Community social barriers to non-technical aspects of flood early warning systems and NGO-led interventions: The case of Pakistan

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Floods are the most common natural hazard in Pakistan, and research on flood risk management is continuously growing to improve policies for effective flood risk management. One of the critical determinants of effective food risk management is better communication of flood risks through the Flood Early Warning System. FEWS have been implemented widely; however, not all at-risk residents have been prompted to take immediate action in response to these alerts. This research looks at community social barriers to the non-technical aspects of FEWS and what Non-Governmental Organizations could do to address these gaping holes. This study used data from a field survey carried out in the four most severely affected districts of Khyber Pakhtunkhwa Province to explore gaps in non-technical aspects of flood early warning systems in Pakistan. The data were acquired through a comprehensive, structured questionnaire (600 household heads in total-150 HHs from each region) and focus group discussions with community leaders and elders (FGDs = 6), NGOs professionals (FGDs = 2) along with more casual exchanges over the phone. The data were analyzed using descriptive statistics and qualitative content analysis. The survey results found that most sampled respondents reported a lack of access to necessities, failure to heed flood alerts, misreading alerts, and poor connection between producers and consumers challenges under warning distribution and communication. Similarly, the critical challenges reported under the preparedness component were the exclusion of social groups from emergency preparedness, uncustomary contingency plans, and lack of political will. Furthermore, the key challenges included limited resources, risk perceptions, and a sense of belonging to ancestral lands under the response capability component. This paper finds that NGOs serve as a bridge between local communities and key disaster management institutions by tailoring solutions to individual community needs, educating necessary authorities about disaster risk reduction, facilitating communication among susceptible populations and authorities, and raising awareness through campaigns. Based on these results, we suggest authorities improve FEWS by improving communication infrastructures, translating early warnings into local

languages, and developing a two-way information exchange system between stakeholders and contemporary emergency response plans.

1 Introduction

Increased disaster risks have enhanced the vulnerability of local communities, households, and ecological systems (Prior and Eriksen, 2013). There is evidence that natural catastrophes, particularly floods, are becoming more and more devastating worldwide, putting millions more individuals' lives at risk (Banholzer et al., 2014; Shah et al., 2022b). It is estimated that nearly 1,507 flood events occurred between 1980 and 2000, which increased to 2,860 between 2000 and 2018 (Rana et al., 2021). The increase in flood events has exposed more populations to disaster risks and has unveiled socioecological systems to various vulnerabilities (Haque and Etkin, 2007). The vulnerabilities to flooding risks are more in the Asian countries where Pakistan is not in exclusion (Rafiq and Blaschke, 2012). In Pakistan, floods are unquestionably the most frequent disaster triggered by natural hazards. Between 1970 and 2020, the country suffered average of two floods yearly. The country has seen the deadliest floods in the last 20 years (2000–2020). In 2010, the country was hit by the biggest floods in its history (till now), which affected 24 million people, destroyed over 2 million hectares of standing crops and cost the economy a total of $10 billion (Shah et al., 2017; Shah et al., 2018). However, this was disproven by the flood disasters in 2022.[1] The 2022 floods in Pakistan affected 33 million people, which is significantly more than the 20 million people affected by the 2010 floods. The increased impact of the 2022 floods highlights the importance of continuous monitoring, preparedness, and response efforts to minimize the risks and impacts of future disasters. It is important for communities and disaster response organizations to work together to improve their capacity to respond to and recover from disasters in order to protect vulnerable populations and reduce the impacts of future events. Flooding in Pakistan is mainly caused by the monsoon rain pattern in the lower Indus River basin or the glaciers that have melted in the higher, upstream mountain regions that flow into the Indus (Shah et al., 2018).

The country's susceptibility to floods is mainly attributable to its inadequate local capability to respond to disaster risks (Shah et al., 2022a). Other attributes such as poor socioeconomic situations, long-standing cultural norms, and low faith in government institutions present communities with several challenges to effective flood warning dissemination, response preparedness, and capabilities (Rana et al., 2021). Most rural residents are unfamiliar with EWS and so do not take part in efforts to lessen the impact of flooding. That makes it more challenging for them to deal with

floods (Shah et al., 2022b). A short time to get early warnings is also to blame for the fact that local communities did not do enough to prevent flooding risks in the country (Mustafa et al., 2015). When a catastrophe occurs, the EWS is used to help local communities drastically reduce the number of deaths and injuries (Sufri et al., 2020a). EWS provides extensive information for managing disasters effectively, enabling local communities and households to protect their lives and property. An effective and comprehensive EWS consists of interconnected components of risk knowledge (first), followed by monitoring (second), dissemination and communication (third), and response capability (fourth) (Sufri et al., 2020b).

To make EWS effective, the critical roles of Non-Governmental Organizations (NGOs) are vital (Omukuti et al., 2021). NGOs focus on helping people who have been left out or neglected by government programs and other mainstream welfare services (Hailey and James, 2004). Their activities range from humanitarian aid and support to communities in need to advocating for human rights and social justice to promoting sustainable development and environmental protection. The specific focus and activities of an NGO will depend on its mission and goals, as well as the needs and challenges of the communities it serves. By working to address pressing issues and improve the lives of people and communities around the world, NGOs play a vital role in creating a better future for all (Murtaza, 2012). In developing countries like Pakistan, NGOs frequently offer crucial services that government agencies or authorities typically handle in affluent nations. The capacity of local communities to deal with flood risks has been bolstered by the involvement NGOs in social mobilization through the transmission of information and raising awareness (Amoako, 2018). More crucially, NGOs-led interventions in EWSs of utmost importance and have increased people's readiness to take preventative measures before floods even occur (Wagner et al., 2021). Therefore, it is crucial to acknowledge and ensure the role of NGOs in EWSs to engage important stakeholders in developing a comprehensive system that may help people respond more rapidly to flood hazards. Without a solid EWS, emergency responders are forced to react to flooding instead of preventing it, which increases the death toll and property losses. This information gap can be narrowed through the active participation of NGOs in flood risk reduction efforts, as NGOs have the potential to be an efficient dissemination mechanism for information related to flood hazards and mitigation strategies.

To the best of our knowledge, this is the first study investigating NGOs' role in reducing communities' social obstacles to flood responses through effective flood warning dissemination in Pakistan. Studies that have already been conducted in Pakistan have investigated the effect of general FEW services (provision of

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[1] https://thediplomaticinsight.com/wwf-reports-differences-between-2010-and-2022-floods/#
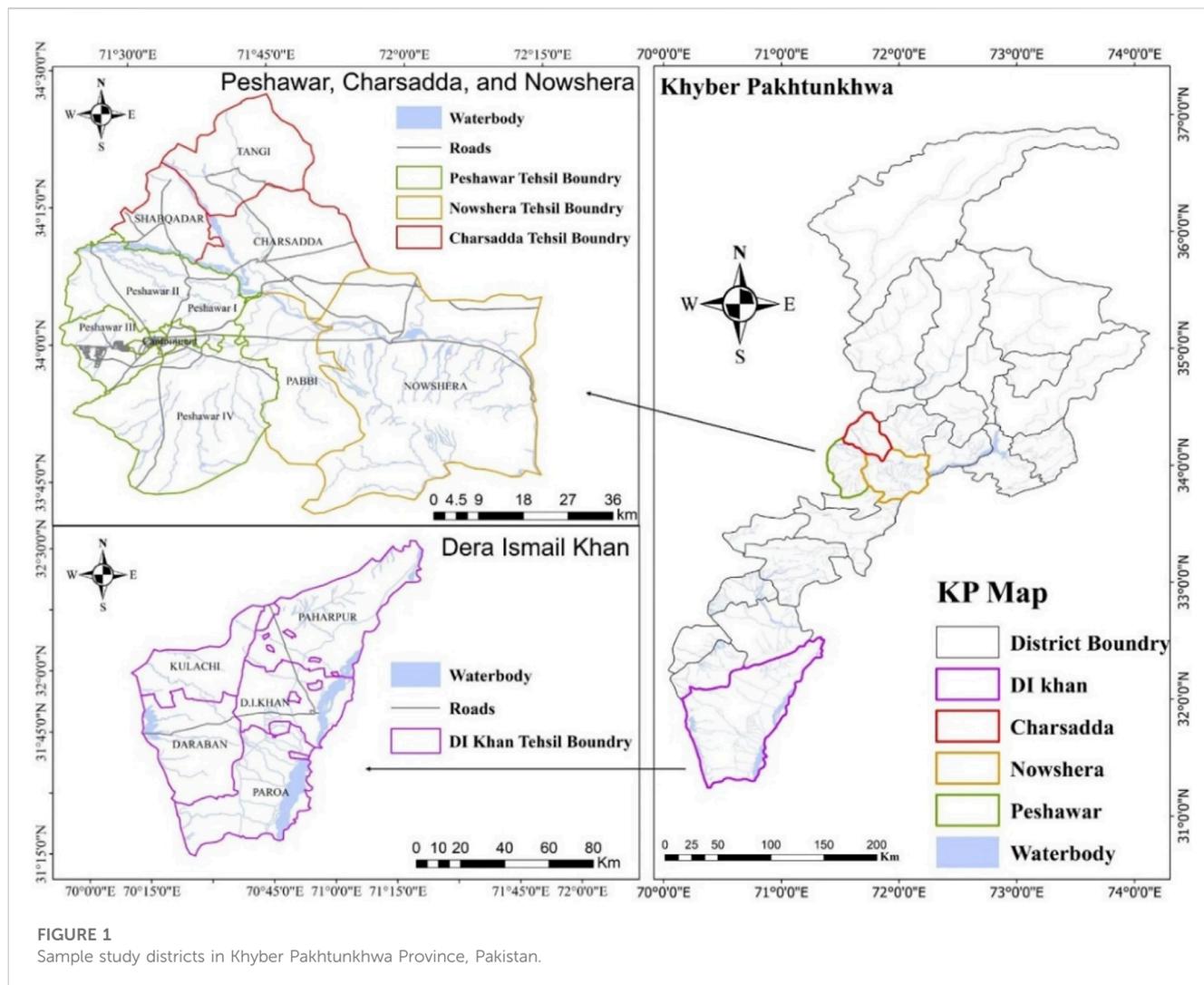
FIGURE 1
Sample study districts in Khyber Pakhtunkhwa Province, Pakistan.

FEW by government institutions and floods and weather information) (Tariq and van de Giesen, 2012; Mustafa et al., 2015; Shah et al., 2022b). Other studies examine people's socioeconomic and institutional factors that determine the adaptation process and households' capacity to respond to disasters across different regions and zones of Pakistan (Ahmad and Afzal, 2020). None of the previous studies explicitly focused on the role of NGOs in relationships with EWS and in building the adaptive capacity of local communities to flood risks in Pakistan. Therefore, this research looks at how NGOs in Pakistan are helping locals prepare for and respond to flooding (focused exclusively on the non-technical aspect of EWS and public knowledge of flood hazards). Communities can better deal with flood hazards if they have timely access to flood information and services provided by NGOs through efficient EWS, allowing for better adaptation to flooding conditions. Therefore, the main objective of the present study is to determine societal obstacles to effective flood warning dissemination, response readiness, and capability; how NGOs might help fill some of these gaping holes, especially at the local community tier; and develop policy proposals that can significantly boost governance and institutional capacities at all tiers.

2 Research methodology

2.1 Study area description

Pakistan has roughly 210 million people and is about 881,913 km^2 in size (Figure 1). Several big floods have affected people in all four provinces in the past few years. Since 1947, sixteen big floods have damaged the economy by a total of PKR 386 billion (Shah et al., 2020b; Shah et al., 2020a; Shah et al., 2022a). Rainfall had a significant role in the country's flood disasters, in addition to anthropogenic influence on rivers and continuous shrinkage of Himalaya and Siachen glaciers coupled with rising temperature, rapidly growing population, and deforestation (Ullah et al., 2021). Early warning of hazards allows residents, communities, and disaster management institutions to plan for and mitigate the effects of catastrophes. Prior to a disaster, forecasting and providing warnings to those who are most at risk are important tasks. Thus, disaster management authorities play an important role in establishing early warning systems and communicating effectively with federal and provincial forecasting agencies. In addition, they need to provide accurate data to multi-hazard warning hubs. Getting

prominent stakeholders involved could make dealing with major catastrophic events much easier (Rana et al., 2021; Shah et al., 2022a). Early warning information must be straightforward, credible, and relevant to the lives of those at risk. An effective warning system would be useless if it is not promptly delivered to the intended users. As a result, the community must improve its ability to prepare for and react to natural catastrophes (Shah et al., 2022b).

The National Seismic and Tsunami Early Warning Center (NSTEWC), the Tropical Cyclone Warning Center (TCWC), the Flood Forecast and Warning Center (FFWC), and the National Drought Monitoring Center (NDMC) have all been established in Pakistan as a positive step towards improving disaster preparedness and response in the country. However, in order to be effective, these centers must be strengthened and properly supported. This may include providing them with the necessary resources, such as funding, equipment, and staffing, as well as ensuring that their findings and warnings are widely communicated and acted upon. It is also important to regularly assess and evaluate the performance of these centers and to make any necessary improvements to their systems and processes. By strengthening these warning centers, Pakistan can better protect its communities from the impacts of natural disasters (Shah et al., 2022b). The Pakistan Meteorological Department (PMD), which connects directly with the District Disaster Management Authority (DDMA), is expected to play the most significant role in EWS. But DDMA does not exist in any of Pakistan districts, and EWS does not have a local custodian (Shah et al., 2022b; Rana et al., 2021). In contrast to the Sendai Framework guidelines, much emphasis has been placed on the monitoring and warning services aspect of EWS. Nearly 90% of the project budget is allocated to this part, which is thought to be technology-intensive and expensive, while the other elements of people-centered EWS are downplayed (Rana et al., 2021). Mukhtar (2018) and Shah et al. (2022b) looked at the hazard EWS plan and argued that two critical elements of EWS, risk knowledge and response capabilities, have not yet been considered. They contended that the forecasting system already operates, and the dissemination of early warning information is a one-way path, with little input from the people into the system overall design. Shah et al. (2022b) further argued that there is no people-centered paradigm. Several organizations gather and disseminate information about flood risks, making the response process more difficult for at-risk areas. Even though an early warning would help protect moveable assets, many citizens still do not comprehend and react to flood alerts (Rana et al., 2021). It is still difficult for the local people to have input into government decision-making since the country operates under a technocracy system (decision-makers). In a technocracy system, decision-makers are chosen based on their technical or scientific expertise rather than their political affiliation or representation of specific groups or communities. While this can lead to more informed and expert-driven decision-making, it can also limit the ability of local communities to have input into government decision-making. This can be especially problematic in disaster management, as local communities often have valuable knowledge and experience that can inform decision-making and improve outcomes. To address this issue, it may be necessary to ensure that there are opportunities for community input and consultation in disaster planning and response efforts, such as through community meetings, public hearings, or other engagement mechanisms. By incorporating the perspectives and needs of local communities into decision-making, the government can improve its ability to effectively respond to and recover from disasters and to better serve the needs of its citizens. Such a system would make it hard for communities and local governments to build distrust between them. Furthermore, the official early warning system uses technical language, making it harder for at-risk populations to comprehend the content and take the necessary precautions (Rana et al., 2021; Shah et al., 2022b). Since the warning information is complex and technical, it is important to consider how it should be conveyed. Thus, warning information (non-technical aspects of FEWS) must be repackaged and adapted for various audiences. The efficacy of warning messages must be evaluated to determine if the intended audience received and processed the information effectively and took appropriate action in response to the information (Šakić Trogrlić et al., 2022).

2.2 Households survey

This current study was conducted in Khyber Pakhtunkhwa (KP), Pakistan. To select the sample respondents from flood-prone regions of Khyber Pakhtunkhwa, multistage sampling and random selection approaches were utilized. The province of KP is specifically chosen in the first stage of the sampling framework (Figure 2) due to its large population and geographic size (total land of 10.17 mh). In the last 20 years, the KP region has been hit by eight disastrous floods. As seen in 2010, the monsoon season caused tremendous havoc on a scale never seen before. According to estimates compiled by the Federal Flood Commission (FFC), the cumulative discharge of the rivers Swat and Kabul reached a new record level of 400,000 cusecs in contrast to the previous value of 250,000 cusecs, which was recorded in 1929. Upon selecting the KP province (first stage), we purposively chose four study districts, i.e., Nowshera, Charsadda, Peshawar, and Dera Ismail Khan (stage two), since they were the most susceptible districts to flood disasters between 2010 and 2014. The third stage involved randomly selecting three Union Councils (UCs) from each sampled district. The fourth stage involved randomly selecting three villages from a list of all affected villages provided by the KP-PDMA within each UC. In the fifth and last stage, 50 HHs were randomly chosen from each sampled village, comprising 600 households (a pictorial view can be found in the Appendix) across four selected districts. Ten graduates from a local university were hired as data enumerators and trained well before the data collection process began.

A total of sixty respondents (10% of the total sample) in one of the sampled districts (e.g., Peshawar) were used to pilot test the survey questionnaire. During the pilot testing, we found that some participants had trouble following the instructions, answering the questions, following the logical progression of the statements, and having inquiries concerning the survey length. After thoroughly reviewing all the feedback, fixing the recurring problems, and re-piloting until no more modifications were needed. All structured interviews were conducted in accordance with a predefined set of research standards and ethical guidelines (Bogner et al., 2009). We first got formal permission to conduct interviews, and participants were given a detailed explanation of the study's goals. The respondents consented to using their data for scientific investigation. Substitute heads of household replaced participants

FIGURE 2
Sampling framework (authors' construction).
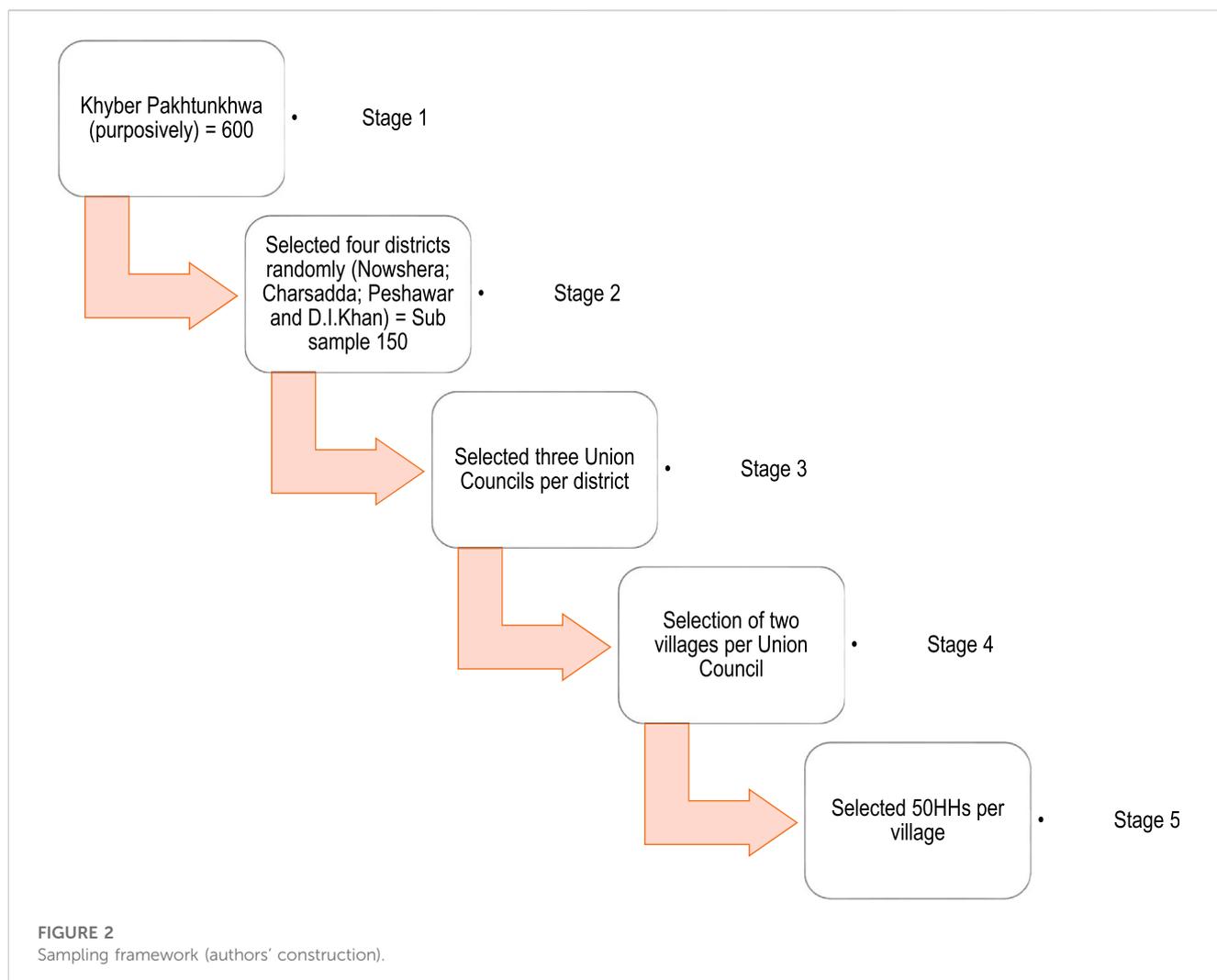
who initially declined to participate in the survey. The whole data collection was done between March 2022 and June 2022.

2.3 Focus group discussions (FGD)

After collecting field data through household survey, we conducted FGDs with various stakeholders involving community elders and leaders (FGD = 6), and NGO professionals (FGD = 1), including those from CARE International and the United Nations Development Program (UNDP). Each FGD included a diverse group of 10–15 participants familiar with the flood EWS and personal experience with flooding. To facilitate constructive discussions, a script was developed that highlighted EWS, community responses to flood risks and capacities, and strategies for addressing community concerns in EWS. Each FGD followed the same script, and all participants were given a verbal consent form outlining the discussion's purpose. The script was written in Pashto (the language spoken by most participants) language to ensure that everyone understood the script. Each FGD lasted somewhere between 2 and 3 hours. The research team took steps to create a supportive and inclusive environment for participants in their study.

By guaranteeing an open and welcoming environment, the team aimed to encourage active participation and engagement among all participants, regardless of their backgrounds or perspective. This approach can help to ensure that the findings of the study are representative of a diverse range of views and experiences and can improve the overall validity and reliability of the research results. Encouraging active engagement can also foster a sense of community and collaboration among participants and can lead to more in-depth and meaningful discussions and insights. By taking a participatory approach, the research team can help to ensure that their study reflects the needs, concerns, and perspectives of all participants. Conversations were recorded in Pashto and then rendered into English. The data were analyzed using qualitative content analysis.

3 Results

3.1 Descriptive statistics of the respondents

In some societies, socioeconomic status refers to a person's or a group's place on the socioeconomic scale and is deeply affected by

TABLE 1 Respondent's characteristics.

HH characteristics	Description	Response
HH age	Average HH age in years	43
HH years of education	Average HH schooling years	5.02
Average HH monthly income	Average HH monthly income	15,222
HH average family size (numbers)	Average HH family members per family	6.13
HH house ownership	1= Owner; and 0, otherwise	67%
HH experience with past floods	1= Yes and 0 otherwise	87%
HH average house distance from a river source	Average HH house distance in km	43%

Field survey, 2022.

financial and social attributes.[2] The descriptive statistics of the study are presented in Table 1. The study findings revealed that the average household head age was 43 years, followed by the average HH years of education (5.02 years), HH monthly income (15,222 PKR), and HH family size (6.13 members). The survey further indicated that 67%, 87% of the total sampled respondents had owned the house and had experience with flood hazards. In comparison, 43% of respondents reported their average house distance from the primary river source as less than 1 km.

3.2 Social obstacles to flood early warning systems

3.2.1 Challenges with warning distribution and communications

Flood warnings and communications can go awry at various dimensions and stages of a disaster. The flood hazards between 2010 and 2014 exemplify how these flaws could lead to social concerns. Survey results in Figure 3 shows that 67% of the total sampled respondents could not access necessities, followed by 71% who could not respond to early flood warnings due to a lack of awareness. The lack of consistent nomenclature, methods, and standards for providing warnings resulted in 55% of the overall survey respondents reporting incomplete warnings or alerts. Similarly, 61% of those who participated in the field survey said that having access to various sources of information has resulted in a lack of comprehension and a misunderstanding of warnings. On the other hand, 77% of respondents saw a lack of coordination between producers and consumers as a significant obstacle to disseminating warnings and communications, as shown in Figure 3.

3.2.2 Challenges in preparedness

Figure 4 emphasizes the results of the study with regard to the challenges respondents had in terms of preparedness. Based on the results depicted in Figure 4, most respondents identified the exclusion (or restricted inclusion) of social groups, particularly

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2   https://www.apa.org/topics/socioeconomic-status

women, as one of the most significant obstacles to overcome while engaging in preparedness activities and developing reaction plans. These left respondents feeling helpless and disinterested, leading to lower response rates. About 66% of the people who answered the survey reported that emergency plans, usually made at the national level, were not often tailored to the communities they were meant for and did not include traditional knowledge. This was because the lack of participatory planning and insufficient development of alerting countermeasures were contributing factors to the problem. Participatory planning involves involving the community, particularly those who are affected, in the decision-making process. In the context of disaster management, participatory planning is important to ensure that the needs and perspectives of local communities are taken into account when developing alerting countermeasures. If participatory planning is insufficient or inadequate, this can result in alerting countermeasures that are not well-suited to the needs and capacities of local communities and may not effectively communicate warnings or provide the necessary information for people to take appropriate action in a disaster. To address this issue, it may be necessary to enhance participatory planning efforts and to work closely with local communities to ensure that alerting countermeasures are developed in a way that is inclusive, effective, and responsive to their needs. When asked about other obstacles to preparedness, 69% of respondents indicated that emergency plans were not being implemented. In addition, 72% of respondents indicated that inadequate political commitment limited emergency preparedness efforts.

3.2.3 Challenges in response capabilities

Figure 5 highlights the societal constraints relating to response capacity. Figure 5 shows that 75% of the sampled respondents had scarce resources, including credible modes of transportation, logistic assistance comprising life vests, rope, boats, headgear, stretchers, information on plausible evacuation pathway alternatives, and protected shelters to react to the alerts. Similarly, 81% of those who took the survey pointed out that they had difficulty paying attention to warnings because each flood disaster is unique and has its own specific risks and impacts, which can be influenced by factors such as climate change, land use changes, and urbanization. As a result, it is important that disaster response plans and techniques are
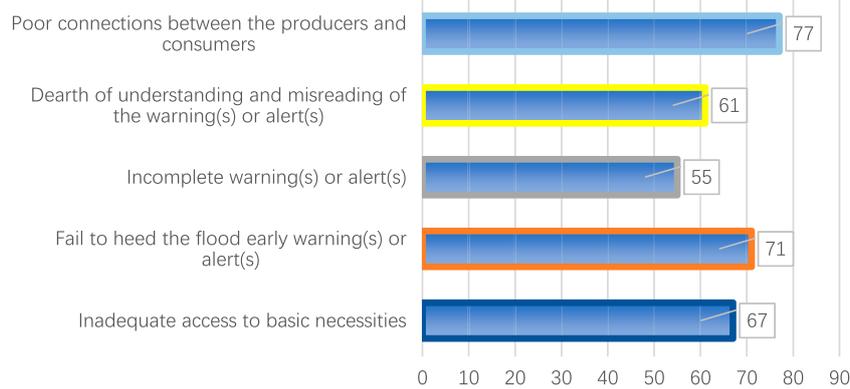
FIGURE 3
Challenges with warning distribution and communications.
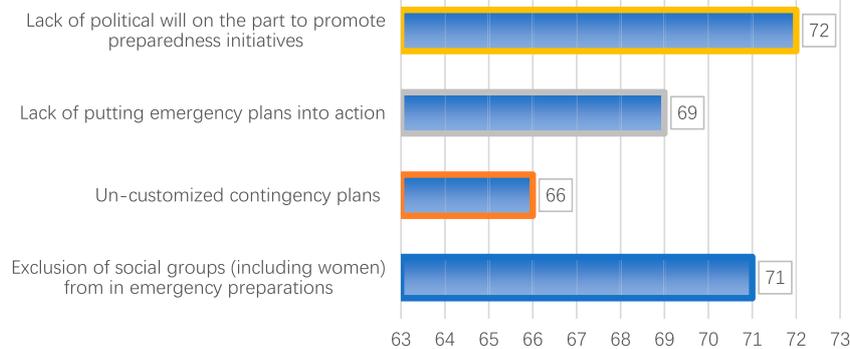
FIGURE 4
Preparedness challenges.
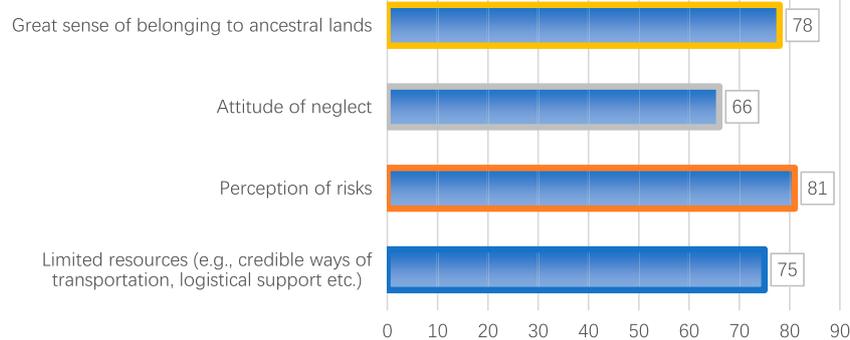
FIGURE 5
Challenges in response capabilities.

regularly updated to be appropriate for current flood scenarios. Simply extrapolating insights from previous flood responses may not be effective in a new flood situation, as the risks and impacts can be significantly different. To ensure that disaster response efforts are effective, it is important to regularly assess and evaluate previous responses, identify areas for improvement, and incorporate new and

FIGURE 6
Level of local community involvement in planning (preparing policies, plans, and actions to mitigate risks) and implementation (implementing measures to reduce risks) by NGOs and Local DRM institutions.

innovative techniques and technologies where appropriate. This may improve understanding of flood risks and impacts and to better inform decision-making in disaster response. By continually upgrading its response plan and techniques, the disaster management system can be better prepared to effectively respond to future flood scenarios. Around 66% of respondents stated that they frequently lacked updated information and failed to comprehend the situation and respond effectively, which resulted in a culture of neglect among the prospective victims. In the same manner, 78% of those polled said they had a deep cultural connection to their ancestral land and that their fear of losing their livelihood and assets hindered responding to early disaster warnings.

3.3 Community involvement in planning and implementation by NGOs and DRM institutions

Figure 6 shows that NGOs and local DRM institutions have a significant role in overcoming social barriers to flood early warning systems in the research area. The survey findings in Figure 6 shows that while 51% of all respondents claimed that local DRM institutions did not involve them in planning (22% in the case of NGO planning), 27% said that local DRM institutions did so to a limited extent (25% for NGO planning). Of all those who took the survey, 12% participated only on rare occasions in local DRM institution planning, followed by 7% of the respondents who were engaged but with limitations.

Furthermore, only 3% of those polled believed that local DRM institutions had done an excellent job involving them in the planning process (10% for NGOs planning). Figure 6 reveals that 14% of the total sampled respondents claimed that they were engaged by the NGOs in implementation (6% for the local DRM institutions). The local inhabitants' engagement in the implementation by the NGOs was viewed positively by 23% of the respondents (13% for the local DRM institutions). Overall, 24% indicated occasionally, 21% said to a minimal extent, and 18% felt no community involvement by NGOs (42% for the local DRM institutions).

4 Discussion

Nowadays, many technology-based flood early warning systems (FEWS) are using a "top-down approach," in which a domestic or international specialized agency sends out warning messages and transmits them to the national authorities (Rana et al., 2021). This knowledge or information has been shared with regional authorities at all levels (particularly district and local municipalities), local emergency management institutions, and non-governmental organizations (NGOs) working in flood risk management (FRM). Media outlets, including newspapers, TV and radio stations, security workers, and local police, are the last to be contacted and tasked with disseminating the alerts to the susceptible people. But early flood warnings did not reach everyone at risk in time, particularly those who lived in the Dera Ismail Khan district. This is presumably because public service announcements were often shown on national or local media (like TV, radio, or online) and because most of the individuals who participated in the survey in the D.I. Khan district were poor, illiterate, and underprivileged. The survey participants across the four selected communities did not have the resources to hear them (Figure 1). During the focus group Discussion (FGD), a 47-year-old community leader from district Nowshera said that

> "Power failures, lack of access to TV and radio, poor cellphone signals throughout natural disasters, and not knowing how to use emergency websites for flood warnings and notifications were why I did not hear the messages."

The survey findings in Figure 3 highlighted that even when a neighborhood receives an alert, the majority failed to take it seriously since they lacked risk awareness and had questions about the warning's legitimacy. There are ways to make early warnings more reliable. For example, the Cuban Institute of Meteorology was able to recapture public confidence by enhancing communication and substituting TV broadcasters with qualified and experienced meteorologists to give warnings (Brown et al., 2014). During the FGD, a 53 years old community elder (who worked actively in the regional meteorology department Peshawar) from district Charsadda said that

> "To function properly, early warning systems must proactively engage those at risk from a variety of risks, promote the dissemination of information about potential hazards to the general audience, and distribute messages and warnings promptly to guarantee that people are always prepared and that early action is possible. The importance of an efficient early

warning system resides in the acceptance of its virtues by the local population."

In another FGD, 63 years old (ex-humanitarian aid worker) community leader stated that;

> "Alternative communications modalities, including sirens and loudspeakers, could be utilized effectively to target low-income disadvantaged communities despite their lack of access to media. This could slow down the response time because early warning goes through a chain of people before it gets to volunteer groups that are in charge of spreading the news through megaphones and other means. Evacuation pathways might become more hazardous, especially for women, infants, and the elderly, who constitute most of the population. In certain circumstances, the employment of very well NGOs, local channels of communication, and social media platforms in the locality could efficiently address these challenges."

Such groups would be more plausible to face socioeconomic obstacles (Gautam and Phaiju, 2013). Research in Nepal and Peru (Perera et al., 2020) shows that cultural and social constraints and stereotypes about women can contribute to the difficulties they face during evacuations. For example, gender norms may restrict women's mobility, making it difficult for them to evacuate in an emergency. Stereotypes that suggest women are weaker, less capable, or less competent than men can also impact their ability to participate fully in evacuation processes. In some cases, these cultural and social constraints can also lead to discrimination and unequal treatment of women during evacuations, further exacerbating their challenges. It is important to recognize and challenge these harmful stereotypes and to work to create evacuation processes that are inclusive and equitable for all individuals, regardless of gender.

Time lags in sending out flood warnings are significantly more critical for the most vulnerable (Kimuli et al., 2021). It has been stated that the delivery of early warnings is a source of difficulty in case of three out of every ten deaths attributable to floods (Kimuli et al., 2021). This means that there are low chances of lessening flood risk consequences. The study discovered that even when warnings are given out, they are frequently insufficient because there is no established nomenclature, procedures, or standards for giving them (Figure 3). This eventually results in incorrect, irrelevant, or missing information (Basher, 2006; Lumbroso, 2018). The sampled respondents frequently believed warnings are confusing if they come from multiple sources (technical authorities, local governments, disaster managers, non-governmental organizations, etc.) unless they have been sent out synchronized and appropriately. In a focus group discussion, 51 years old community leader from the Charsadda district stated that;

> "To ensure that there are numerous means to reach the most susceptible groups, it is crucial to incentivize multiple communication strategies. The warnings may not be comprehended or may not be obvious if they do not originate from the same location or are poorly coordinated."

Similarly, a FGD with a 53 years old community elder (who served the provincial disaster management authority department

and actively engaged during 2010 flood relief operations in D.I. Khan) from Dera Ismail Khan district stated that;

> "There must be a plan of action that is precisely tailored to the local community needs when it comes to flood warnings, and this requires the use of their native language and content."

In flood-prone places that are distant from urban areas, people with no or little education are particularly vulnerable to specific warnings that they cannot understand or take action on because of their lack of education. For instance, in a country like Pakistan, where multiple languages are used at the national, state, and local levels, alerts ought to be interpreted based on the group at risk so that they might pay attention. Likewise, community flood alerts in developing economies are crucial for ensuring the inclusion of the entire community in flood-prone areas. The scientific terms used in early warning alerts were very professional, and people who could not read or write had difficulty understanding them. Individuals with limited education may have difficulty understanding complex information about evacuation procedures and the dangers of a flood, making it harder for them to take appropriate action. In rural and remote areas, limited access to information and resources can compound this problem, putting these individuals at a higher risk during a flood. It is important for disaster response organizations to take into account the needs and capacities of vulnerable populations, including those with limited education, in their planning and response efforts. This may include providing clear, simple information and resources in local languages or working with community leaders to ensure that critical information [millimeters (mm) of precipitation or likelihood of flooding] is effectively communicated (Shah et al., 2022b).

Multiple stakeholders must be involved in various disciplines, necessitating a compelling chain of alert communication. Furthermore, there are frequently poor inter-organizational and interpersonal ties between those who produce and those who use early warnings (International Federation of Red Cross and Red Crescent Societies, 2009). In most instances, there is a lack of coordination or inefficiency, which hinders communication skills between relevant agencies that provide warnings and communications authorities tasked with alerting the public (Basher, 2006). The lack of formal specialized institutional mechanisms with the capacity to generate and transmit warnings to individuals at risk is a consequence of the unclear duties performed by each disaster management institution participating in the warning-communication chain. For instance, Zahmatkesh et al. (2019) pointed out that watershed communications are hampered by the lack of a formal network linking the provinces of Canada and the United States. In another study, a FEWS analysis found a similar gap for the Bhotekoshi River at the border between China and Nepal, the Karnali River, which flows along the border between Nepal and India, and the Brahmaputra River, which flows along the border between India and Bangladesh (Rahman et al., 2018). People become less interested in and believe in FEWS due to all the gaps mentioned above, which can ultimately lower people's propensity to act on flood alerts.

The survey findings regarding preparedness challenges revealed that most sampled respondents mentioned that they were left out of or did not allow to participate in preparedness activities (e.g.,

making response plans). They felt like they do not have much authority, which causes them to lose interest and lower response rates (Figure 4). Involving all flood-prone citizens in decision-making and including indigenous knowledge is essential if the community adheres to flood warnings. However, people rarely realize the importance of engaging women and other marginalized groups (such as ethnic, religious, and gender minorities) in decision-making processes (Bhatt et al., 2019). Many of these groups have been identified as highly vulnerable to Gender Equality and Social Inclusion (GESI) (Madhavi Malalgoda Ariyabandu, 2018). There is a lack of comprehension of GESI concerning DRR among government departments and agencies involved in disaster risk management (DRM). The exclusion or constrained participation in preparedness actions (including developing action plans, people feel unmotivated) resulted in a lower response rate. Also, when governments dealt with women's concerns, they focused more on how vulnerable they were and how to help them as victims of disasters than on what they could do and how to treat them as individual residents with roles to perform during and after disasters, which brings up the limitations of gender dynamics research and how they affect leadership and participation in DRR preparedness initiatives.

Flood emergency contingency plans routinely developed at the national and provincial levels do not always take the target communities into account or incorporate indigenous knowledge because of a paucity of integrated approaches during the design and implementation of early warning countermeasures (Figure 4). Despite the lack of resources (technical and financial resources), the problem is exacerbated since contingency plans were not updated frequently enough. Our findings agree with the results of UN-DRR, which responded that approximately 80% of Mozambique contingency plans are funded by donor agencies (UNISDR, 2014). These donations are not constant, so it may be hard to find enough funds to update contingency plans. Furthermore, the Sendai Framework for DRR requires evidence-based contingency planning.

A scientific approach is required, ideally one that uses socioeconomic data. However, these records are often unavailable in flood-prone areas, limiting the reach and utility of preparedness efforts. In an attempt to fill this void, Ohara et al. (2018) developed a method for communities to prepare for flood catastrophes through contingency planning. This approach has been found not very useful because it has not been tested in different flood-prone places worldwide (Clarke, 1999). The execution of planned activities is hampered by insufficient information distribution capacity and poor coordination across all stakeholders, which makes it harder for people to find out about risk areas, alert codes, evacuations, and locations. For instance, Mauritania has plans and programs that have not yet been implemented. In Indonesia, most contingency plans were given in theory but never implemented in emergencies (UNISDR, 2014).

Lack of political will or dedication to promoting preparedness initiatives (given the current political and institutional paradigm of post-disaster aid rather than risk reduction techniques) impedes the ability of government stakeholders to be prepared for unanticipated events (Figure 4). Consequently, not too many financial and technical resources are available, which stings authorities' capacity to allocate resources and respond quickly. The

communities need to work together to build their capacity in areas like planning for evacuation, keeping plans up-to-date, having the right resources at the right time, and allocating those resources. Flooding can occur fast in small river basins, but it might take a long time to appear in large river basins. In all circumstances, potential victims must act promptly to reduce human, social, and economic damages. Targeted communities have a difficult time responding to early warnings for a variety of reasons, such as perception of risk, poor communication network, lack of choice (resources) for responding, lack of knowledge of escape routes, inadequate infrastructure, risk of losing livelihoods, assets, livestock, the culture of ignoring warnings, and lack of trust in early warning systems. In certain situations, the locals may not only be unsure of what to do or where to go during an evacuation, but authorities frequently have not even considered these issues.

Residents who were affected did not have enough resources (Figure 5) to react to alerts, such as reliable ways to get around, logistical support like life jackets, ropes, a boat, headgear, stretchers, awareness of safe escape routes, and safe places to stay. For example, people Nowshera district near Kabul did not have access to clean drinking water or toilets during severe flooding. In some areas where FEWS works, it was found that safe upstream shelters for disaster victims were neither good enough nor non-existent. The study findings in Figure 5 highlighted that flood victims in rural areas, particularly those without flood shelters, were forced to rely on the meager resources of public schools. With few potential escape routes and forms of transportation, it was difficult to leave the area. As a consequence of the flooding, evacuees are typically confronted with insufficient boats for transportation, bad road conditions, degraded infrastructures, and inadequate public transport services.

Risk perception is the next fundamental difficulty for flood-prone communities (Figure 5), significantly impacting their willingness to follow the warnings. People at risk of flooding tend to compare how they responded to flood warnings in the past to how they should react now. However, each flood is different because the threats are changing due to climate change. As a result, the response strategy and procedures need to be revised to reflect current flood conditions. Additionally, in coping with low-intensity flood disasters, it may be helpful to compare previous experiences and use indigenous knowledge (such as studying animal behavior, changes in fauna and flora, monitoring wind direction, and the form of a star and crescent, and astronomy) (Kalanda-Joshua et al., 2011). But this knowledge has not helped deal with rapid, intense, and frequent events (Mavhura et al., 2013). Rural inhabitants in the four chosen locations lacked access to timely information, leaving them in the dark about how to respond to the emergency. This resulted in a "culture of neglect," particularly for the most vulnerable members of society (women, children, the elderly, and those with limited education) in flood-prone areas (as illustrated in Figure 5). For example, Perera et al. (2020) noticed that even though alerts were given, only about 50 of the FEWS inhabitants reacted to the warnings. This tendency to ignore alerts is prevalent among FEWS (Rahman et al., 2018), especially in a developing country

like Pakistan. Immediately upon the dissemination of the warning, action is necessary to guarantee the safety of people, livestock, and household essentials. Despite this, cultural links to ancestral land hinder a community's capacity to react to early warnings (Figure 5). Respondents in high-risk communities were reluctant to leave their ancestral lands because of sentimental attachments to them or because they feared losing their homes if they did not have adequate documentation to prove their ownership. All these, in turn, either lengthen the time it takes to respond, making the situation more dangerous, or change the response times.

NGOs are classified as non-market or non-state organizations where individuals band together to seek common goals in the public sphere. NGOs frequently work with local communities and assist DRR activities by disseminating DRR knowledge, skills, and practices (Tomlinson, 2013). Uncovering the role of NGOs in shuttering the social gap that exists (as discussed in Section 3.2.3) is essential since NGOs know more about the community, how disasters affect people at risk, and how to connect local government with people at risk. The survey findings in Figure 6 show the scores from the answers to a survey about how NGOs and local disaster management institutions entail the local inhabitants in planning and implementation. A score of 1 indicates no engagement, while a score of 5 indicates active community participation. Figure 6 clearly show that most respondents (42%) think there is no community involvement at all by local disaster management institutions (scores at level 1). The NGOs level of engagement was scored as level 3 by over 25% of the total sampled respondents, which suggests that they only occasionally include locals in planning (30%) and implementation (24%). Most respondents who took part think that local institutions in charge of disaster management either do not involve residents or only involve them to a small degree. The respondents, however, said NGOs community interaction falls between ratings three and five, i.e., occasionally, with some limitations, or is exceptionally beneficial. As a result of this venture, new local initiatives, new alliances, and NGOs acting as national advocacy groups have been formed, and government agencies have been persuaded to alter their plans and policies so that residents are included. Here are some examples of how NGOs have dealt with the societal concerns related to FEWS.

In Figure 6, we talked about how important it is for disaster management institutions to be clear about their roles and responsibilities and to have customized contingency plans for what to do if something goes wrong. In Khyber Pakhtunkhwa worst flood-prone locality, NGOs helped address residents' fears about recurring floods and raised awareness of their legal rights before, during, and after catastrophes. The Provincial Disaster Management Authority (PDMA) organized community and non-profit workshops to develop and carry out a campaign in which effective flyers were disseminated door-to-door, highlighting the steps to be taken during, before, and after the catastrophe. In addition, a march was organized to enhance public awareness of the role of government institutions that can assist in the aftermath of a natural disaster.

Clear responsibilities and roles for institutions and customized plans about what to do if something goes wrong were problems with

warning dissemination. In the most flood-prone region of Khyber Pakhtunkhwa, NGOs helped address community issues about recurring floods and raised an understanding of flood victims' entitlements before, during, and after catastrophes. Provincial Disaster Management Authority (PDMA) coordinated community and non-profit meetings to plan and conduct a campaign in which impactful posters were distributed door-to-door, stressing the actions to undertake during, before, and after catastrophes. Also, a march was staged to raise awareness about the role of government agencies that can assist in the event of a disaster. Thus, residents of high-risk locations began creating their contingency plans. Prior to the flooding, community flood rescue teams were established to offer information to disaster management institutions and develop links with the various flood management agencies. As a result of these efforts, communities protected themselves from floods better and thus became more resilient.

In an attempt to implement policy into action, CARE-a major international humanitarian aid organization and NGOs consortium member that provides emergency relief and long-term international development projects, set up a multi-stakeholder Citizens Platform to bring local government and community members together and resolve local issues about DRR in the highly vulnerable areas of Khyber Pakhtunkhwa province. This forum has made the local disaster management institutions more attentive to community needs and made sure that everyone works together by giving people a direct way to talk to local government officials about their problems. High-risk segments like women, kids, and the elders are included in the community engagement groups, and seminars were held to develop community capability so that residents could recognize local problems and take appropriate action to lessen risks. More volunteers joined the program through community engagement in capacity development workshops and made an effort to reduce risks in their neighborhoods.

The preparedness operations have also been plagued by a lack of community involvement in decision-making. During a FGD with the NGO officials (CARE International Organization), a Program Manager stated that

> "Recurring flooding in the study locations was triggered by garbage obstructing river flow during the monsoon season. The NGO led a discussion with the communities and the local authorities about what should occur next. They all worked together to find a solution that worked for everyone. The garbage was then dredged out of the waterway to make the water move faster, which stopped flooding during the monsoon season the following year."

These joint actions are more productive and get to the root cause of the problem, making measure improvements more likely to endure. Another problem raised is the lack of female involvement in DRR efforts. In Khyber Pakhtunkhwa, the CARE International and UNDP Organizations revealed that women are highly susceptible to disasters. NGOs understood that women would have a ripple effect throughout families and communities. In recognition, CARE International and the UNDP hosted a workshop for female participants to discuss catastrophes and ways to mitigate their impact. This also highlighted the relevance of DRR dedication to diversity and inclusion. The participants learned how to make popular tourist souvenirs as part of the workshop alternative livelihoods component. Such efforts could lead to the long-term participation of women in DRR operations in developing nations, where livelihood is a major concern. Thus, women could acquire more control over their lives by being involved in disaster preparedness efforts and learning how they might help their families become more resilient in the face of calamities.

5 Conclusion and policy recommendations

Climate change has increased the vulnerability of socioecological systems. The frequency and intensity of natural disasters, particularly flooding, have increased significantly during the past 2 decades. Pakistan is often hit by natural hazards owing to its climate, geographic location, and weather. Pakistan experienced two significant floods on average per year between 1970 and 2015, which destroyed millions of homes, displaced a large number of people, and cost substantial financial losses. Flood Early warning systems (FEWS) are a fundamental feature of the DRR approach. Early warning is usually described as offering information about a risky event to happen so that measures can be implemented ahead of time to minimize the threat. There are two main parts to the EWS description. The first one is more complex, i.e., the technical aspect, and the second has something to do with people, i.e., the human factor. The lack of preparation and poor communication among locals are perhaps major causes of EWS failure. The purpose of this research was to identify and address social barriers in warning-related communications, preparedness, and response processes by analyzing data from a field survey and focus group discussions conducted in the four worst-hit districts of Khyber Pakhtunkhwa Province.

The survey results found that, even when warnings are sent out with plenty of time, not everyone who could be affected receives them. Most people did not pay attention when the alerts got to the most vulnerable communities. The information provided in the form of alerts was frequently deficient, written in a different language, or unnecessarily complicated for the benefit of possible victims. Most communications were not targeted to the community needs or prepared to be easily understood by the vulnerable communities across the selected regions. The survey findings found poor coordination and information exchange between the actors involved in early warning systems. This was especially true for the Kabul and Indus Rivers basins. FEWS preparedness component faced several difficulties, including public apathy toward early warnings and inadequate risk knowledge, insufficient training sessions, generic contingency planning rather than personalized and customized to the community, lack of political will and dedication, and minimum involvement of community members in making important decisions. The part of FEWS that deals with response capabilities outlined disparities that included incorrect hazard perceptions despite shifting flood patterns, a tradition of neglect, and a lack of trust in local disaster management

institutions. Overall, plenty of the emergent cross-cutting difficulties included insufficient community participation and solving their problems in warnings, phases of FEWS preparedness and responses, failure to adequately translate DRR frameworks and policies into implementation at the commune level, and a lack of community and key stakeholder understanding of DRR.

Furthermore, efforts are being made to resolve these challenges, especially by NGOs that serve as a bridge between local communities and essential disaster management institutions. They tackled these difficulties in a variety of ways, including tailoring solutions to individual community needs, educating necessary authorities about DRR, improving communication among people who are at risk and the local disaster management institution authorities, community empowerment, and involvement to create proactive responses and actions, and running advocacy campaigns that help people become more resilient to catastrophic events. An effective early warning system necessitates a concerted effort from all relevant stakeholders to ensure that everyone at risk of flooding may act quickly and effectively. DRR goals set in the Sendai Framework call for considerable reductions in flood disaster-related risks and building resilience in all communities affected by flooding.

Under warning and dissemination challenges, the following recommendations are made; 1) enhance the accessibility of the information communication infrastructures so that warnings can reach isolated communities of Khyber Pakhtunkhwa province vulnerable to flood disasters. This is specific to the Khyber Pakhtunkhwa province in Pakistan and its isolated communities (e.g., Charsadda, Nowshera, Peshawar, D.I. Khan) that are vulnerable to flood disasters. The availability of effective warning systems and their ability to reach isolated communities can vary greatly depending on the region and the resources available. In some regions, there may be robust infrastructure to issue and disseminate warnings, while in others, there may be significant barriers to doing so. Therefore, it is important to consider the specific context when evaluating the validity of statements about warning systems and their reach; 2) customize early warnings in local languages (e.g., Pushto and Saraiki languages) to make them easier to understand; 3) set up concise two-way information exchange between the local government, relevant disaster management institutions, and the communities at risk about up to date emergency response plan, organizational structures, and institutional obligations; 4) necessitate well-prepared NGOs in the means of communicating the alert, and this will make it easier for the residents to comprehend the warning, and 5) an effort should be made to educate FEWS administrators and developers concerning non-technical and social dimensions of FEWS.

Under preparedness challenges faced by the local inhabitants, the following recommendations are made based on the current study findings; 1) encourage greater participation in the local community, as well as a greater comprehension between stakeholders; 2) community outreach through better strategic outlets of information exchange, and putting DRR policies into practice on the ground, and 3) stimulate flood risk reduction at the local level through funding the networks of NGOs and community volunteers for gender inclusion and social inclusion to increase preparedness by implementing funding-related initiatives. The response capabilities related challenges, the following recommendations are made; 1) increase trust in the accuracy of flood warnings and the preparedness of flood-prone areas by strengthening the working connections between agencies that issue flood warnings and the people on the ground who are in charge of responding to disasters; and 2) significantly enhance outreach and public outreach by making media, information exchange, and DRR policies effectively. This will ensure that the community responds quickly and helps when a disaster happens.

Data availability statement

The data that has been used in the article can be acquired from the first author AS (shahaa@cau.edu.cn; ahmad.ashfaq1986@gmail.com) upon request.

Author contributions

AS: Conceived and designed the study; Performed the field survey; Analyzed and interpreted the data; Wrote the paper. AU, NK, AK, MT, and CX: edited and reviewed the paper.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Appendix

FIGURE A1
Pictures were taken during the field survey.