RESEARCH ARTICLE

▪ Vol. 5, No. 4 (Fall 2024)
▪ p-ISSN: 2791-0237
▪ e-ISSN: 2791-0202
▪ Pages: 34 – 48
▪ DOI: 10.55737/qjss.978722571

Open Access

QLANTIC JOURNAL OF SOCIAL SCIENCES

Impact of Situational Awareness on Flood Vulnerability Reduction in Nowshera, Pakistan

Mushtaq Ahmad Jan [1] Muhammad Kaleem [2] Syed Irfan Ullah [3] Rooh Ullah [4]

Abstract: *The study was carried out in District Nowshera with the aim of investigating the relationship between situational awareness and flood vulnerability reduction in Nowshera, Pakistan. The study is purely quantitative in nature, and the outcome of the quantitative data was collected from 384 respondents in the study area. Univariate and bivariate analysis methods with indexation have been used for the analysis of data. The findings of the study reveal that heightened situational awareness and risk knowledge substantially enhance flood preparedness, evacuation compliance, and adaptive capacity. The research identifies key contributing factors of situational awareness and risk knowledge, including knowledge about the causes and consequences of floods, awareness of flood-prone areas, structural integrity of buildings, land use planning, capacity building, and robust solid waste and sanitation systems at the community level. The findings established significant associations between these factors and flood vulnerability reduction. The study emphasizes the importance of community engagement, effective governance, and resilience measures in development planning to minimize flood vulnerability. The outcomes inform data-driven flood risk management strategies, underscoring the imperative of integrating situational awareness and risk knowledge to mitigate vulnerability and enhance resilience in susceptible communities like District Nowshera.*

Key Words: Vulnerability, Flood, Risk Knowledge, Situational Awareness, Disasters

Introduction

Understanding factors creating vulnerability to floods is a necessary component for mitigating and managing risks related to disasters, especially floods. This is reflected in key global frameworks, including the Sendai Framework for Disaster Risk Reduction, which prioritizes understanding disaster risk and vulnerability, and the United Nations' Sustainable Development Goals (SDGs), specifically goals 11 and 13, emphasizing the importance of resilience and climate action (Jamshed et al., 2020). Pakistan, being a signatory of these frameworks and subsequent ongoing efforts to improve disaster risk reduction and climate change adaptation, remained highly vulnerable to extreme flooding. Several reasons can be attributed to Pakistan's vulnerability to floods. These factors include diverse topographic dimensions (Hussain et al., 2023), overutilization of natural resources (Khan et al., 2021), poor risk governance (Jan & Muhammad, 2020), climate change and variability (Otto et al., 2023), rapid and unplanned urbanization (Zia et al., 2023), population growth (Ullah et al., 2019), poverty and social inequality (Memon, 2023), lack of risk assessment (Shah et al., 2023), weak implementation of building codes (Cheema, 2023), encroachment of floodplain (Malik, 2022) limited early warning system access (Khayyam & Noureen, 2020), silos-based approach (Jan & Muhammad, 2020), lack of inter-organizational collaboration (Yousefian et al., 2021) and lack of situational and public awareness (Khan et al., 2021). These factors have negatively affected the country's ability to reduce risk and adapt to climate change. To build resilient

[1] Assistant Professor, Centre for Disaster Preparedness and Management (CDPM), University of Peshawar, Peshawar, Khyber Pakhtunkhwa, Pakistan. Email: mushtaq@uop.edu.pk
[2] Assistant Professor, Department of Sociology, Bacha Khan University, Charsadda, Khyber Pakhtunkhwa, Pakistan.
[3] Software Engineer, Centre for Disaster Preparedness and Management (CDPM), University of Peshawar, Peshawar, Khyber Pakhtunkhwa, Pakistan. Email: mushtaq@uop.edu.pk
[4] MS Scholar, Centre for Disaster Preparedness and Management (CDPM), University of Peshawar, Peshawar, Khyber Pakhtunkhwa, Pakistan. Email: mroohullah113@uop.edu.pk

▪ **Corresponding Author:** Muhammad Kaleem (kaleem@bkuc.edu.pk)
▪ **To Cite:** Jan, M. A., Kaleem, M., Ullah, S. I., & Ullah, R. (2024). Impact of Situational Awareness on Flood Vulnerability Reduction in Nowshera, Pakistan. *Qlantic Journal of Social Sciences*, 5(4), 34-48. https://doi.org/10.55737/qjss.978722571

communities, Pakistan needs to shift from reactive to proactive policies, focusing on risk reduction strategies. However, this requires a deeper understanding of the underlying vulnerabilities, risk factors, and resilience levels of at-risk populations. Without this insight, strategies are unlikely to succeed, emphasizing the need for vulnerability assessments to inform effective disaster risk reduction (Hamidi et al., 2020).

Out of the mentioned causes, situational awareness (SA) of local realities and understanding of factors causing vulnerabilities at the community level is very important. Effective situation awareness goes beyond preparedness, requiring a deep understanding of the environmental and situational context to inform impactful responses (Sawalha, 2020). Situation awareness refers to "the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future" (Endsley, 1995). It plays a key role in achieving success in diverse domains such as aviation, healthcare, emergency management, military operations, disaster management, transportation, air traffic control, and power grid operations (Endsley, 2021). SA is paramount for mitigating flood vulnerability and empowering individuals, communities, and authorities to proactively prepare for, respond to, and recover from flood events. This entails perceiving, analyzing, and comprehending critical data regarding the floods, including their magnitude, consequences, and dynamics. Effective situational awareness encompasses several important components, including advanced early warning systems (Bouzidi et al., 2022), comprehensive risk assessments (Rana et al., 2020), robust emergency preparedness (Titko & Ristvej, 2020), real-time surveillance (Sawalha, 2020), interdisciplinary collaboration and communication (Qazi et al., 2020), public education and awareness initiatives (Bouzidi et al., 2022), thorough damage evaluations (Fan et al., 2020), land zoning (Estelaji et al., 2023) and strategic long-term planning (Sanders et al., 2020). Communities and states can enhance flood situational awareness by investing in monitoring technologies, risk assessments, warning systems, public education, clear communication, and emergency planning and collaboration. Studies have demonstrated that communities with strong SA and risk knowledge are more resilient to floods. However, research in Pakistan, specifically in Nowshera, has neglected the critical link between SA and flood vulnerability reduction. Existing research in Pakistan has focused on flood risk assessment, management policies, and infrastructure but has overlooked the essential role of SA. Our study answers two basic research questions: What is the level of situational awareness regarding flood vulnerability among communities in Nowshera? How do situational awareness and understanding of risk factors impact vulnerability to floods? The findings inform evidence-based strategies tailored to local needs, ultimately enhancing flood resilience. By investigating SA and RK, this research aims to provide actionable insights for policymakers, emergency responders, and community leaders to mitigate flood vulnerability in Nowshera and similar regions. By prioritizing situational awareness, communities can minimize devastation, reduce flood vulnerability, and increase resilience, ultimately preserving lives and property.

Material and Method

The study is purely quantitative and seeks to assess the level of situational awareness among local communities regarding flood risks and consequences and examine their understanding of risk factors contributing to flood vulnerability. Additionally, the study analyzes the relationship between situational awareness and vulnerability reduction to floods, explaining how informed communities can mitigate flood vulnerabilities. To achieve these objectives, we conducted an intensive literature review to understand the role of situational awareness in flood vulnerability reduction. These findings informed the development of a three-Likert scale quantitative tool, i.e., a structured interview schedule for the survey, and helped identify the selection of geographic clusters for data collection within the district of Nowshera. Following are the details of the study area, sample selection, data collection, and analysis.

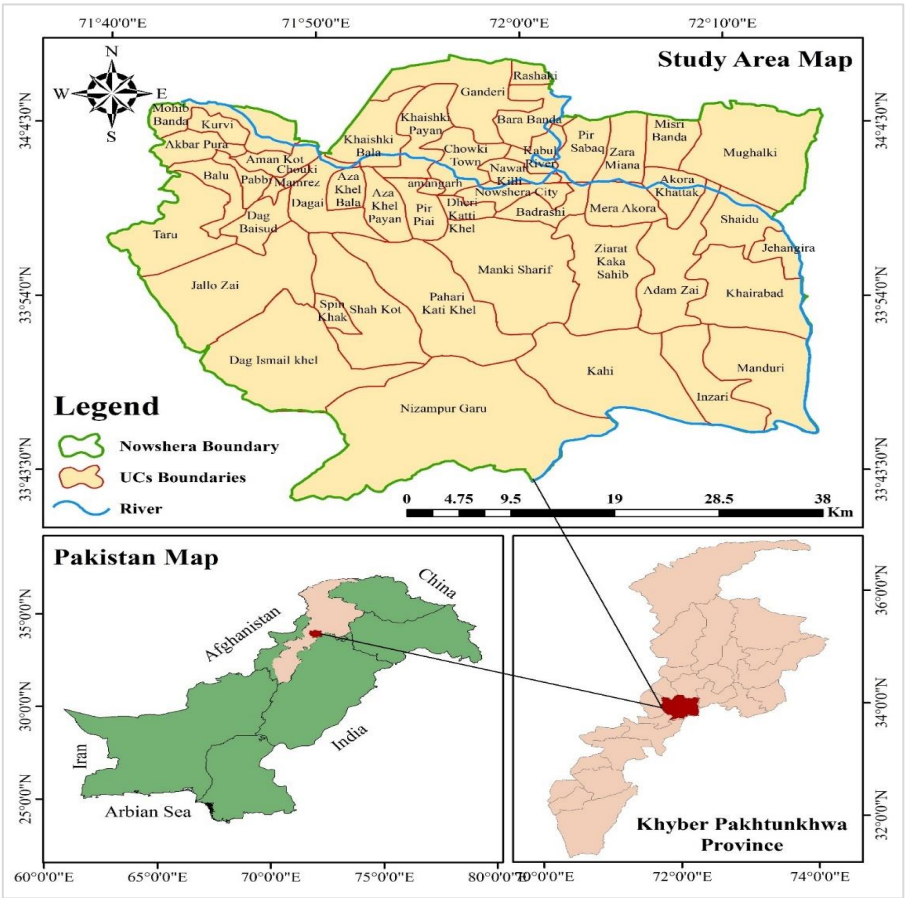
Study Area

District Nowshera is located in Khyber Pakhtunkhwa, a northwestern province of Pakistan (Nasir et al., 2022) located at *34°0'55N latitude and 71°58'29E longitude* (Maryam Ehsan, 2012). The district comprises 259,911 households, a population of 1,740,705, and spans 1,748 km² (Government of Pakistan, 2023). Located adjacent to Peshawar, District Nowshera shares borders with several neighbouring districts,

including District Mardan to the north, District Swabi to the northeast, District Kohat to the south, and District Attock of Punjab to the east (see study area Map in Figure 01). The district is administratively divided into three tehsils (Zulfiqar et al., 2019) and consists of 47 Union Councils (Government of Khyber Pakhtunkhwa, 2019). Geographically, the district is diversified as the northern part consists mainly of plains, intersected by the Kabul, Kalpani, and many canals. In contrast, the southern part features gentle slopes and hills, primarily reliant on rainfall and facing water scarcity (Zulfiqar et al., 2019). In the recent past, the district has been severely hit by flooding, including floods in 2010 and flood 2022 (Government of Pakistan, 2022b). Figure No. 02 provides details of damages caused by floods in the district between 1976 and 2022. The district has been placed and declared as the most at-risk district for floods in Pakistan by the National Disaster Management Authority and Provincial Disaster Management Authority based on its relative risk severity index score (Government of Khyber Pakhtunkhwa, 2024). The Kabul River is the primary source of flooding in District Nowshera. The 15 km stretch between the M1 bridge and Nowshera is highly susceptible to flood hazards due to the confluence of several major rivers. Furthermore, the district is vulnerable to flooding due to the backwater effect of the Indus River at Kund, Attock, where the Kabul River meets the Indus (Government of Khyber Pakhtunkhwa, 2019). During the 2010 floods, a record discharge of around 400,000 cusecs in Kabul (exceeding the average capacity of 160,000 cusecs) and substantial discharge from the Trabela Dam (8,33,000 cusecs on July 27, 2010) hindered water drainage in Kabul (Government of Pakistan, 2010). This led to massive flooding along Kabul's river and damaged 67892 houses. During 2022, a peak discharge of 336500 cusec on August 27 in River Kabul at Nowshera caused very high floods. River Swat, a Tributary of rive Kabul, experienced a historic high flood of 246392 cusecs compared to 1755F46 cusecs in 2010 (53% higher). The peak discharge in River Swat damaged the middle three bays of the Munda Headworks upstream and sustained serious damages (Government of Pakistan, 2022a). This massive flow of water joined the Kabul River downstream and caused devastating floods in Nowshera.

Figure 1

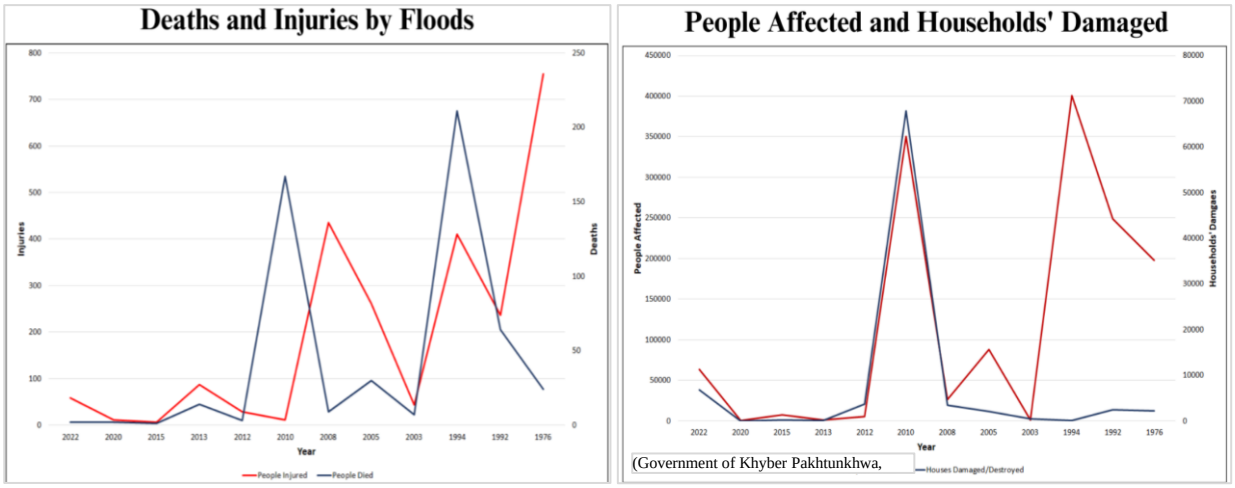
Map of the study area



(Adapted from Huda, 2024)

Figure 2

Damages caused by floods in district Nowshera



(Government of Khyber Pakhtunkhwa,

Sample Size Selection

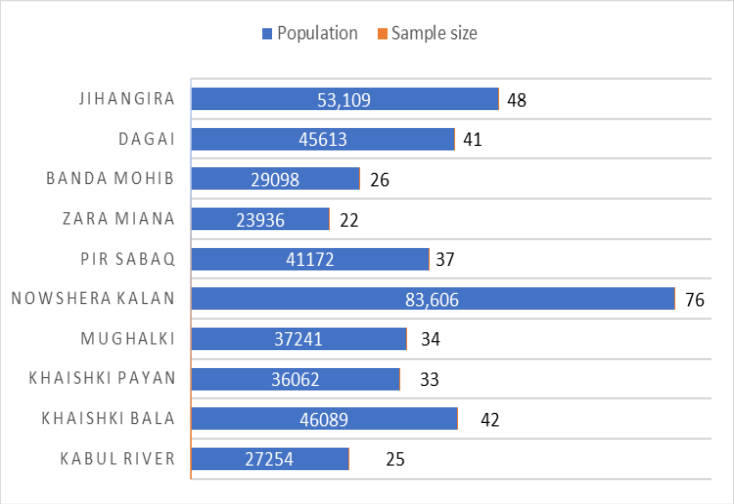
As mentioned earlier, the district consists of 47 Union Councils, and out of these, 10 UCs have been declared as very highly vulnerable to flooding (Government of Khyber Pakhtunkhwa, 2019). We selected these 10 UCs through the cluster sampling method as the locale of the study and applied the Sekaran analogy to determine the total sample size (Sekaran, 2016). Out of the total 423180 population, a sample size of 384 was taken (Government of Pakistan, 2023). To ensure a representative distribution, the sample size was then proportionally allocated (Equation i) across the sampled union councils as per details mentioned in Figure No. 3.

$$n = \left(\frac{N1}{Ni}\right) ni \quad \text{.....(i)}$$

Source: (Cochran, 2007)

Figure 3

The population of each UC and the sample size of the study



Data Collection and Analysis

Data collection was conducted using a structured interview schedule comprising closed-ended questions and a Likert Scale with three response options. To make sure everyone understood, statements were read in Pashto. On the spot, responses were recorded. To address cultural sensitivity, a female data investigator interviewed female respondents. Statistical Package for Social Sciences (SPSS) was used for quantitative analysis, whereas GIS Software was used to prepare a location map of the study area. The data gathered from the respondents was statistically analyzed using both univariate and bivariate techniques. The percentage and frequency distributions were used for univariate analysis. The internal consistency and

reliability of the scales were examined through Cronbatch's Alpha test (Value 0.775) (Nachmias & Nachmias, 1992), while the bivariate analysis was performed using the Chi-square test. The bivariate analysis examined the relationship between the independent and dependent variables. Through the SPSS software, the dependent variable was indexed and cross-tabulated with the independent variable. The following Chi-Square formula was used for the analysis of data.

$$\chi^2 = \sum_{i-1}^{c} \sum_{j-1}^{r} \frac{(o_{ij} - e_{ij})^2}{e_{ij}} \text{.....(ii)}$$

Source: (McCall & Kagan, 1975)

Results and Discussion

In this section, we are presenting the quantitative result of the study. Tables No 01 and 02 provide data for the univariate analysis, whereas, Table No 04 provides bivariate analysis data.

Socio-Economic Profile of the Respondents

Table No. 01 provides the socio-economic and demographic data of the respondents. The demographic analysis showed that the largest proportion of respondents (28.6%) fell within the 51-60 age range, followed by 24% in the 41-50 age range. Out of the total, 83.6% of respondents were male, and 16.4% were female. The low representation of females in the study was due to the restriction of the local cultural fabric on female participation in community affairs. Females are not allowed to interact with males or participate in public affairs openly. Hence, a female data operator was hired to cover the women's perspective and fulfil the needs of this study. The majority of the respondents, i.e., 68.8 %, are living in joint families, followed by 24.2% living in nuclear families. The education level of respondents shows that 34.4% are illiterate, and 21.6% have education up to matriculation. Only 14.3% and 11.2 % were educated up to bachelor's and master's respectively. This disparity highlights the need for targeted interventions to improve access to quality education and promote literacy. Improvement in the literacy ratio in the study area will positively influence flood risk knowledge and will subsequently reduce vulnerabilities to floods and other disasters. The occupational distribution showed that 39.1% were farmers, followed by 14.1% as public/private, 8.9% were running their businesses, and 6.8% were laborers. Notably, 12.5% relied on foreign remittances, while 10.7% were unemployed. Agriculture dominates the landscape, highlighting the vulnerability of these significant livelihood sources to climate change and disasters. The reliance on remittances (12.5%) underscores the substantial impact of domestic and international migration on local economies. During emergencies, these remittances work as a buffer to support the household economy. However, unemployment remains a pressing issue, with 10.7% of respondents without employment requiring strategies to address job scarcity and promote economic growth amid the climate crisis. The monthly family income distribution of the respondents reveals a varied economic profile. The majority, 33.6%, earned between PKR 30,001-40,000, closely followed by 22.4% earning PKR 40,001-50,000. Additionally, 17.4% earned PKR 50,000 and above, while a small fraction, i.e., 1%, earned less than PKR 10,000. The median monthly family income falls within the PKR 30,001-40,000 range, with nearly 55% of families earning between PKR 30,001-50,000. Furthermore, 17.4% enjoyed relatively higher incomes, while 1% struggled with very low incomes. These statistics provide insights into the region's economic dynamics, highlighting areas for targeted interventions to reduce income disparities and promote economic growth to ensure the economic resilience of the communities towards disasters like floods.

Table 1

Socio-economic profile of the respondents

Respondents Age (In Years)	Frequency	Percent
Up to 20	14	3.6
21-30	80	20.8
31-40	51	13.3
41-50	92	24.0
51-60	110	28.6
60 +	37	9.6
Total	384	100

Respondents Age (In Years)	Frequency	Percent
Gender		
Male	321	83.6
Female	63	16.4
Total	384	100
Family Type		
Single parent family	6	1.6
Nuclear family	93	24.2
Joint Family	264	68.8
Extended family	21	5.5
Total	384	100
Education		
Illiterate	132	34.4
Matric and below	83	21.6
Intermediate Level	67	17.4
Bachelor Level	55	14.3
Masters Level	43	11.2
MS/MPhil & PhD	4	1.0
Total	384	100
Respondents Occupation		
Jobless/Unemployed	41	10.7
Students	20	5.2
Farmers	150	39.1
Horticulturist	8	2.1
Working as Labourer	26	6.8
Employees in the Public/Private Sector	54	14.1
Businesses	34	8.9
Industrialist and Manufacturer	1	0.3
Dependent on Remittances	48	12.5
Others	2	0.5
Total	384	100
Income in PKR (Monthly Basis)		
Up to 10000	4	1.0
Between 10001-20000	32	8.3
Between 20001-30000	66	17.2
Between 30001-40000	129	33.6
Between 40001-50000	86	22.4
50000 and above	67	17.4
Total	384	100

Situational Awareness about Flood Risk: Univariate Analysis

Univariate analysis of the study in Table No 02 reveals that a significant majority, i.e.,94.5%, claim to have sufficient knowledge about flood risks and consequences, but only 80% are aware of flood-prone areas, indicating a gap in location-specific knowledge about flood hazards. This lack of knowledge of 20% raises concerns over the effectiveness of the public awareness and training programmes implemented by the disaster management authorities and nongovernmental organizations. In terms of infrastructure, residential and commercial properties lack adequate flood mitigation measures, as believed by 88.8% of the respondents. The reason for the high level of vulnerability of the buildings is the absence of implementation of physical flood resilience measures. Limited financial resources, rapid population growth, and low levels of awareness are the main causes of the nonadaptation of flood resilience measures. Additionally, weak enforcement of building codes and regulations, ineffective emergency response planning, and limited institutional capacity to implement and maintain flood mitigation measures

compound the issue. Regarding physical flood protection, 66.4% of respondents said that the protection wall has effectively increased physical resilience in their community against flood. This positive perception suggests that the protection wall has been successful in enhancing flood resilience. As a result, the existing flood mitigation measures demonstrated the need for further infrastructure investments to sustain resilience. A disagreement of 14.3% was noted in UCs, where the wrong placement of the mitigation wall increased the vulnerability. For example, in Pir Sabaq UC, the wall has been constructed between the confluence point of the River Kalpani and River Kabul rather than the UC side.

During peak flow, it pushes water towards the inhabited area rather than protecting it. An overwhelming 93.5% of the respondents think that the land-use plans are either missing or not disseminated. However, the land use plan has already been prepared by the KP government only for the land currently in use; it lacks provisions for how the land will be used in the future to protect people from future floods. The community was found unaware of the availability of the said plan. This highlights the need for improved land-use planning and communication to reduce flood risk in the area. The government's response to flood risk reduction through the implementation of policies also raises concerns. Only 5.5% of respondents believe the government has imposed strict prohibitions on construction in high-risk zones like riverbanks, meanders, or river basins. Several laws prohibit the construction in risky zones, but the inadequate enforcement of these laws hinders flood risk reduction efforts due to various factors, including corruption, Insufficient public awareness, or lack of political will. The results also underscore the impact of economic factors creating flood vulnerability. The vast majority, 89.6%, recognize the link between poverty and flood vulnerability. Poverty compels people to reside in vulnerable areas. The continuous occurrence of floods has set back poverty reduction efforts, and the poverty ratio has increased due to continuous flooding.

On the other hand, social and physical sector development enhances flood resilience by 4.2% in the study area. Mainstreaming flood risk reduction efforts to social and physical infrastructure projects was highly emphasized. Although local people are aware of it, at the government level, it is still in the initial stage, as responded by 89.8% of respondents. There is a need to enhance community-based training initiatives (agreed by 46.6% of respondents) focused on disaster risk awareness and early warning recognition as a priority. These findings underscore the importance of strengthening training programmes for flood risk management. Regarding evacuation and flood preparedness, only 11.5% of respondents agreed that their community is prepared for floods with established evacuation routes and secure food provisions, while 82.8% disagreed. This alarming lack of preparedness is calamitous for residents, as floods often unleash catastrophic repercussions, encompassing loss of life and extensive property damage. The functionality of water supply and sanitation infrastructure during floods is questioned by 55.5%, highlighting the significance of improved and resilient infrastructure. Additionally, a mere 27.6% and 28.1% think government officials possess the expertise to reduce flood risks and design successful response plans, respectively. These results indicate a perceived gap in expertise, eroding trust, and a pressing need for capacity building, underscoring the necessity of collaborative flood risk management and response planning that engages experts, local communities, and stakeholders.

Table 2

Situational awareness about flood risk

Statement/Attribute	Response /Option			Total
	Agree	Disagree	Neutral	
I have sufficient knowledge about flood risks and consequences in my area	363 (94.5%)	05 (1.3 %)	16 (4.2%)	384 (100%)
I am aware of the flood-prone areas in my community	307 (80%)	60 (16%)	17 (4%)	384 (100%)
The residential and commercial properties in our area possess adequate flood mitigation measures	05 (1.3%)	341 (88.8%)	38 (9.9%)	384(100%)

Statement/Attribute	Response /Option			Total
	Agree	Disagree	Neutral	
The protection wall has increased the physical resilience against flood in our community	255 (66.4%)	55 (14.3%)	74 (19.3%)	384(100%)
Effective land use planning strategies have been developed and disseminated	00 (00%)	359 (93.5%)	25 (6.5%)	384(100%)
The government has imposed a strict prohibition on construction activities in high-risk zones, including riverbanks and riverbeds	21 (5.5%)	336 (87.5%)	27 (7.0%)	384(100%)
Poverty exposes people to environmental risks, forcing them to live in vulnerable locations to flooding	344 (89.6%)	9 (2.3%)	31 (8.1%)	384(100%)
The aim of the physical, social, and economic development in our community is to enhance flood resilience and safety of people	16 (4.2%)	345 (89.8%)	23 (6.0%)	384(100%)
Community-based training initiatives prioritize disaster risk awareness and early warning recognition.	179 (46.6)	129 (33.6)	76 (19.8)	384 (100%)
Our community is prepared for floods with established evacuation routes and planning	44 (11.5%)	318 (82.8%)	22 (5.7%)	384(100%)
The water supply and sanitation infrastructure remain functional, minimizing disease outbreak risks	159 (41.4)	213 (55.5)	12 (3.1)	384(100%)
Government officials possess the expertise and technical capabilities to effectively reduce flood risks	106 (27.6%)	119 (31.0%)	159 (41.4%)	384 (100%)
Government officials possess the expertise to design and implement successful response and recovery plans	108 (28.1%)	91 (23.7%)	185 (48.2%)	384 (100%)

Association Between Situational Awareness and Flood Vulnerability Reduction: Bivariate Analysis

Situational awareness and understanding risk factors play a critical role in reducing vulnerability to flood. To effectively mitigate disaster risks, it is essential to recognize key contributing factors, such as flood knowledge, awareness of flood-prone areas, structural integrity, and location of homes etc. Additional vital considerations include land use planning, capacity building, resilient planning, and robust sanitation systems. By understanding these factors, communities can develop targeted strategies to enhance their resilience and reduce vulnerability to disasters. Table No. 03 reveals a highly significant association (p=.000) between flood hazard knowledge (causes, impacts, and mitigation measures) and vulnerability reduction. Knowledge, experience, and different sources of information enhance situational awareness about floods. Data reveal that lack of this information enhances vulnerability to floods. Understanding factors causing floods and creating vulnerabilities informs flood risk management strategies, thus reducing vulnerabilities across nations and communities (Mondino et al., 2020). The table also depicts a highly significant association between knowledge of flood-prone areas and vulnerability reduction (p=.000). Knowledge of flood-risk zones has a profound impact on behaviour, prompting individuals to take proactive measures, such as informed land use planning for housing, businesses, and climate-resilient agriculture. Previous studies indicate that location-specific situational awareness and collaborative assessment through community engagement enhance flood hazard knowledge and management strategies tailored to site-specific risk reduction decision-making (Sanders et al., 2020).

Data also reveals that existing buildings (commercial, public, and residential) in the study area are inadequately equipped to withstand future flood events. Although building strength is strongly linked to reduced vulnerability (p=.004), the current infrastructure lacks resilience to absorb flood-related shocks. This highlights non-compliance with building regulations, which creates flood disaster vulnerability in the area. Previously, the Building Codes 2007 (PEC, 2008) did not have any provisions for hydrological disasters, but in the new Building Codes approved in 2021, indicators for hydro-meteorological risks have been included (PEC, 2021). However, it is only applicable to public sector buildings, and there is no provision for private and commercial sector buildings. While DRR efforts concentrate on protecting buildings, they often address a single hazard, ignoring or even worsening vulnerabilities to other hazards. This phenomenon highlights the need to consider multiple hazards and minimize unintended consequences (de Ruiter et al., 2021). Adaptation measures at the household and commercial levels are crucial for reducing flood vulnerability. Nevertheless, various factors affect household-level adaptation, including flood risk perception, geographic location, adaptive capacity, reliance on social protection, and socioeconomic status (Abebe et al., 2020). Similarly, physical resilience projects, such as protection walls, are also vital for flood vulnerability reduction. Our study shows that the majority considered protection walls to be effective (p=0.000) mitigation measures. Diverse opinions exist (14.3% disagreement) due to wrong placement of the mitigation walls or poor quality of construction in some communities. These findings guide policymakers to evaluate, improve, and engage with the community. Weak disaster risk governance in the study area has led to numerous homes and buildings being built on riverbanks or even inside the river basin. Therefore, community engagement is necessary for sustainable flood mitigation projects (Shajahan & Reja, 2011). Unfortunately, the context of community participation in project feasibility and design is missing in the study area at the government level, which increases community vulnerability to floods (Jan & Muhammad, 2020). To combat this issue, implementing a ban on construction in vulnerable locations is crucial, as research shows a significant association between such bans and reduced vulnerability (p=.000).

The current construction practices are not only hazardous but also exacerbate the risks, particularly in areas like Nowshera, where the entire population lives along the river Kabul. Several policies, including the Khyber Pakhtunkhwa River Protection Ordinance 2002 and the (National Disaster Management Act 2010)empower the local administration to maintain a ban on encroachment in rivers and prohibit people from constructing in vulnerable areas (Government of Pakistan, 2010) (Government of Khyber Pakhtunkhwa, 2002). The implementation of these policy documents increases situational awareness and can reduce vulnerability to a maximum level. Developing a robust and inclusive land use plan is imperative for the study area, as empirical evidence reveals a significant correlation (p=0.000) between land use planning and vulnerability reduction. Effective land use planning serves as a multifaceted tool, guiding residential and public sector construction, identifying optimal locations for diverse activities, incorporating Disaster Risk Reduction protocols, and providing vital support to disadvantaged communities in building secure and resilient homes. A land use plan has already been prepared for the study area, but its implementation and communication with the local people are questioned all the time (Government of Khyber Pakhtunkhwa, 2019). Social problems like poverty often compel individuals to settle in hazardous areas due to financial constraints. However, a well-crafted land-use strategy can effectively alleviate this issue by offering affordable housing solutions and minimizing vulnerabilities to floods. In this regard, a highly significant association (p=.000) between poverty and disaster vulnerability reduction was found. Specifically, poverty compelled residents to inhabit vulnerable areas, often in fragile adobe houses that are highly susceptible to disaster impacts. Research suggests that poverty significantly exacerbates vulnerability to disasters, perpetuating a cycle that further increases poverty. This interdependence underscores that poverty reduction and vulnerability reduction are interconnected and mutually reinforcing (Hamidi et al., 2020) (Hallegatte et al., 2020).

Current development plans in the study area don't prioritize disaster risk reduction, but the study results (p=.000) show that integrating resilience measures into social and physical sector development planning significantly reduces vulnerability. To make a difference, development projects should be risk-sensitive and people-friendly. Global initiatives like the Sustainable Development Agenda and Sendai Framework emphasize addressing poverty, inequality, and climate change to reduce disaster risks. Building flood resilience in development planning goes beyond risk prevention; it also entails reducing

vulnerability and cultivating preparedness to adapt and respond efficiently to floods (Norizan et al., 2021). This can be achieved by increased public awareness and training programmes. Community-based training initiatives accord paramount importance to disaster risk awareness and early warning recognition. Statistical analysis established a significant correlation (p=0.000) between community-based training initiatives prioritizing disaster risk awareness and early warning recognition with flood vulnerability reduction. Households' vulnerability to floods can be addressed through a comprehensive approach combining capacity building, targeted training, and effective communication to promote resilience (Shah et al., 2020). These trainings enable local people to adapt to the changing circumstances through early warning messages, evacuation planning, and emergency preparedness. Evacuation planning is essential in the context of the study area due to the repeated nature of the flooding. This study also found a highly significant correlation (p=.000) between evacuation planning, alternate evacuation routes, and vulnerability reduction. Establishing safe and accessible evacuation routes ensures public safety and enables government agencies to swiftly respond to local communities during emergencies. Well-planned evacuation routes and awareness of evacuation sites significantly enhance community resilience and diminish population vulnerability. Well-articulated evacuation routes, centres, and maps inform communities about the safest routes and locations in times of emergencies and reduce their vulnerabilities (Tsai & Chang, 2023).

A significant majority of respondents reported inadequate sanitation, poor sewerage, solid waste, and water supply systems despite their critical role in mitigating vulnerability to floods and any subsequent health hazards. This is especially alarming, considering the statistically significant correlation between proper sanitation, water supply, and reduced vulnerability (p=0.008). The lack of resilience of the water and sanitation system led to the outbreak of certain epidemic diseases, including cholera, dengue, and malaria, with many other health concerns (Manzoor & Adesola, 2022). Inadequate sanitation systems, untreated water, and lack of solid waste management lead to health and environmental impacts such as polluting drinking water. Poorly maintained drainage systems increase the chances of flooding, especially in urban areas. In the study area, people are not environmentally conscious and lack an understanding of environmental stability due to careless behaviour (Ijaz et al., 2021). Around 83.25% of households dispose of solid waste in open spaces, while a mere 0.77% have their waste collected by municipal services (Government of Pakistan, 2021). This alarming situation highlights two critical issues. Firstly, widespread improper waste disposal clogs drains and waterways, increasing the risk of waterborne diseases and enhancing flood risk due to blocked drainage systems. Secondly, inadequate municipal waste management indicates insufficient infrastructure and resources, hindering proper waste collection. These factors exacerbate flood vulnerability by impeding water flow, polluting water, and compromising disaster response and recovery efforts. Addressing these issues is crucial to reducing flood vulnerability and promoting resilience in the study area.

Research shows that there's a strong link between government officials' expertise and reducing vulnerability to floods (p=.000). However, there's a mismatch between community perceptions and reality. While community-level respondents view government officials as highly qualified and technical, officials in certain departments like Irrigation, Communication and Works, Pakistan Meteorological Department, and Rescue 1122 possess technical competencies, whereas those in Provincial and District Disaster Management Authorities lack technical expertise (Jan & Muhammad, 2020). To bridge this gap, the government should reassess recruitment criteria in civil protection institutions to cultivate a skilled disaster management workforce. Effective governance and coordination are crucial at local, national, and international levels. This ensures risk reduction in all phases of disaster management. Situational awareness about the recovery framework is also necessary to reduce vulnerabilities. Effective recovery plans are crucial in reducing vulnerability after a disaster. Results of this study show a strong link between officials' capacity for recovery planning and vulnerability reduction (p=.000). Inefficient post-disaster recovery can sometimes worsen the impact of the disaster itself. Well-organized recovery mechanisms can prevent people from falling into poverty traps and minimize the devastation caused by disasters. To achieve this, the "build back better and smarter" approach encourages officials and communities to rebuild safer, more resilient, and sustainable communities.

Table 3

Association between situational awareness and flood vulnerability Reduction

Attributes/Statements	Attitude	Vulnerability Level			Total	Statistics
		Low	Medium	High		
I have sufficient knowledge about flood risks and consequences in my area	Agree	42 (11.6%)	88 (24.2%)	233 (64.2%)	363	(p =.000) (χ2=22.039)
	Disagree	00 (0.0%)	0 (0.0%)	5 (100.0%)	5	
	Neutral	3 (18.8%)	11 (68.8%)	2 (12.5%)	16	
	Total	45 (11.7%)	99 (25.8%)	240 (62.5%)	384	
I am aware of the flood-prone areas in my community	Agree	33 (10.7%)	78 (25.4%)	196 (63.8%)	307	p=.000 χ2=21.974
	Disagree	8 (13.3%)	10 (16.7%)	42 (70.0%)	60	
	Neutral	4 (23.5%)	11 (64.7%)	2 (11.8%)	17	
	Total	45 (11.7%)	99 (25.8%)	240 (62.5%)	384	
The residential and commercial properties in our area possess adequate flood mitigation measures.	Agree	2 (40.0%)	3 (60.0%)	0 (0.0%)	05	(P=.004) (χ2=15.138)
	Disagree	42 (12.3%)	81 (23.8%)	218 (63.9%)	341	
	Neutral	1 (2.6%)	15 (39.5%)	22 (57.9%)	38	
	Total	45 (11.7%)	99 (25.8%)	240 (62.5%)	384	
The protection wall has increased the physical resilience against flood in our community	Agree	22 (8.6%)	70 (27.5%)	163 (63.9%)	255	p=.000 χ2=29.418
	Disagree	18 (32.7%)	13 (23.6%)	24 (43.6%)	55	
	Neutral	5 (6.8%)	16 (21.6%)	53 (71.6%)	74	
	Total	45 (11.7%)	99 (25.8%)	240 (62.5%)	384	
The government has imposed a strict prohibition on construction activities in high-risk zones, including riverbanks and riverbeds	Agree	1 (4.8%)	6 (28.6%)	14 (66.7%)	21	(p =.000) (χ2=36.855)
	Disagree	43 (12.8%)	73 (21.7%)	220 (65.5%)	336	
	Neutral	1 (3.7%)	20 (74.1%)	6 (22.2%)	27	
	Total	45 (11.7%)	99 (25.8%)	240 (62.5%)	384	
Effective land use planning strategies have been developed and disseminated	Agree	00	00	00	00	(p=.000) (χ2=35.246)
	Disagree	44 (12.3%)	80 (22.3%)	235 (65.5%)	359	
	Neutral	1 (4.0%)	19 (76.0%)	5 (20.0%)	25	
	Total	45 (11.7%)	99 (25.8%)	240 (62.5%)	384	
Poverty exposes people to environmental risks, forcing them to live in vulnerable locations to flooding	Agree	35 (10.2%)	84 (24.1%)	225 (65.4%)	344	(p=.000) (χ2=25.081)
	Disagree	6 (66.7%)	1 (11.1%)	2 (22.2%)	9	
	Neutral	4 (12.9%)	14 (45.2%)	13 (41.9%)	31	
	Total	45 (11.7%)	99 (25.8%)	240 (62.5%)	384	
The aim of the physical, social, and economic development in our community is to enhance flood resilience and safety of people	Agree	2 (12.5%)	1 (6.3%)	13 (81.3%)	16	(p=.000) (χ2=37.613)
	Disagree	42 (12.2%)	80 (23.2%)	223 (64.6%)	345	
	Neutral	1 9 (4.3%)	18 (78.3%)	4 (17.4%)	23	
	Total	45 (11.7%)	99 (25.8%)	240 (62.5%)	384	

Attributes/Statements	Attitude	Vulnerability Level			Total	Statistics
		Low	Medium	High		
Community-based training initiatives prioritize disaster risk awareness and early warning recognition.	Agree	10 (5.6%)	49 (27.4%)	120 (67.0%)	179	(p=.000) (χ2=30.398)
	Disagree	13 (10.1%)	38 (29.5%)	78 (60.5%)	129	
	Neutral	22 (28.9%)	12 (15.8%)	42 (55.3%)	76	
	Total	45 (11.7%)	99 (25.8%)	240 (62.5%)	384	
Our community is prepared for floods with established evacuation routes and planning	Agree	5 (11.4%)	17 (38.6%)	22 (50.0%)	44	(p= .000) (χ2=37.678)
	Disagree	29 (9.1%)	79 (24.8%)	210 (66.0%)	318	
	Neutral	11 (50.0%)	3 (13.6%)	8 (36.4%)	22	
	Total	45 (11.7%)	99 (25.8%)	240 (62.5%)	384	
The water supply, sanitation, sewerage system, and waste disposal remained functional, minimizing disease outbreak risks	Agree	24 (15.1%)	27 (17.0%)	108 (67.9%)	159	(p= .008) (χ2=13.775)
	Disagree	20 (9.4%)	70 (32.9%)	123 (57.7%)	213	
	Neutral	1 (8.3%)	2 (16.7%)	9 (75.0%)	12	
	Total	45 (11.7%)	99 (25.8%)	240 (62.5%)	384	
Government officials possess the expertise and technical capabilities to effectively reduce flood risks.	Agree	22 (20.8%)	18 (17.0%)	66 (62.3%)	106	(p= .000) (χ2=36.893)
	Disagree	15 (12.6%)	18 (15.1%)	86 (72.3%)	119	
	Neutral	8 (5.0%)	63 (39.6%)	88 (55.3%)	159	
	Total	45 (11.7%)	99 (25.8%)	240 (62.5%)	384	
Government officials possess the expertise to design and implement successful response and recovery plans	Agree	15 (13.9%)	15 (13.9%)	78 (72.2%)	108	(p=.000) (χ2=35.908)
	Disagree	22 (24.2%)	20 (22.0%)	49 (53.8%)	91	
	Neutral	8 (4.3%)	64 (34.6%)	113 (61.1%)	185	
	Total	45 (11.7%)	99 (25.8%)	240 (62.5%)	384	

Conclusion

Enhanced awareness and knowledge are critical for reducing flood vulnerability. Effective mitigation relies on flood knowledge, land use planning, capacity building, and effective governance. Understanding these factors enhances situational awareness and reduces vulnerability to floods. A multi-faceted approach is necessary, incorporating short-term initiatives like establishing a flood early warning system, public awareness campaigns, distributing flood risk maps and evacuation routes, training community volunteers, and integrating flood education into local curricula. Medium-term strategies include developing mobile applications for flood alerts, installing warning sirens, conducting regular drills, and incorporating flood risk reduction into local development plans. Long-term measures involve comprehensive flood risk assessments, flood-resilient infrastructure, capacity building, resilient agriculture practices, and establishing a flood research centre. Effective stakeholder engagement, leveraging technology, and capacity building through training and expertise sharing are also vital. By prioritizing these initiatives, policymakers can enhance situational awareness, reduce vulnerability, and foster resilience, ultimately saving lives and livelihoods and withstanding flooding's devastating impacts, with future studies focusing on scaling up these interventions.

References

Abebe, Y. A., Ghorbani, A., Nikolic, I., Manojlovic, N., Gruhn, A., & Vojinovic, Z. (2020). The role of household adaptation measures in reducing vulnerability to flooding: a coupled agent-based and flood modelling approach. *Hydrology and Earth System Sciences*, *24*(11), 5329–5354. https://doi.org/10.5194/hess-24-5329-2020

Bouzidi, Z., Amad, M., & Boudries, A. (2022). Enhancing Warning, Situational Awareness, Assessment and Education in Managing Emergency: Case Study of COVID-19. *SN Computer Science*, *3*(6). https://doi.org/10.1007/s42979-022-01351-2

Cheema, S. M. (2023). Relationship among safety, quality and productivity in construction projects. *Journal of Development and Social Sciences*, *4*(1), 183–193. https://doi.org/10.47205/jdss.2023(4-I)17

Cochran, W. G. (2007). *Sampling techniques (3rd ed.)*. John Wiley & Sons Incorporated.

de Ruiter, M. C., de Bruijn, J. A., Englhardt, J., Daniell, J. E., de Moel, H., & Ward, P. J. (2021). The Asynergies of Structural Disaster Risk Reduction Measures: Comparing Floods and Earthquakes. *Earth's Future*, *9*(1). https://doi.org/10.1029/2020EF001531

Endsley, M. R. (1995). Toward a Theory of Situation Awareness in Dynamic Systems. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *37*(1), 32–64. https://doi.org/10.1518/001872095779049543

Endsley, M. R. (2021). SITUATION AWARENESS. *Handbook of Human Factors and Ergonomics*, 434–455. https://doi.org/10.1002/9781119636113.ch17

Estelaji, F., Aghajari, A. A., & Zahedi, R. (2023). Flood zoning and developing strategies to increase resilience against floods with a crisis management approach. *Asian Review of Environmental and Earth Sciences*, *10*(1), 14–27. https://doi.org/10.20448/arees.v10i1.4439

Fan, C., Jiang, Y., & Mostafavi, A. (2020). Social Sensing in Disaster City Digital Twin: Integrated Textual–Visual–Geo Framework for Situational Awareness during Built Environment Disruptions. *Journal of Management in Engineering*, *36*(3), 04020002. https://doi.org/10.1061/(asce)me.1943-5479.0000745

Government of Khyber Pakhtunkhwa. (2002). Khyber Pakhtunkhwa River Protection Ordinance (Ordinance No. III of 2002) (pp. 1–20). Provincial Assembly. http://kp.gov.pk/uploads/2016/02/10._Rivers_Protection_Ordinance,_2002_.pdf

Government of Khyber Pakhtunkhwa. (2019). Final Land Use Plan District Nowshera. https://urbanpolicyunit.gkp.pk/wp-content/uploads/2020/07/Nowshera-Updated-18-02-2020.pdf

Government of Khyber Pakhtunkhwa. (2024). Summer Monsoon Contingency Plan 2024. https://www.ndma.gov.pk/storage/plans/July2024/iBXpRAwOGQHRN6pNgP5U.pdf

Government of Pakistan. (2010). Annual Flood Report 2010. https://mowr.gov.pk/SiteImage/Misc/files/2010%20Annual%20Flood%20Report%20of%20FFC(1).pdf

Government of Pakistan. (2021). Pakistan Social and Living Standards Measurement Survey. https://www.pbs.gov.pk/publication/pakistan-social-and-living-standards-measurement-survey-pslm-2019-20-provincial

Government of Pakistan. (2022a). Annual Flood Report 2022. https://ffc.gov.pk/wp-content/uploads/2023/11/Final-Annual-Report-2022-Oo-CEA-CFFC.pdf

Government of Pakistan. (2022b). Pakistan Flood 2022: Post Flood Damage Need Assessment . https://www.pc.gov.pk/uploads/downloads/PDNA-2022.pdf

Government of Pakistan. (2023). 7th Population and Housing Census-2023. https://www.pbs.gov.pk/digital-census/detailed-results

Hallegatte, S., Vogt-Schilb, A., Rozenberg, J., Bangalore, M., & Beaudet, C. (2020). From Poverty to Disaster and Back: a Review of the Literature. *Economics of Disasters and Climate Change*, *4*(1), 223–247. https://doi.org/10.1007/s41885-020-00060-5

Hamidi, A. R., Zeng, Z., & Khan, M. A. (2020). Household vulnerability to floods and cyclones in Khyber Pakhtunkhwa, Pakistan. *International Journal of Disaster Risk Reduction*, *46*, 101496. https://doi.org/https://doi.org/10.1016/j.ijdrr.2020.101496

Hussain, M. A., Shuai, Z., Moawwez, M. A., Umar, T., Iqbal, M. R., Kamran, M., & Muneer, M. (2023). A Review of Spatial Variations of Multiple Natural Hazards and Risk Management Strategies in Pakistan. *Water*, *15*(3), 407. https://doi.org/10.3390/w15030407

Ijaz, S., Miandad, M., Mehdi, S. S., Anwar, M. M., & Rahman, G. (2021). Solid waste management as a response to urban flood risk in Gujrat city, Pakistan. *Malaysian Journal of Society and Space, 17*(1). https://doi.org/10.17576/geo-2021-1701-01

Jamshed, A., Birkmann, J., Rana, I. A., & McMillan, J. M. (2020). The relevance of city size to the vulnerability of surrounding rural areas: An empirical study of flooding in Pakistan. *International Journal of Disaster Risk Reduction, 48*, 101601. https://doi.org/https://doi.org/10.1016/j.ijdrr.2020.101601

Jan, M. A., & Muhammad, N. (2020). Governance and disaster vulnerability reduction: A community based perception study in Pakistan. *16*(4), 138–149. http://www.innspub.net

Khan, A. A., Rana, I. A., Nawaz, A., & Waheed, A. (2021). Gender-based emergency preparedness and awareness: empirical evidences from high-school students of Gilgit, Pakistan. *Environmental Hazards, 20*(4), 416–431. https://doi.org/10.1080/17477891.2020.1839375

Khan, I., Saqib, M., & Hafidi, H. (2021). Poverty and environmental nexus in rural Pakistan: a multidimensional approach. *GeoJournal, 86,* 663–677. https://doi.org/10.1007/s10708-019-10090-6

Khayyam, U., & Noureen, S. (2020). Assessing the adverse effects of flooding for the livelihood of the poor and the level of external response: a case study of Hazara Division, Pakistan. *Environmental Science and Pollution Research, 27*(16), 19638–19649. https://doi.org/10.1007/s11356-020-08303-4

Malik, I. H. (2022). Anthropogenic causes of recent floods in Kashmir Valley: a study of 2014 flood. *SN Social Sciences, 2*(8), 162. https://doi.org/10.1007/s43545-022-00463-z

Manzoor, A., & Adesola, R. O. (2022). Disaster in public health due to flood in Pakistan in 2022. *Health Science Reports, 5*(6). https://doi.org/10.1002/hsr2.903

Maryam, E. (2012). Allelopathic potential of Anagalis arvensis L. *AFRICAN JOURNAL OF BIOTECHNOLOGY, 11*(46). https://doi.org/10.5897/AJB11.1657

McCall, R. B., & Kagan, J. (1975). *Fundamental statistics for psychology (2nd ed.).* Harcourt Brace Jovanovich, Inc.

Memon, M. H. (2023). Poverty, Gap and Severity Estimates for Disaster Prone Rural Areas of Pakistan. *Social Indicators Research, 166*(3), 645–663. https://doi.org/10.1007/s11205-023-03082-0

Mondino, E., Scolobig, A., Borga, M., & Di Baldassarre, G. (2020). The Role of Experience and Different Sources of Knowledge in Shaping Flood Risk Awareness. *Water, 12*(8), 2130. https://doi.org/10.3390/w12082130

Nachmias, F. C., & Nachmias, D. (1992). *Research Methods in the Social Sciences (4th ed.).* St. Martin's Press.

Nasir, M. J., Tufail, M., Ayaz, T., Khan, S., Khan, A. Z., & Lei, M. (2022). Groundwater quality assessment and its vulnerability to pollution: a study of district Nowshera, Khyber Pakhtunkhwa, Pakistan. *Environmental Monitoring and Assessment*, *194*(10). https://doi.org/10.1007/s10661-022-10399-9

National Disaster Management Act , 1 (2010). http://www.ndma.gov.pk/storage/NDMA-Act/NDMA-Act.pdf

Norizan, N. Z. A., Hassan, N., & Yusoff, M. M. (2021). Strengthening flood resilient development in malaysia through integration of flood risk reduction measures in local plans. *Land Use Policy, 102*, 105178. https://doi.org/10.1016/j.landusepol.2020.105178

Otto, Zachariah, M., Saeed, F., Siddiqi, A., Kamil, S., Mushtaq, H., Arulalan T, AchutaRao, K., T, C. S., Barnes, C., Philip, S., Kew, S. F., Vautard, R., Koren, G., Pinto, I., Wolski, P., Maja Vahlberg, Singh, R., Arrighi, J., & Maarten van Aalst. (2023). Climate change increased extreme monsoon rainfall, flooding highly vulnerable communities in Pakistan. *Environmental Research: Climate*, *2*(2), 025001–025001. https://doi.org/10.1088/2752-5295/acbfd5

PEC. (2008). Safety Codes. *In Official Document Extract* (p. 4). https://www.pec.org.pk/building_code_pakistan.aspx

PEC. (2021). Building Code of Pakistan. https://www.pec.org.pk/wp-content/uploads/2024/09/BCP2021-Final-Draft-dated-26.10.2021.pdf

Qazi, A., Qazi, J., Naseer, K., Zeeshan, M., Hardaker, G., Maitama, J. Z., & Haruna, K. (2020). Analyzing situational awareness through public opinion to predict adoption of social distancing amid pandemic COVID - 19. *Journal of Medical Virology, 92*(7), 849 - 855. https://doi.org/10.1002/jmv.25840

Rana, I. A., Jamshed, A., Younas, Z. I., & Bhatti, S. S. (2020). Characterizing flood risk perception in urban communities of Pakistan. *International Journal of Disaster Risk Reduction*, *46*(46), 101624. https://doi.org/10.1016/j.ijdrr.2020.101624

Sanders, B. F., Schubert, J. E., Goodrich, K. A., Houston, D., Feldman, D. L., Basolo, V., Luke, A., Boudreau, D., Karlin, B., Cheung, W., Contreras, S., Reyes, A., Eguiarte, A., Serrano, K., Allaire, M., Moftakhari, H., AghaKouchak, A., & Matthew, R. A. (2020). Collaborative Modeling With Fine-Resolution Data Enhances Flood Awareness, Minimizes Differences in Flood Perception, and Produces Actionable Flood Maps. *Earth's Future*, *8*(1). https://doi.org/10.1029/2019ef001391

Sawalha, I. H. (2020). A contemporary perspective on the disaster management cycle. *Foresight, 22*(4), 469–482. https://doi.org/10.1108/FS-11-2019-0097

Sekaran, U. (2016). *Research methods for business: A skill building approach (5th ed.).* John Wiley & Sons.

Shah, A. A., Ullah, A., Khan, N. A., Shah, M. H., Ahmed, R., Hassan, S. T., Tariq, M. A. U. R., & Xu, C. (2023). Identifying obstacles encountered at different stages of the disaster management cycle (DMC) and its implications for rural flooding in Pakistan. *Frontiers in Environmental Science, 11.* https://doi.org/10.3389/fenvs.2023.1088126

Shah, A. A., Ye, J., Shaw, R., Ullah, R., & Ali, M. (2020). Factors affecting flood-induced household vulnerability and health risks in Pakistan: The case of Khyber Pakhtunkhwa (KP) Province. *International Journal of Disaster Risk Reduction, 42*, 101341. https://doi.org/10.1016/j.ijdrr.2019.101341

Shajahan, A., & Reja, M. Y. (2011). Towards sustainable flood mitigation strategies: A case study of Bangladesh. Disaster, Risk and Vulnerablity Conference, 271–276.

Titko, M., & Ristvej, J. (2020). Assessing Importance of Disaster Preparedness Factors for Sustainable Disaster Risk Management: The Case of the Slovak Republic. *Sustainability, 12*(21), 9121. https://doi.org/10.3390/su12219121

Tsai, M.-T., & Chang, H.-W. (2023). Contribution of Accessibility to Urban Resilience and Evacuation Planning Using Spatial Analysis. *International Journal of Environmental Research and Public Health, 20*(4), 2913. https://doi.org/10.3390/ijerph20042913

Ullah, S., You, Q., Ullah, W., Hagan, D. F. T., Ali, A., Ali, G., Zhang, Y., Jan, M. A., Bhatti, A. S., & Xie, W. (2019). Daytime and nighttime heat wave characteristics based on multiple indices over the China–Pakistan economic corridor. *Climate Dynamics, 53*(9), 6329–6349. https://doi.org/10.1007/s00382-019-04934-7

Yousefian, S., Sohrabizadeh, S., & Jahangiri, K. (2021). Identifying the components affecting intra-organizational collaboration of health sector in disasters: Providing a conceptual framework using a systematic review. *International Journal of Disaster Risk Reduction, 57,* 102146. https://doi.org/https://doi.org/10.1016/j.ijdrr.2021.102146

Zia, A., Rana, I. A., Arshad, H. S. H., Khalid, Z., & Nawaz, A. (2023). Monsoon flood risks in urban areas of Pakistan: A way forward for risk reduction and adaptation planning. *Journal of Environmental Management, 336,* 117652. https://doi.org/https://doi.org/10.1016/j.jenvman.2023.117652

Zulfiqar, M., Mian, I. A., Khan, N., Gul, N., Hanan, F., Qazi, M. A., ... & Naushad, M. (2019). Impacts of climate change on livelihood of older people in District Nowshera-Pakistan. *Int J African Asian Stud*, 2409-6938.