms of Discrimination Against Women and the Women's National Action Plan, 1998. Most of the provisions are only on paper and rarely put into practice.

Pakistan is susceptible to various disasters triggered by natural hazards, including floods. Floods struck Pakistan for five years in a row (2010–2014), killing thousands of people, destroying livelihoods, and affecting over five million people. The floods in Pakistan predominantly impacted those segments of the society who were the most susceptible owing to their socioeconomic status, gender, age, and geographic location [4,7,8]. Until 2005, disaster management in Pakistan was largely dependent on a reactionary approach. The Hyogo Framework of Action (HFA) enables a paradigm change from purely reactive to proactive behavior. As a result, the National Disaster Management Agency (NDMA) produced a 10-year national disaster management strategy that includes a comprehensive EWS plan for multi-hazards [36]. The plan establishes the foundation for federal, provincial, and local governments to forecast and distribute alerts about potential hazards to community partners, non-governmental organizations, and other relevant stakeholders in the DRR process. The plan specifies the number of activities, such as conducting baseline investigations, identifying hazards, formulating short-term and long-term project plans, and putting in place a strong monitoring alert system. A total of USD 188.5 million was reserved for long- and short-term early warning programs or projects [36]. The Pakistan Meteorological Department (PMD), which sends alerts immediately to the District Disaster Management Authority (DDMA), is meant to be the key actor in EWS. The PMD has been assigned this role because the monsoon rains can best be predicted and handled by PMD. PMD employs satellite images of clouds and radar data to anticipate floods from quantified rainfall measurements to supplement standard weather forecasting resources. PMD is responsible for communicating flood forecasts and warnings promptly to avoid disasters like the floods of 2010, which devastated Pakistan even though PMD had issued a flood warning before the actual flood [37].

However, in 2010 prior alerts were still ineffective in persuading inhabitants to flee their homes out of the flooded area, resulting in significant losses in life and property. Most of the residents stayed in their homes as they were skeptical of the flood warnings (http://floods2010.pakresponse.info/assessments/Gender_Preliminary_Rapid_Assessment.pdf (accessed on 20 June 2022)). Weather forecasting in Pakistan is hampered

by the relatively small number of weather stations (80 in total). The existing data acquisition procedures of the PMD do not permit the integration of public or non-governmental information accumulation channels. Public outreach and educational institutions are important components of the meteorological data collection process, but citizen-based data collection can also be a valuable addition to the formal system in many other places across the world [14]. Additionally, the PMD in Khyber Pakhtunkhwa (KP) has a very small number of meteorological stations (14 in total) and only one stream gauge, which is inadequate for such a large and hugely important region.

3. Research Methodology

3.1. Study Area Description

Pakistan has a population of around 210 million people and is located between 23.35 and 37.50 North latitude and 60.50 and 77.50 East longitude. Its total size is approximately 881,913 square kilometers (Figure 1). Recent years have seen several large-scale flooding incidents that have affected vulnerable people in all four provinces of Pakistan. Pakistan has been hit by 16 major floods since gaining its independence in 1947 and PKR 386 billion in economic damages have been recorded [38]. Aside from “human influence on rivers and continuing shrinking of Himalaya and Siachen glaciers owing to rising temperatures, rapid unplanned development, and deforestation,” rainfall was a big contributor to the country’s flood disasters. Early warning of the risks allows citizens/communities/authorities to prepare for and mitigate the effects of disasters. A pre-disaster phase entails forecasting and disseminating early warnings to the vulnerable group. Establishing early warning systems and effective communication with national and regional predicting agencies is the obligation of disaster management authorities, who must also provide accurate factual evidence to the multi-hazard warning centers. Engaging important stakeholders may improve the ability to cope with extreme catastrophes. When developing an early warning system, it is critical to have a strong community/people-centered network. The early warning communication should be clear, trustworthy, and pertinent to the susceptible community. The warning system is useless unless it reaches the desired audience in time. This also necessitates the development of the community’s capacity to react efficiently to an impending disaster.

In the country of Pakistan, several early warning systems have been put in place (including the (1) National Seismic and Tsunami Early Warning Center; (2) The Tropical Cyclone Warning Centre; (3) Flood Forecast and Warning Center, and (4) National Drought Monitoring Centre, etc.) but they need to be strengthened [11]. With the aid of all partners, the Khyber Pakhtunkhwa Provincial Disaster Management Authority is putting existing resources to good use by channeling them through correct processes to lessen the impact of natural hazards and increase readiness for flooding. There is no room for dispute about the provincial government’s commitment to investing in a flood control system; however, owing to the dearth of proper water storage, ineffective regulation, and poor early warning systems, it is impossible to design a working and efficient flood risk management system. In the Khyber Pakhtunkhwa province, the existing early warning and forecasting of floods are currently reliant on telemetry installed by the Water and Power Development Authority (WAPDA) and the Irrigation Department. There is the main river called the Indus that runs through the province. The Indus River catchment area is comprised of the province’s upper regions connected by numerous tributaries from the Northern Regions along with rivers like the Kabul, Swat, and Kurram, as well as various mountain channels. Currently, the Irrigation Department has a reaction time of 24–48 h in the Swat River, followed by 5–7 h in the Kabul River and 60–48 h in the Indus River. This is a short period for the evacuation of disadvantaged groups in the affected areas [39].

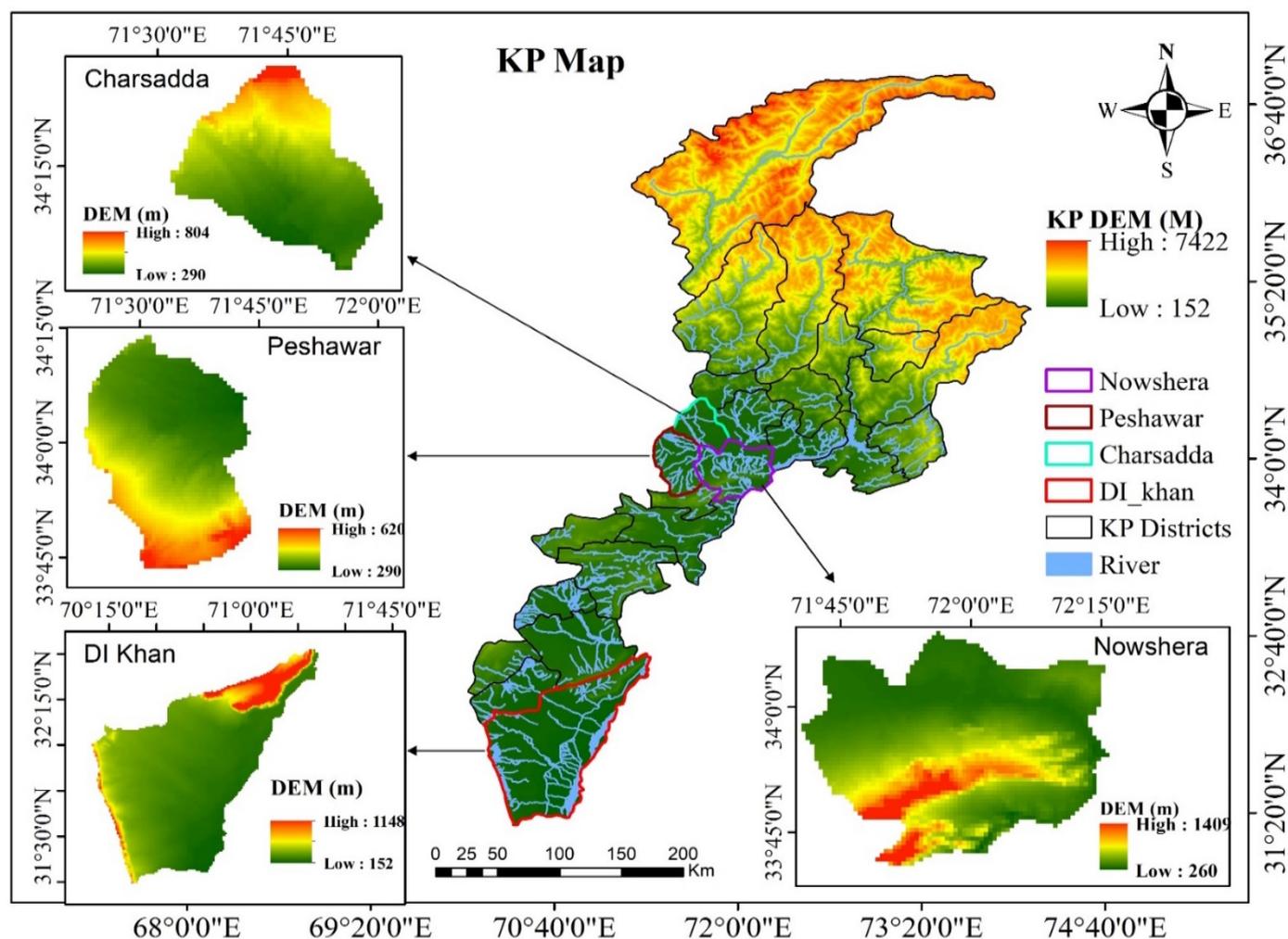


Figure 1. Sample study districts in Khyber Pakhtunkhwa Province, Pakistan.

3.2. Sampling Plan of the Study

The current research study was performed between March 2021 and June 2021. The province of KP was purposively selected because of its population (over 15 million people living in the KP province) and size (which occupies a total land of 10.17 mh). In the past two decades, eight devastating floods have occurred in this region. This province was hit hard by a flood in 2010 that devastated 24 of the 25 districts [40]. After the selection of Khyber Pakhtunkhwa as a study province, we deliberately selected four districts (particularly Nowshera, Charsadda, Peshawar, and Dera Ismail Khan), which were listed as the most susceptible districts in the 2010 flood disaster. The stakeholder consultation was carried out, and information was collected through key informant interviews (30 in total; Table 1), focus group discussions (FGDs) in rural communities with men and women (eight FGDs per district, including 4 male FGDs and 4 Female FGDs; 32 in total), and informal discussions as well as telephone conversations. Table 2 shows the selection of the study province, sampled districts, focus group discussions, and key informants consulted during the study.

Gender analysis is premised on the idea that a person's gender is something that would be learned and unique to their family, friends, and other social group members. For these reasons, we need to explore and better understand the differences in gendered labor and the roles and identities that go along with it. One of the main purposes of gender analysis is to reveal the social and economic gaps between men and women by highlighting the gender-based causes of these inequalities. Gender analysis would illuminate the core causes of power imbalances and gender inequality distinguish between how men and women

view risk and susceptibility [41]. Analyzing the data was a key component of the current investigation. Studies on gender analysis have produced numerous paradigms of frameworks. For instance, the Harvard Analytical Framework (HAF) [42], the Moser Gender Planning Framework (MGPF) [43], the Gender Analysis Matrix Framework (GAMF) [43], and the Women's Empowerment Framework (WEF) [44]. However, in the current study, we utilized a gender analysis of the four pillars of people-centered early warning systems (Figure 2) to analyze the data obtained from diverse sources across the four study districts. Social risk-amplifying processes intersect with gendered sensitivity to hazards, resulting in geographic vulnerabilities. This junction serves as the starting point across all policy interventions. In a nutshell, there must be a solid scientific and technical foundation for early warning systems against natural disasters and a systemic approach that considers all all of the relevant factors in risk exposure [31].

There are four interdependent components [14,18,37] that make up a strong early warning system, as indicated in Figure 2; namely: risk knowledge (1st component) followed by a monitoring and warning service (2nd component); dissemination and communication (3rd component), and response capability (4th component). Every component of the system was evaluated regarding disparities in roles and functions, involvement, and decision-making. This includes disparities between men and women in recognizing risks, keeping track of and anticipating impending events, analyzing and spreading warnings that are easy to grasp, and responding appropriately and promptly to such warnings. The analysis was aided by preparing important aspects for each of the four components of early warning systems. For instance, are women and men equally aware of their susceptibilities and potential risks? Are warnings sent to both females and males?

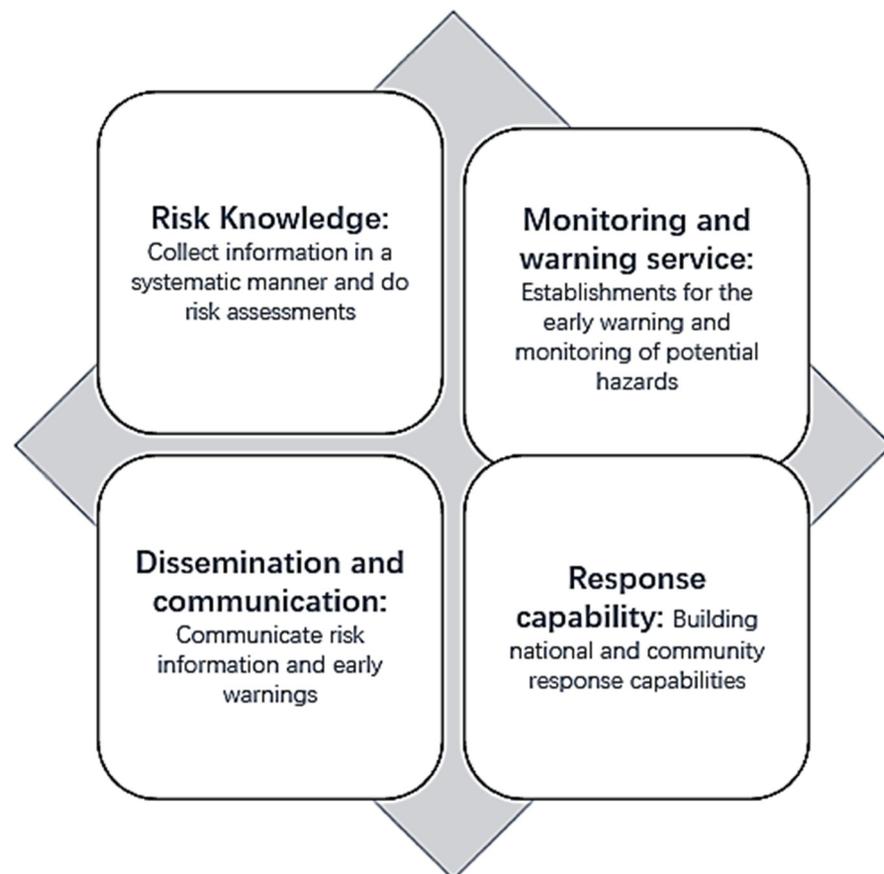


Figure 2. People-centered flood early warning system.

Table 1. Local institutions consulted during the study.

S.No	Government Departments	KI Interviews
1	Provincial Disaster Management Authority (PDMA)	05
2	District Disaster Management Authority (DDMA)	04
3	Finance Department	01
4	Provincial Revenue Department	01
5	Planning & Development	01
6	Social Welfare	01
7	Public Health Engineering Department	01
8	Civil Defense	01
9	Communications and Works Department	01
10	Urban Policy Unit	01
11	Rescue 1122	01
12	Pakistan Meteorological Department	02
13	Water and Power Development Authority-WAPDA	01
14	Local Government-WSSP	01
15	Peshawar Development Authority	01
16	Town Municipal Administration	02
17	National Disaster Management Authority (NDMA)	05
	Total	30

Table 2. Sample size distribution across the four selected districts.

Province	Districts *	FGDs **	Key Informant Interviews
KPK	4	32	30

* Namely Peshawar, Charsadda, Nowshera, and D. I. Khan. ** Eight FGDs per district, including four male FGDs and four female FGDs, and each FGD comprised of 8–12 members.

4. Results and Discussion

Early warning systems necessitate inputs from diverse actors, including institutions, communities, governmental/non-governmental organizations, and the scientific community [45]. To assess the status and efficacy of contemporary early warning systems in Khyber Pakhtunkhwa province, Pakistan, officials from 17 institutions (especially those responsible for flood risk management) engaged in multiple domains of disaster risk reduction were interviewed (on institutional arrangements and policies). These major stakeholders' wide range of functions was examined from a gender perspective through key informant interviews in the respective departments. Instead of being 'neutral', 'gender neutral' disaster risk management measures lead to women's distress, humiliation, and an increased chance of becoming a victim of violence, as well as maintaining a system that restricts their access to opportunities and options [46]. These issues can be minimized to a certain extent by including women in all phases of the cycle so that any possible detrimental effects of particular measures (or lack of action) and decisions on women can be identified and addressed appropriately. In a country like Pakistan, there are no explicit policy guidelines for the involvement of women in early warning system initiatives. However, the National Planning Commission's guidelines are frequently followed by government entities, which include a mechanism for the inclusion of women in development programs. In this regard, gender analysis was carried out for the 17 institutions following the tasks associated with each of the four major parts or pillars of efficient people-centered early warning systems in Khyber Pakhtunkhwa province, Pakistan (Table 3).

Table 3. Description of the results from the institutional analysis.

S.No	Government Departments	Scope of Work	Gender Integration		Women Working in EWS	
			Yes	No	Yes	No
1	Provincial Disaster Management Authority (PDMA)	Coordination and sharing of information	✓			✓
2	District Disaster Management Authority (DDMA)	Coordination and execution		✓		✓
3	Finance Department	Resource allocation, financial rules and regulations, and managing treasury operations		✓		✓
4	Provincial Revenue Department	Land revenue assessment and recovery to build an effective system for mobilizing provincial resources		✓		✓
5	Planning & Development	Comprehensive planning and building plans, socio-economic impact analysis, and developmental program monitoring and evaluation		✓		✓
6	Social Welfare	Awakening people's sense of social responsibility and enabling them to identify and contribute to community building and welfare programs		✓		✓
7	Public Health Engineering Department	Delivery of safe drinking water and sewerage system		✓		✓
8	Civil Defense	Delivering emergency assistance to keep morale high throughout natural and man-made disasters		✓		✓
9	Communications and Works Department	Working on development and construction		✓		✓
10	Urban Policy Unit	Urban DRR and policies		✓		✓
11	Rescue 1122	Sharing of information and rescue		✓		✓
12	Pakistan Meteorological Department	Forecast floods and issue flood warnings		✓	✓	
13	Special Development Unit	Developmental projects		✓		✓
14	Local Government-WSSP	Facilitating collaborative efforts		✓		✓
15	Peshawar Development Authority	Facilitating collaborative efforts		✓		✓
16	Town Municipal Administration	Facilitating collaborative efforts		✓		✓
17	National Disaster Management Authority (NDMA)	The National Disaster Management Authority (NDMA) is a federal institution dealing with disaster-related activities. The scope of NDMA's activity or its position in EWS as policymaking, coordinating and sharing of information	✓			✓

Source: Field survey data, 2021.

4.1. Risk Knowledge: Using the Gender Lens to Explore the Institutional Analysis of Flood EWS

The term “risk knowledge” alludes to the community’s comprehension of disaster risk. Instead of relying on previous disasters for historical context, residents in disaster-prone areas benefit more from learning about the repercussions of future disasters. In a rural setting, risk knowledge is very important (moving from an area of known risk to an area where the risk is less known) [47]. Individuals’ perceptions or interpretations of vulnerability to local hazards influence the extent to which risk information and involvement in hazard management promote their adaptation to local hazards [48]. Risk mapping would help prioritize the demands of early warning systems and lead to preparedness for disaster response and preventative actions [49]. Pakistan’s disaster risk reduction (DRR) institutional arrangements have evolved in two distinct streams. The first stream is the

well-established, influential, and legally obligated provincial revenue and administrative support, which in their additional duties as enforcement agencies and revenue-raising, are also responsible for early warning dissemination, response, and rehabilitation, as well as other disaster management operations. The second is the predominantly donor-funded and supported stream, including the NDMA and PDMA. They act as the government's point of contact with international funders, but there is minimal clarity under legislative power (Pakistan federal structure) or adequate budget allocation. This tension (between old and modern streams, forceful and apparent) is also evident in the EWS segment of disaster risk management [37].

The PMD has the statutory right to issue formal flood early warnings in Pakistan. This formal early warning information is provided to the provincial secretaries as well as the NDMA, who then pass it on to the patwari (the patwari is the lowest-ranking officer in the Revenue Collection System, and his primary function is to gather revenue by inspecting agricultural lands, keeping track of property ownership and is assumed to be in charge of distributing community-wide warning messages). We were met with perplexed and ambiguous expressions when we inquired about what occurs once the patwari hears of the floods' early warnings or how might potential targets (victims) be made aware of the warning? The explicit and implicit assumptions appeared that as long as the patwari is provided with the warning, the purpose of providing an early warning was accomplished. However, the acquisition phase does not include any of the features of people-based early warning systems in which the potential victims are engaged in comprehending and shaping the hazard risk messages.

The PMD is a solitary department that has minimal engagement with the customers who use its services. Involving the general public in the collection of data, which is an important part of the risk knowledge component (first component) of a people-centered flood early warning system, could greatly improve the amount of data collected; it could also make the process of data collection more clear and perfectly reasonable to the general public, which would also significantly raise the authenticity of the institution and its projections in the eyes of the general public. The PMD's work is also poorly understood at the government level. For instance, the Assistant Commissioner (AC) Charsadda district in Khyber Pakhtunkhwa province, Pakistan, acknowledged that when he started receiving the inundation alert messages for his territory back in 2010–2011, he had no idea what it meant since it discussed the possibility of particular millimeters of rain falling, in terms of percentage. Without any doubt, the year 2010 became one of the most damaging for the Nowshera District in terms of flooding, he further added.

It seems even more critical to understand this issue when one contemplates the geographical scope of the warning issued. On the other hand, the potential victims' gendered, cognitive, and functional spaces are significantly more nuanced. For example, an official from the PDMA stated that

“The flood hazard ratings along major streams or coastal areas within districts should be more geographically defined, and viable refuge places should be more explicitly listed. These kinds of places where people can seek sanctuary or escape, depending on particular gender function spaces.”

Most participants from the government sector who were interviewed acknowledged the deficiencies in their ability to properly distribute risk information and the necessity of a timely and effective EWS. The PMD officials indicated that their objective is to provide timely warnings to the NDMA, PDMA, media authorities, and DDMA. In addition to that obligation, they also share information with non-governmental organizations whenever requested. The information in Table 3 depicts the roles of several institutions and the level to which gender is incorporated within their purview. The results from the key informant interviews highlighted (Table 3) those policies, plans, and guidelines that make provisions for women's organizations to participate in the capacity development of women and men. The Pakistani government has also set rules and statutory directives requiring a certain number of women to be included in community development programs. It has not yet

been attempted to design gender-sensitive alerts and messaging, nor has it been possible to provide enough education on hazard susceptibility assessment using relevant methods or standards. Only a few officials (PMDA and NDMA; Table 3) claimed that their early warning systems had a formalized structure for collecting and sharing information. However, neither of the institutions conducted a thorough hazard and susceptibility assessment with enough attention to conventional knowledge and perceptions among women. An official from PDMA stated that

“Funders, humanitarian organizations, and other NGOs put pressure on the organization to include a gender perspective as a symbolic gesture.”

While stressing the importance of reaching out to women to disseminate a risk message, most participants in this study agreed that women are more susceptible to disasters than men. Males (stereotypically) in good physical shape are portrayed as heroic types who save the elderly, women, and children while also protecting their possessions. In contrast, women have been viewed as powerless and reliant upon men for assistance. A PDMA representative said that

“That is not what we say: women and children ought not to be informed of what would transpire during a flood. However, they must be trained on how to defend themselves and their children to help their husbands and reduce their burden. This raises the chances of saving more people, property, and cattle.”

4.2. Monitoring and Warning Service

It is essential to have a solid scientific foundation for anticipating catastrophic disasters. To ensure timely warnings, constant monitoring of potential disaster precursors is required. Approaches that target a wide range of hazards and engage several monitoring bodies are most effective [49]. Monitoring and warning service is the second component of a people-centered EWS that deals with timely and accurate alerts, the ability to spot risk precursors, forecast hazard progression, and disseminate warnings [14,18,31,37,49]. Most individuals in four districts were unaware that their area had a formal EWS to respond to flooding. The official EWS is generally not well-known, and the local community has no control over it. All four selected districts overwhelmingly identified the “Rivers Kabul and Indus” as the primary source of floods and epidemics that threaten their daily life. A 37-year-old male FGD member from Nowshera District stated:

“Rainwater-induced collapse of roofs and walls has claimed many people’s lives. Residents of the Kabul and Indus rivers are particularly susceptible; in some instances, entire homes are destroyed. Furniture, clothing, and pets were swept away by the floodwaters in our area.”

Following the loss of people’s lives, most of the sampled respondents cited the faulty drainage system, which allowed water to infiltrate their houses even during moderate floods, as a cause of “cholera” (diarrhea) and other infections. The “Rivers Kabul and Indus” are a persistent cause of worry for the local inhabitants, and it is their constant alertness functions as an early warning system. This is what a 23-year-old male FGD member from Nowshera District stated:

“In the monsoon season, I spend sleepless hours watching the Kabul and Indus rivers for signs of impending floods and preparing for them, which is normal.”

A 31-year-old female member of the FGD group stated that

“It’s acceptable to presume that the water’s surface (Kabul and Indus Rivers) is up to a certain point. However, we begin to worry about flooding whenever the water rises to that level. As a result, we begin packing our most important possessions, such as a television, a refrigerator, and other valuables, and moving them to a more secure location in the house.”

The results of the FGD with male and female participants across the four selected districts revealed that the majority of the FGD members (both male and female), despite hearing loud warning messages from the mosques, had no idea what an official EWS was, how it works, or what its purposes were, except for the sirens that had been placed nearby at points where the Kabul River enters and passes through the susceptible communities. Despite this, they rarely heard the alert before a flood struck. They felt that the sirens were malfunctioning because of insufficient maintenance. Only a few male and female FGD members in Nowshera and Charsadda reported that before the flooding, they had heard sirens several times. This indicated that they would have little involvement with the EWS operator or had no involvement in establishing the settings for its functioning. This was verified during our discussion with the Pakistan Meteorological Department (PMD) officials based in the regional meteorological center (RMC) Peshawar, who stated that:

“Formal threshold for EWS operations was much higher than flood levels are often seen by communities that live across its riverbank [it is activated if 600 mm of rain falls in 24 h]. It seems likely that even if the system is activated, it will only sound a siren to alert people in the flood plain to the impending danger.”

Our discussion with the elderly FGD participants in the Nowshera and Charsadda districts revealed that they could forecast the severity of the flood (rainfall and flow conditions) because they had lived near the Kabul and Indus Rivers their entire lives. A 49-year-old male FGD member from Banda Shaikh Ismail village in Nowshera District remarked that

“Whenever Banda Shaikh Ismail [a rather low-lying locality] gets flooded, we become aware that flooding might happen at any time.”

A 46-year-old male FGD participant in the Charsadda district remarked that

“Residents in our region have been told to be on the lookout for floods whenever I find that it is approaching.”

The male FGD participants from Nowshera District said that mosques were a crucial source of information, even though flood warnings did not frequently occur. Other potential information sources included television and calls from family and friends on cell phones. Female FGD members from the villages of Kurvi and Camp Koruna stated they had not heard any sirens (placed nearby at points where the Kabul River enters and passes through the susceptible communities) or announcements (via loudspeakers) from the mosques warning them of approaching flooding. Additionally, the monitoring of local risks (only the PDMA, NDMA, and PMD institutions were engaged in hazard assessment and warning services, and they sought the help of women’s groups and individuals to undertake risk assessments; Table 3) on a regular basis by both men and women is critical for gathering data for early warning systems. This would be accomplished by allowing both men and women to participate equally in the development of an alert system for all possible hazards, followed by the establishment of a system to confirm the equitable distribution of warning messages to both men and women, the use of diverse resources in training both men and women how to predict possible risks, and also taking into account the traditional knowledge of both genders when making risk predictions. The participation of both women and men will aid in the precise, timely, and early identification of information, as well as the reduction of hazards.

4.3. Dissemination and Communication: Gendering Risk-Related Information and Early Warnings

Those who are at risk need to hear loud and clear warnings that they can comprehend. The warnings must provide clear, usable information that allows individuals to respond appropriately [49]. Getting the word out about flood risk necessitates reaching as many people as possible and ensuring they understand the warnings given to them. As a result of the persistent gender division of labor in Pakistani culture and the widening gaps in socioeconomic status, education, age, religion, and ethnicity that exist throughout the Indus basin, people’s ability to access information is severely restricted. Women frequently take

on caretaker tasks in the home [4], and as a result, they are much less exposed to other sources of knowledge [37]. In the case of the Khyber Pakhtunkhwa province, Pakistan, males who deal with the patwari regularly are far more likely to obtain flood warnings than women who rarely speak with male government officials. Their responsibilities severely curtail women's leisure time in the domestic sphere. In addition, sporadic electricity and weak mobile phone connection in some locations (for instance, in D. I. Khan and Charsadda) make this media an untrustworthy source of information. A 34-year-old female FGD participant from Nowshera District said:

“Women are the primary caretakers of domestic affairs in Pakistani society, which is based on a more primitive system. Furthermore, a large percentage of Pakistani society, particularly the Pashtun tribe, has tightened limitations on women's empowerment [e.g., social, economic, and educational]. A woman's plight in Pashtun culture, especially in rural communities, begins well before she gives birth because a girl's baby is not necessarily considered “desirable. As soon as she is born into this world, she may face a lifetime of hardship and prejudice. Traditionally, men are believed to have a significant part in all aspects of a girl's life starting at an early age, from her schooling through the choice of her spouse. Her spouse and in-laws might take control of her life when she married. They could decide various things, such as the number of children she has, her involvement in society, and her restrictions on school or work. Women in such regions are generally the first ones to wake up and the last ones to sleep, so when food supplies are low, they are in jeopardy of hunger. She has no choice but to accept the harsh reality of patriarchal culture.”

Additionally, the language used to convey risk can be an obstacle in communication. Many female FGD members were unconcerned with rainfall amounts expressed in millimeters or as a percentage of flooding occurring, and a vast number of Pushtun women in the study regions did not understand the official very Persianized Urdu language used on television. A 37-year-old female FGD participant from district Peshawar said:

“I spend more time watching TV and listening to programs regarding early warning systems, but their vocabulary eludes me. As a result, I must depend on my hubby's knowledge to fully absorb the message.”

In the Charsadda District (one of the sampled study districts), Munda-I-II is home to an estimated 1007 (<http://kpkcar.org/images/docs/Afghan%20Refugees%20Camp%20Population%20in%20KP%20March%202018.pdf> (accessed on 20 June 2022)) Afghan refugees and ethnic Pashtuns from other areas of Pakistan. People live in mud-walled shacks with no electricity and no safe drinking water, as the local inhabitants mostly rely on dug wells. However, there are seven mosques in the neighborhood. The area is marked by a stricter purdah, which restrains women's mobility. Males in the community work as daily wage earners, but women are more likely to stay home and care for the children. This has a significant impact on their access to information. A 43-year-old female (A housewife in Munda 1, Charsadda) member of the FGD group said:

“There is a strict policy prohibiting us from leaving our homes. Flooding is a real threat, as our men have informed us. Owing to the unavailability of power, loudspeakers in the mosques could not broadcast the warning. No alert or siren has ever woken us up in our homes, although we are always inside our homes.”

Women in the selected regions practice purdah, which stipulates that no woman can leave her home without consent from her husband or male parent. A 31-year-old female FGD group member in D. I. Khan said:

“In a flood, we are not permitted to leave our homes unless a male accompanies us. To protect ourselves, we look for safe havens within our own homes. Without the approval of our spouses and fear of punishment, we are often unable to relocate.”

The study findings further revealed that women across the four selected districts were not regarded as recipients when emergency notifications were sent. Using radios

and cellular phones to broadcast catastrophe warnings does not guarantee that women and girls would get them. Women's groups had been founded by several institutions (in Table 3); however, the messages and methods of distribution were not gender-sensitive.

4.4. Response Capability: Performing Masculinities versus Performing Femininities

People's preparedness and readiness to respond to a warning are critical, eventually influencing reaction plans. People react to flooding heavily influenced by the socially built and anticipated acts or behavior of masculinities and femininities. Women are portrayed as hapless victims in public, the institutions, and the media discourses perpetuating gender stereotypes, where they must be protected by heroic and caring men [50,51]. This stereotype is completely at odds with what occurs on the ground, where the gender division of labor necessitates that women be responsible for caring for the old, disabled, and children, as well as animals. Female participation in disaster preparedness, evacuation, and sheltering has been repeatedly documented in the scientific literature [25,39,50–52]. Earlier studies in Pakistani and the Global North have found that women and men place different values on different items and have different priorities when faced with a crisis [50]. For example, a 39-year-old female member of the FGD group in Dera Ismail Khan said:

“She was concerned about her ability to feed her children after losing her cooking utensils in the 2010 floods, which caused her feelings of stress and worry.”

On a more profound level, the contradiction between the stereotypical portrayal of femininity (women as perpetual victims, physically wholly reliant on men) and the performed femininity (where women bear the responsibility of providing food and livelihood for their families) tends to place women in a difficult situation. This results in a successful response to one message causing a failed answer to another (and vice versa), which may cause them to feel strange or uncompensated no matter their response. Women's capacity to respond quickly and efficiently is further limited by the fact that they frequently rely on indirect information (provided by males). Despite this, the overwhelming majority of female respondents (except for Munda I and II; Charsadda District and D. I. Khan) stated that they had the power to make their own decisions and could leave their houses or relocate their children as well as their personal belongings to the top roof once they received flood early warnings (Female FGD members from Nowshera District and Peshawar, respectively).

It is important to note that drug usage, particularly among men, is pervasive in the less affluent areas around Peshawar District. Most families in these situations depend on women to provide the financial means to survive; therefore, they alone must shoulder the responsibility of guaranteeing their families' well-being in times of emergency. As expressed by a 29-year-old female FGD member from D. I. Khan district, who worked as a cleaner:

“Before or during the deluge, it is entirely up to me what I do. Because my partner spends most of the day lazing around the house, I'm the one who has to work to make a living each month.”

In the same vein—as highlighted by some of the respondents—men who receive risk alerts while away from home face a similar set of challenges generated by the desire to execute the manly chores of saving their families while also safeguarding their businesses, such as secure the shop or fruit cart before rushing back to the house.

Many non-governmental organizations (NGOs) are active in Peshawar, Nowshera, Charsadda, and D. I. Khan districts, but disaster relief is not their primary focus. Nonetheless, several self-organized solutions were discovered during the study. For instance, in Nowshera and Charsadda Districts, some female FGD participants claimed that they construct floodgates (as a protective approach well before the monsoon season) on their doorsteps to keep water from penetrating their bedrooms. They boxed and arranged their goods at a height close to the ceiling. They further said that they had to leave their homes and take their children to live on their roofs in certain situations. For the most part, two-story residences are rented by two separate families, and the household on the ground level

is more susceptible to flooding. With an improved early warning system, they will be able to fortify their floodgate ahead of the doors and relocate essential kitchen stuff and blankets to more secure locations. In this case, having a timely and understandable early warning would benefit both men and women to take the necessary actions. Some inhabitants of the Kabul River plain (Nowshera District) retain buffaloes, cows, and encroachments invading their property lines. During the rainy season, the district's sewer infrastructure is frequently overrun by floodwaters. Many of the participants in the Nowshera District who took part in the male FGD advised building walls along the Kabul riverbank to keep it from overflowing.

The vast percentage of the local institutions assessed (see Table 3) were significant in developing response capacity. However, this was not carried out systematically or connected with the functioning of the early warning system. Even though women play a significant role in disaster response and can cope with, adapt to, and survive disasters, they are typically excluded from early warning system operations. Questions have been raised concerning the role of women in developing response capability as an important component of early warning systems. Women's participation in assessing hazards, vulnerabilities, and capacities ensured that they were also actively associated with developing community response capacities. Women were more widely available for the risk assessment and other community engagement tasks since men are more likely to work outside the home.

5. Institutional Challenges and Gaps for the Integration of Gender Aspects into Early Warning Systems in Khyber Pakhtunkhwa Province, Pakistan

In Pakistan, inundation is a significant issue during the monsoon season [4,53]. The current study has discovered key institutional challenges and gaps in incorporating gender concerns into early warning systems in Khyber Pakhtunkhwa province, Pakistan. Most of the points pertain to enhancing early warning systems' efficiency and long-term viability. Still, they are listed since these advancements are important for effectively incorporating gender considerations. The main points are listed below in Table 4.

Table 4. Institutional challenges and gaps for integrating gender aspects into early warning systems.

Challenges and Gaps
Evacuating residents from flood-prone neighborhoods was perhaps the most pressing issue for the local government, as reported according to interviews with key sources from local institutions. It did not matter that the early warning had been issued; people stayed put. Representatives from the PDMA said that the Short Message Service (SMS) has also been used to send warning alert messages to the cellphones of people in the PDMA registry. However, few people left their homes due to the obvious alerts.
Another problem with the EWS is the paucity of information exchange between the different institutions. The PDMA's are not required by law to comply with the NDMA following the 18th constitutional amendment, which delegated authority to the provincial governments. Therefore, over time, the connection between them has weakened. The NDMA and PDMA also do not communicate directly with the municipal or district governments nor transmit information to lower echelons. Furthermore, the national and provincial governments have various agendas, including energy shortage, poverty, and terrorism, which can often conflict. Therefore, it is necessary to improve liaison and cooperation to address these issues.
Capacity is underutilized due to a major lack of female participation. The involvement of women is typically confined to user institutions, which play a limited function and have minimal active engagement in decision-making processes.
At the highest levels of decision-making, women tend to remain underrepresented, highlighting the importance of encouraging and providing more openings for women in the future
Numerous institutions have started disaster reduction activities on their own, but to have the maximum impact, these efforts must be linked to those of other institutions.
Only a small portion of the province is currently protected from flooding by flood early warning systems, but as technology progresses, this might be expanded to cover the entire province and country
Early warning systems must be tailored to the local environment because of the daily difficulties and challenges communities confront daily. Additionally, advanced applications should be employed to transmit messages that would also be valuable for community livelihood requirements, such as weather forecast trends to assist crop-related choices, marketplace, and storage/transportation decision-making

Table 4. Cont.

Challenges and Gaps
Efforts must be taken to include women on an equal footing with men in the process of developing and receiving early warnings and alerts since women play an active part in the security of family livelihoods
Educating people about gender-sensitive early warning systems, susceptibility and risks, and what activities could be undertaken to improve early warning system efficacy is important. However, it is difficult to coordinate and manage this at the national and district levels
In Khyber Pakhtunkhwa province, Pakistan, most institutions include a legislative framework for the involvement of women in user groups that has worked successfully. In DRR programs, such required provisions are nonexistent, including EWS

6. Conclusions and Policy Implications

DRR focuses on prevention rather than relief. An EWS is one of the most crucial aspects of emergency preparedness. This has become a key aspect of managing catastrophic risk in areas prone to flooding. An effective EWS system relies on accurate forecasts, timely transmission, and reaction mechanisms in areas prone to flooding. Improved early warning systems necessitate establishing gender-sensitive tools and methods for broadcasting and receiving alerts and improving the response capability of women and men. Despite progress in comprehending gender concerns, the KP institutions (e.g., PDMA, etc.) are only beginning to incorporate a gender viewpoint into their early warning systems, particularly those for flood hazards. The current study findings revealed that Pakistan's EWS requires significant improvement. Rural residents who live in flood-prone areas do not trust the EWS because it is poorly understood. Households of lower socioeconomic status tend to be located in more exposed regions, which increases their risk. EWS compliance is hampered in low-literacy areas by residents' inability to comprehend and follow emergency measures. This research only looked at four flood-prone rural communities; it cannot be extrapolated to rural areas. However, the country's EWS can be evaluated using more complex statistical techniques and larger samples. Another critical element of an EWS that needs to be investigated in depth is trust (or lack thereof). Even though the usefulness of the EWS was only examined in four communities, it was clear and definitive that the EWS designed and implemented in the country faces challenges regarding its functioning and efficacy. It seems that a connection between the EWS and the more casual societal perspective is missing. The goal is to create and execute a society-inclusive approach in which the relevant institutions quickly learn and adapt from successful flood warning systems applied in developed or developing nations. Nonetheless, Pakistan requires a system that includes the entire community and is reliable, up-to-date, and incorporates necessary routes for effectively disseminating early warnings.

The EWS model in Pakistan falls short of reaching all the standards for a people-centered EWS (gender-sensitive). The PMD is at the core of the formal EWS and takes a very technocratic and science-based approach. However, notwithstanding the emphasis on science, the data gathering network is considerably inadequate even in the context of regional standards. The key informant interviews with the relevant disaster management institutions officials revealed an enormous communication barrier between official jargonistic early warning messages via electronic media and those being comprehended by the general population. However, although people live in heavily urbanized areas, most respondents still rely on locally developed early warning systems based on anecdotal evidence of rain and flood events. Women are obligated to safeguard their homes and lives, yet they are left out of the generalized risk messages due to various culturally imposed restrictions on their movement. Another strategy for customizing risk messages to get an adequate response is to include both men and women in flood risk monitoring and acknowledge their gender-specific roles during emergencies.

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