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Sociological Dimensions of Disaster Vulnerability: A Case Study of Khyber Pakhtunkhwa, Pakistan

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ABSTRACT

This research explored the complex relationship between sociological factors and disaster vulnerability in Khyber Pakhtunkhwa, Pakistan, employing a qualitative case study approach and thematic analysis. Focusing on four districts (Dera Ismail Khan, Nowshera, Charsadda, and Swat), the study drew on a diverse sample of officials from line agencies, NGOs, and local communities. Data was gathered through 27 in-depth interviews and 08 focus group discussions. The findings reveal a critical connection of deep-rooted poverty, discrimination, and social exclusion with fragile physical environments and cultural factors, eroding community resilience. Notably, poverty restricts access to resources, exacerbating disparities and marginalizing vulnerable groups, while inadequate infrastructure heightens disaster risk. Furthermore, analysis shows that poverty and inequality amplify physical vulnerability, compounded by social exclusion and cultural factors limiting information access and disaster preparedness. These findings underscore the imperative for inclusive disaster risk reduction strategies prioritizing community-led decision-making, marginalized group empowerment, and context-specific understandings of vulnerability. By highlighting the importance of culturally sensitive approaches, this research contributes to the sociological discourse on disaster vulnerability, informing efforts to mitigate disaster risk and promote sustainable development.

Background

Disasters result from the intersection of hazardous events and vulnerable conditions (Kuran et al., 2020 Kelman et al., 2016). Understanding disaster requires examining the concept of vulnerability, where disasters arise from the intersection of hazards and human susceptibility, often exacerbated by development-related issues (Jan & Muhammad, 2020; Steckley, 2006; & McEntire, 2001). Disasters are perceived and understood differently by each person, reflecting their individual experiences and worldview (Cornia et al., 2016). However, our comprehension

of disasters has evolved significantly over time. Notably, in the 1990s, disasters were often viewed as divine retribution or an act of God. The conventional view of disasters as solely natural events was challenged by scholars from sociology, anthropology, and social geography (Dilek & Kahya, 2023 & Steckley, 2006). Early critics of the natural disaster paradigm, including Burton et al. (1993) and Hewitt (1983), argued that human behaviors play a crucial role in shaping disaster outcomes. The hegemonic discourse exhibited a reactive orientation, marginalizing the proactive paradigms of disaster risk reduction, notably preparedness and mitigation. Burton et al. (1993) and Hewitt (1983) proposed a paradigm shift, redefining disasters as the outcome of complex interactions between human behavior, development trajectories, and hazardous agents. The key distinction between the dominant and alternative paradigms lies in the latter's emphasis on the intrinsic connection between disaster risk and societal development (Steckley, 2006). Subsequently, sociologists further advanced the notion that disasters are, in essence, unresolved consequences of development actions and decisions (Quarantelli, 1998b, 1998a). Social scientists' pioneering work revealed that disasters are not solely physical events with devastating consequences, but also socially constructed phenomena shaped by human factors (Webb, 2007). This paradigmatic shift has given rise to a “holistic approach”, offering a more comprehensive understanding by integrating multiple factors, dynamic processes, and complex relationships across various social, technological, physical, and economic systems (McEntire, 2001). In the list of famous sociologists, Max Weber's sociological work (1864-1920) has profoundly impacted theory and social research (Ringer, 2004). Although he didn't directly address disasters, his political sociology has been applied to inform disaster and emergency management. Researchers, such as Shamim (2016), Stallings (2002) and McEntire (2004) have utilized Weber's perspective in disaster studies, revealing key insights into disaster vulnerability. Specifically, they have found that culture significantly contributes to vulnerability, exacerbated by weak institutions, lack of professionalism, and ineffective land use regulation and disaster response. Additionally, social inequalities, including class, status, power, wealth, gender, ethnicity, religion, and age, increase vulnerability, which can be examined through Weber's conflict model. Furthermore, organizational behaviors and interests also create vulnerability, emphasizing the need for clear authority, control, and collaboration among agencies. Overall, Weber's work highlights the crucial role of societal factors, including cultural practices, social inequalities, organizational behaviors, and institutional weaknesses in disaster vulnerability.

These theoretical foundations compelled the social scientists to recognize the complexity of disaster risk and subsequently, they shifted their focus toward analyzing the interplay between socio-political and economic systems and vulnerabilities, leading to comprehensive vulnerability management (Pelling & Uitto, 2001). This approach encompasses a comprehensive, multifaceted strategy for disaster risk reduction, aiming to mitigate disaster impacts, enhance resilience, and reduce societal resistance to disasters (McEntire et al., 2002). This analysis highlights that disaster vulnerability stems from a multifaceted interplay of factors, compromising systems' ability to anticipate, mitigate, prepare, absorb, and recover from disasters (Palliyaguru et al., 2014; Eshghi & Larson, 2008 & Wisner et al., 2003). The Pressure and Release model,

developed by Blakia et al. (1994) and later on expanded by Wisner et al. (2003) offers a holistic framework for analyzing vulnerability in societal contexts. This model suggests that vulnerability evolves through the complex interplay of underlying root causes, dynamic pressures, and unsafe conditions, ultimately leading to disaster when a hazardous event occurs. PAR model views disaster risk as the intersection of vulnerability and hazard, emphasizing the dynamic relationship between these factors. Building on Wisner et al. (2003) foundational work, social sciences researchers have deepened their understanding of vulnerability within a comprehensive framework. It states that vulnerability is the unique characteristics and conditions of individuals or groups that determine their susceptibility to natural hazard impacts and their capacity for coping and recovery. Alexander (2013) further refined the concept of vulnerability, emphasizing its socially constructed nature and the critical role of sociopolitical and economic factors in shaping disaster risk through decision-making processes. From this viewpoint, it is evident that major disasters, such as earthquakes, floods, and droughts, were not solely natural phenomena. Their effects varied greatly across different regions due to differences in vulnerability and exposure. For example, the Indian Ocean Tsunami of 2004, resulted in significantly higher disaster-related mortality compared to Hurricane Katrina (Shaw et al., 2006 & Lay et al., 2005). Empirical evidence from the Indian Ocean Tsunami and Hurricane Katrina highlights the disparate mortality outcomes associated with these disasters. Despite Hurricane Katrina's severe economic impact, the proactive measures taken by US civil protection institutions significantly mitigated its effects through timely public information and advisory efforts. Conversely, the death toll is disproportionately higher in poor and developing nations due to inadequate preparedness, limited coverage of early warning systems, limited mitigation efforts, slow disaster response mechanisms, and insufficient public awareness (CDPM, 2013). In contrast, the disaster resilience of developed countries is attributable to a combination of factors, including robust preparedness systems, secure livelihoods, higher income levels, and effective hazard mitigation strategies (IFRC, 2019). Disaster vulnerability in underdeveloped and developing countries is compounded by a range of factors, including weak institutional frameworks, restricted access to services, limited civic participation, inadequate spatial planning, entrenched gender inequalities, and pervasive socioeconomic disparities. These interconnected challenges exacerbate the risk of multiple disasters. The aforementioned factors are inherently linked to societal systems, culminating in severe disaster consequences for communities, including widespread service disruptions and destruction of physical infrastructure. This underscores the notion that natural hazards do not inherently constitute disasters. Instead, disasters emerge from human activities detrimental to the environment and systemic inaction hindering preparedness, mitigation, response, and recovery capacities.

Khyber Pakhtunkhwa Province of Pakistan is prone to various natural disasters, including earthquakes, floods, droughts, heatwaves, and landslides. Despite efforts to enhance disaster management, the province remains vulnerable due to socio-economic, cultural, and governance factors. The existing literature highlights the need to understand the sociological dimensions of disaster vulnerability to develop effective strategies for resilience and risk reduction. This study

addresses this knowledge gap by exploring the complex relationships between social factors, disaster, and vulnerability in Khyber Pakhtunkhwa Province. The study investigates the sociological factors contributing to disaster vulnerability in the study area. The study's objectives are to identify the socio-economic, cultural, physical, and attitudinal factors influencing disaster vulnerability in Khyber Pakhtunkhwa Province and to explore the experiences and perceptions of local stakeholders regarding disaster vulnerability and resilience. The research questions of this study are: What are the socio-economic, psychological, and cultural factors that contribute to disaster vulnerability in Khyber Pakhtunkhwa Province? & How do these factors influence community physical resilience and disaster vulnerability? This study contributes to the understanding of disaster vulnerability in Khyber Pakhtunkhwa Province, informing policy and practice to enhance community resilience and reduce disaster risk. The findings will benefit disaster management authorities and policymakers, local communities, civil society organizations, researchers, and academics in disaster studies and sociology.

Methodology

The present study is qualitative and uses a case study design method to investigate the factors leading to disaster vulnerabilities in the Khyber Pakhtunkhwa province. Case study research is a qualitative methodology employed in social sciences to examine complex issues within bounded systems. Through in-depth investigations utilizing diverse data sources (interviews, observations, documents), this approach seeks to elucidate detailed understandings and foster novel theoretical perspectives (Coombs, 2022). It examines a real-life phenomenon scientifically, exploring its complexities and dynamics within a specific environmental context. This can involve studying an individual, team, organization, event, issue, or unusual occurrence (Ridder, 2017). Complying with the case study protocols, we conducted a detailed literature review on the vulnerability, factors of vulnerability, disaster profile of the study area, and organization responsible for vulnerability reduction in the study area. The literature reviews enabled us to select potential geographical clusters, identify the study population, and develop data collection tools.

Universe and Sample Size of the Study

The selection of the study universe is guided by the nature and scope of the research problem (Creswell, 2014). This study focuses on Khyber Pakhtunkhwa province, examining the factors that lead to disaster vulnerability. The province comprises 35 districts, with 11 identified as highly vulnerable by the National Disaster Management Authority's Relative Severity Index Score (Government of Pakistan, 2024). Within these 11 districts, Districts Nowshera, Swat, Charsadda and Dera Ismail Khan indicate extreme vulnerability. The Provincial Disaster Management Authority has also declared these districts as highly vulnerable to disasters (Government of Khyber Pakhtunkhwa, 2024). These districts were selected as local of the study due to their high severity index scores and history of disaster. In each sampled district, two Union Councils (UCs) were purposively selected based on their vulnerability status, past disaster impacts, and recommendations of the district disaster management units during the interviews. The study population comprises the officials of relevant government departments, NGOs, and

local communities in the targeted four districts. We used a purposive sampling method as a sampling strategy. Participants from the relevant line departments and NGOs were selected considering their roles in planning and executing projects. The distribution of participants across departments reflected their level of engagement in disaster risk reduction. The sample size from these departments was 27 (see Figure 01).

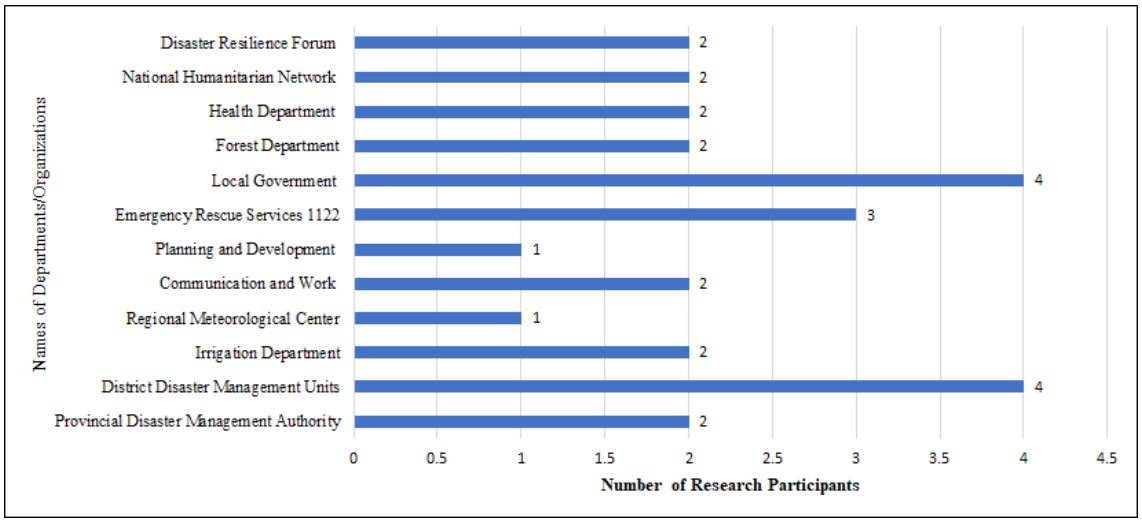

Figure No. 01 Participants from Government Departments & NGOs

Participants from the community were selected through an inclusion criterion i.e., must be local inhabitants, living in hazard-prone locations and affected by the recent disasters (see Figure 02). This approach aligns with Creswell's (2014) guidance on purposeful sampling in qualitative research, ensuring informed perspectives on the research question. Furthermore, the participant's selection was based on the Creswell & Creswell (2018) recommended criteria for case study research i.e., the research environment (setting) that shapes the study, the key individuals or groups (actors) involved, the specific events, activities, or practices (events) being explored, and the dynamic and evolving processes (process) that unfold over time.

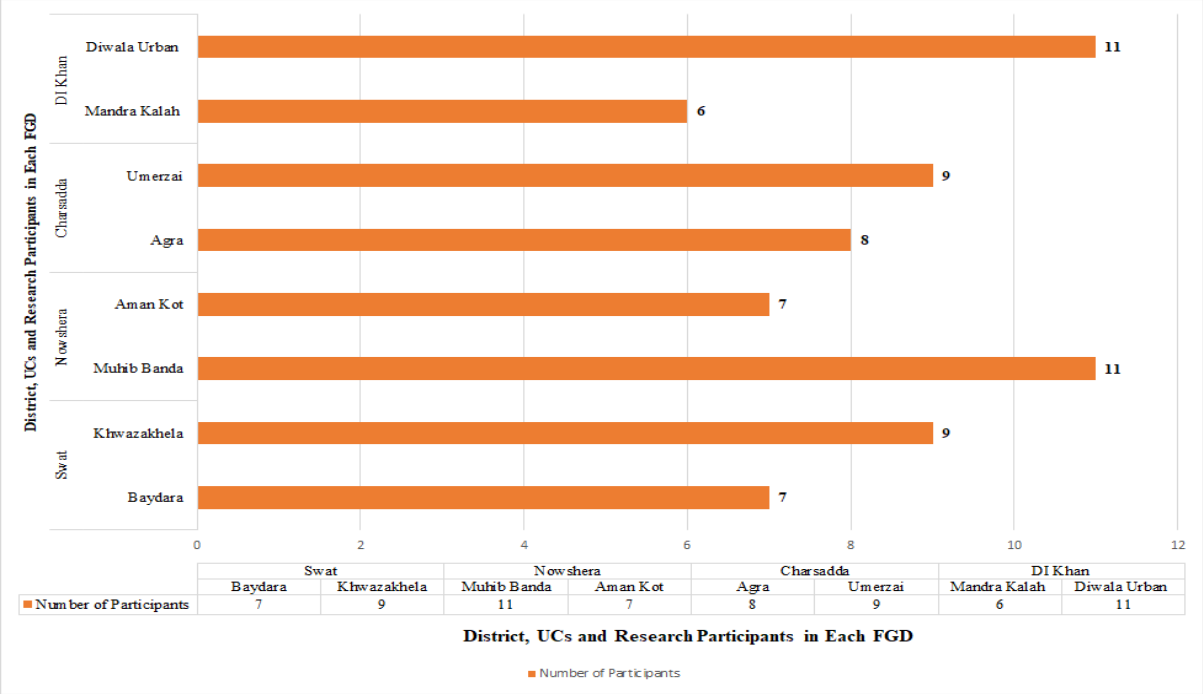

Figure No. 02 Details of FGDS Participants

Data Collection and Analysis

This study utilized In-Depth Interviews (IDIs) and Focus Group Discussions (FGDs) to gather insights on factors of vulnerability in KP from the official's and local communities' perspectives. The IDI approach was selected due to its effectiveness in exploring perspectives within a sample population on specific issues, programs, or contexts (Neuman, 2014). The number of total IDIs was 27. The FGDs were conducted with communities. This method enabled participants to share their views on a communal platform, allowing researchers to gather authentic insights through cross-view discussions. Following Neuman (2011) guidelines, FGDs were conducted with 6-12 participants to ensure optimal interaction. A total of 8 FGDs was conducted and the total number of research participants in FGDs was 68. Due to cultural restrictions, female participants were not included in the general FGDs. However, to incorporate their perspectives, six key informant interviews were conducted with female research participants, facilitated by a female investigator. The IDIs and FGDs were conducted in the Pashto language.

The thematic analysis method was used for data analysis (see Figure No. 03). To ensure data accuracy, interviews, and FGDs were audio-recorded, transcribed verbatim, and verified against field notes. Transcripts underwent multiple reviews for transcription errors and conceptual consistency. Audio recordings and notes were reviewed repeatedly to gain an in-depth understanding, informing the subsequent coding phase. Coding involved concise labels, unique identifiers, and careful consideration of expected, surprising, and conceptually interesting codes (See Figure No. 04). This process facilitated the identification of major themes, which

were then interpreted and presented systematically. Codes were grouped into themes and then reviewed for consistency. All themes were refined, defined, and named (Figure No. 05). To maintain methodological rigor and trustworthiness, a multi-faceted approach was employed. This comprised verifying transcripts for accuracy, fostering intercoder reliability through regular collaborative researcher meetings, and validating codes through independent comparison. Furthermore, the study's findings were triangulated with existing literature and personal observations, thereby enhancing validity and reliability.

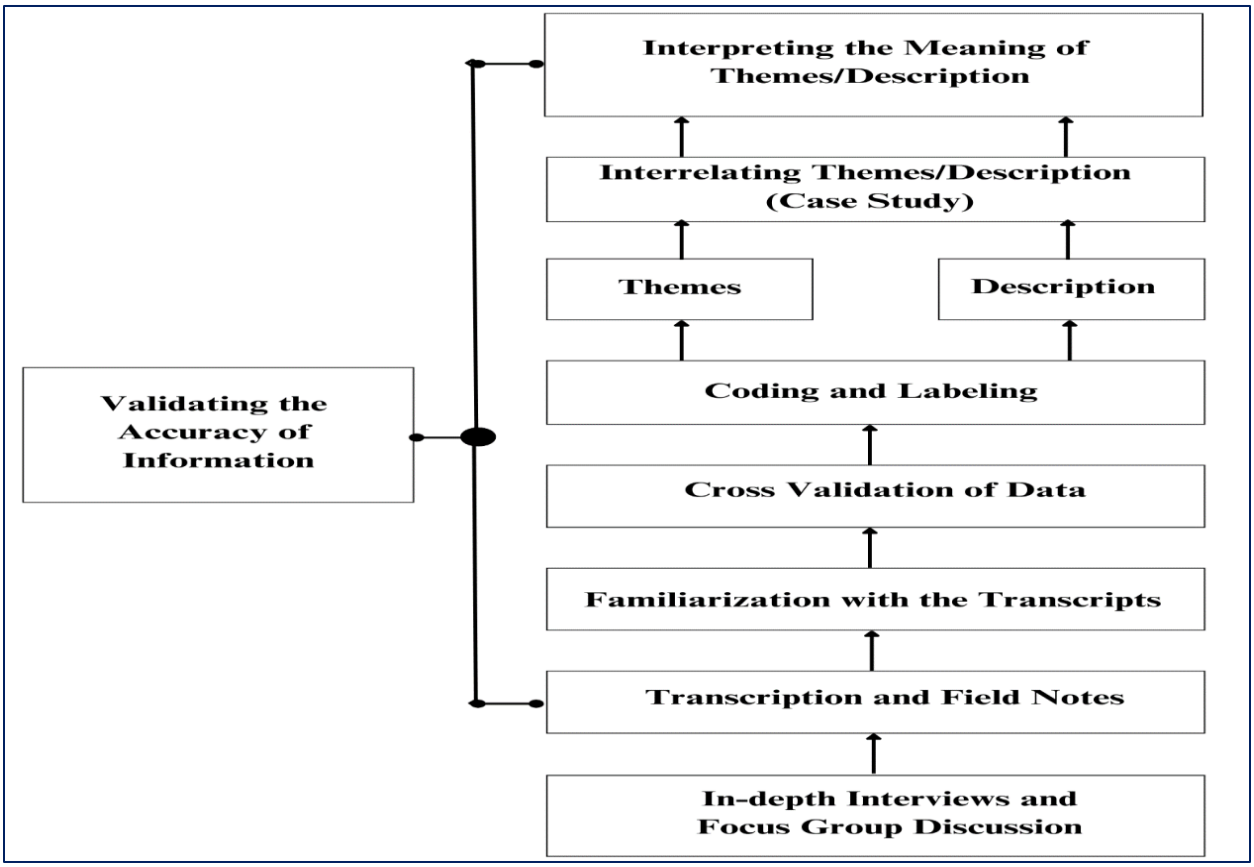

Figure No. 03 Methodological Framework

By integrating these measures, the research ensured a robust and credible analytical framework. Team-based research benefited from regular collaborative meetings, shared analytical insights, and intercoder reliability measures, including code validation through independent comparison. By adopting these measures, the study ensured methodological integrity, fostering confidence in the analysis and minimizing biases and errors. To enhance depth and validity, qualitative findings were triangulated with existing literature and personal observations through comparative analysis. This study upheld rigorous ethical standards, aligned with thematic analysis principles. Participants provided informed consent, understanding the study's objectives, data use, and academic purpose, with the freedom to withdraw at any stage. The researcher protected respondents' rights by using inclusive language, maintaining

confidentiality, ensuring anonymity, and employing culturally sensitive data collection methods. Government participants' confidentiality concerns were addressed, and their information was safeguarded.

Data	Code
Well, firstly, our province is located in a seismically active region, making us prone to earthquakes. Additionally, climate change has led to more frequent and intense floods, snowstorms, Droughts, and heatwaves. We've faced many floods and earthquakes here.	Seismic activity, climate change Floods, Earthquakes, Droughts and Heatwave
The 2010 and 2022 floods were devastating. People were displaced Many homes were destroyed, and people lost everything including crops.	Displacement, Houses Damages and Livelihoods
Population growth, urbanization, and poverty have led to informal settlements in high-risk areas. Lack of awareness, inadequate infrastructure, and poor disaster preparedness exacerbate the situation.	Population growth, urbanization, poverty
Weak institutional capacity, inadequate funding, and lack of coordination among stakeholders hinder effective disaster management.	Weak institutional capacity, inadequate funding
Rising temperatures, changing precipitation patterns, and increased frequency of extreme weather events increase flood and landslide risks.	Rising temperatures, changing precipitation patterns
Awareness, passivity, Inadequate drainage systems, poorly constructed buildings, and lack of early warning systems increase disaster risk.	Inadequate drainage, poorly constructed buildings, Fatalism, Lack of Awareness
Enhanced governance, community-based disaster risk reduction, climate-resilient infrastructure, and improved early warning systems are crucial.	Enhanced governance, community-based initiatives, climate-resilient infrastructure

Figure No 04. Code Identification

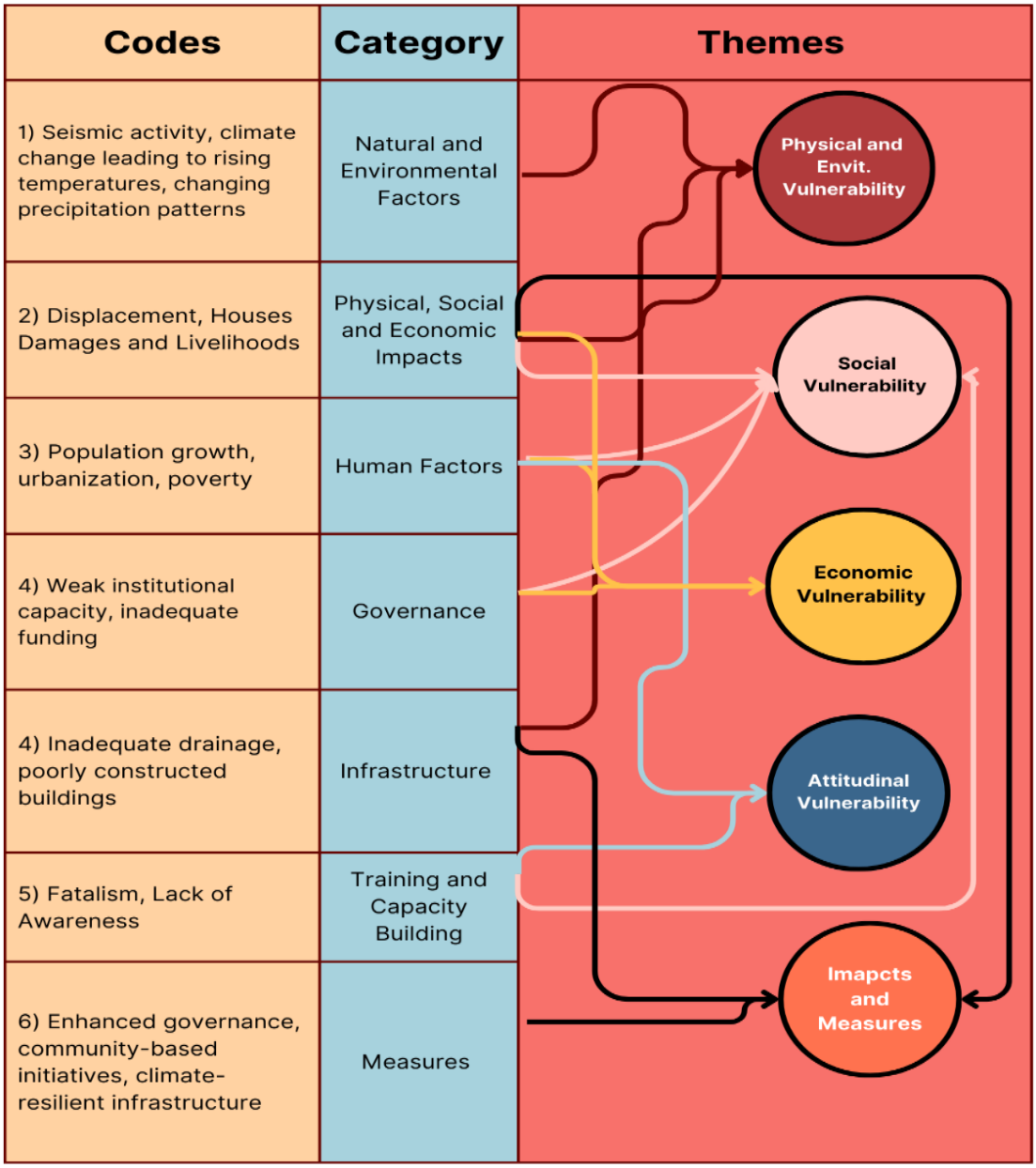

Figure No 05. Code Labeling and Themes Identification

Results

Khyber Pakhtunkhwa's diverse geography gives rise to unique disaster vulnerability patterns. The region's distinct topographical zones - northern mountainous regions, central floodplains, and southern arid districts exhibit varied vulnerability profiles. Through field research and stakeholder consultations, this study identifies four key components of disaster vulnerability: social, physical, economic, and attitudinal factors. These components are shaped by the region's topography, with different hazard types prevalent in each location.

Factors of Social Vulnerability

Social vulnerability is characterized by the reduced capacity of communities, societies, and individuals to withstand disaster impacts due to factors such as inequality, social exclusion, powerlessness, and weak governance (Ciurean, Schröter, & Glade, 2013; Adger, 2006; Bara, 2010; Schmidtlein, Deutsch, Piegorsch, & Cutter, 2008; Wisner et al., 2003). In the study area, research participants identified several underlying causes of social vulnerability, including unequal community participation, limited access to resources and power, illiteracy, social stratification, high dependency, weak ties with government agencies, insufficient disaster risk reduction knowledge, and short-sighted planning. These factors collectively exacerbate the vulnerability of communities to disasters. A District Disaster Management Unit representative shared similar concerns, emphasizing the need to address these underlying issues.

"Social capital supports emergency response in local communities, yet marginalization and unequal access to resources intensify disaster vulnerability. Resource constraints and reliance on political leaders hinder agencies' ability to engage with the general public."

In the study area, deep social capital and networks enable local communities to provide mutual support during disasters and emergencies. Before external aid arrives, family bonds, neighborhoods, brotherhoods, and volunteerism facilitate community survival. These networks serve as the primary resources for response and recovery efforts. Harnessing their potential can significantly reduce vulnerability. This finding aligns with research on Cyclone Pam ((Vachette, King, & Cottrell, 2017), Zurita et al., (2018) study in Australia and Allen (2006) study in the Philippines. While social connectivity ensures safety and security, decisions leading to exclusion exacerbate social vulnerability. A study participant from the local community in FGD said:

"Grassroots marginalization silences vulnerable voices, while stakeholders prioritize political interests over community engagement, hindering vulnerability reduction."

Restricted community participation in DRR projects heightens disaster vulnerability in the study area. This finding aligns with a Aslam (2018) study on Pakistan flood management, highlighting inadequate community involvement in risk reduction. Park (2015) similarly notes underrepresentation and ineffective participation. In the study area, political elites dominated DRR project inclusion, restricting grassroots decision-making and increasing vulnerability among marginalized groups. Gopalakrishnan & Okada (2007) stresses the importance of inclusive decision-making processes, beginning at the local level, to build and create resilience.

Furthermore, societal stratification and inequality intensify vulnerability, which is compounded by the exclusion of marginalized groups from participating in critical processes such as vulnerability assessments, planning, and project implementation, thereby perpetuating their vulnerability. This underscores the importance of ensuring inclusive and equitable access to these programs. A community-level research participant said:

"Government officials' visits to our community typically exclude the majority, as local leaders neglect to inform and involve the wider population in the feedback process."

Research suggests that socioeconomic factors, including gender, age, race, poverty, wealth, and ethnicity, play a crucial role in determining vulnerability to natural hazards, ultimately affecting disaster outcomes and recovery (Tierney, 2006; & Bolin & Kurtz, 2018). Specifically, deep-rooted social and economic inequalities exacerbate vulnerability, while gender-based discrimination limits women's involvement in decision-making processes, increasing the marginalization of already vulnerable groups. Women's excessive workload, unmet specific needs, and new forms of discrimination during crises, such as girl-child marriages and limited access to healthcare and education, increase their vulnerability to disasters in the study area. A female research participant from the local community said:

"Despite efforts by various agencies to promote disaster awareness through community-level training, women in our village were largely overlooked, as these initiatives mainly engaged male community members. Nevertheless, we acknowledge the vital role education plays in enhancing disaster preparedness. By acquiring knowledge about disaster causes and safety measures, we can empower ourselves and effectively educate our children, thereby fostering a culture of resilience."

Another female research participant working in an NGO in Dera Ismail Khan said:

"Women face many hurdles in disasters. In the predisaster phase at the community level, their involvement is restricted to disaster risk reduction and resilience-building initiatives. During disasters, they are deprived of access to early warning messages and information on safe evacuation routes and sites. In post-disaster, they face violence, harassment, and exposure to diseases compromising their pre and post-natal health."

These findings underscore the disproportionate impact of disasters on women, highlighting the multifaceted hurdles they encounter across the disaster management cycle. Before disasters, women's participation in community-level disaster risk reduction and resilience-building initiatives is limited, restricting their potential to contribute to mitigation efforts. During disasters, women face significant barriers to accessing critical information, including early warning messages and safe evacuation routes. This lack of access exacerbates their vulnerability, compromising their safety and well-being. In the post-disaster phase, women are exposed to heightened risks of violence, harassment, and disease outbreaks, which severely compromise their physical and mental health, particularly during pregnancy and postpartum periods. Socio-economic, cultural, and political contexts may vary across societies, but practices perpetuating gender inequality universally increase women's exposure and vulnerability to disasters, resulting in higher mortality and morbidity rates. In Khyber Pakhtunkhwa, social vulnerability is heightened by a combination of factors, including feudalistic social structures, male dominance, lack of coordination and accountability, corruption, and complex social hierarchies. Furthermore, top-down bureaucratic governance, limited awareness, patriarchal norms, and the absence of community-based organizations exacerbate these vulnerabilities. To effectively mitigate these risks, establishing a culture of inclusive disaster risk reduction is crucial, emphasizing the need for a multifaceted approach that addresses these underlying societal issues.

Factors of Economic Vulnerability

Economic vulnerabilities exacerbate social and physical vulnerabilities. Shifting from a hazard-centered approach to a resilience-focused perspective reveals that disasters result from underlying social and economic conditions. The severity of community impacts is directly influenced by the intersection of hazardous events and underlying economic vulnerability Noy & Yonson (2018); Cannon (2000). In the study area, livelihoods are divided between agriculture, livestock, horticulture, small industries, commerce, foreign remittances, and public services. According to research participants, economic vulnerability stems from several interconnected factors, including widespread poverty, limited economic diversification, social disparities, fragile livelihoods, high dependency ratios, irregular employment opportunities, and a prevalence of unskilled labor. Poverty, in particular, has a pervasive impact, permeating every aspect of life in the study area and exacerbating economic instability and disaster vulnerability. This reality was underscored by a local female resident, who noted:

"As a mother of five, I live in constant fear for my children's safety. Our small, two-bedroom adobe house is on the verge of collapse, especially during heavy rainfall. Having lost my husband in the 2022 floods, I struggle to make ends meet and cannot afford the necessary repairs. He was swept away by the floodwaters while trying to salvage timber, leaving me as the sole caregiver for our three daughters and two sons."

Poverty drives local communities to settle in risky locations, hindering their ability to build resilient homes and exacerbating vulnerability to disasters. Furthermore, it reduces their purchasing power, limiting investments in essential services like education and healthcare. As a result, families have been trapped in debt bondage and struggle with malnutrition, rendering them even more susceptible to disaster impacts. This vicious cycle of poverty ultimately intensifies the devastating consequences of disasters. A study participant from a local community in an FGD said:

"Every night, I worry about finding work tomorrow. Three days without employment means starvation for my family. We've relied on neighbors' charities and loans from relatives, but those options are dwindling due to my limited income and unpaid debts."

Khyber Pakhtunkhwa's poverty headcount ratio stood at 48% in 2018. According to the World Bank and United Nations (2010), in developing contexts, such as Pakistan, poverty-stricken communities are disproportionately vulnerable to disasters due to financial constraints and elevated expenditures. This vulnerability generates a recursive feedback loop, exacerbating poverty and hindering socioeconomic development, thereby impeding effective poverty alleviation strategies (Sawada & Takasaki, 2017). In the study area, unemployment and unskilled labor face significant challenges both before and after disasters. The absence of formal mechanisms to mobilize unskilled labor towards daily wage-earning opportunities severely restricts individuals' capacity to earn a livelihood and invest in family security. An interviewee from PDMA said:

"Poverty prevents communities from building disaster-resilient homes in safe locations, due to two primary barriers: lack of awareness about engineered construction technologies and insufficient financial resources to cover construction costs. As a result, vulnerable populations are forced to settle for inadequate housing, exacerbating their risk to disasters."

Raising awareness about hazard-resistant construction technologies may not sufficiently reduce vulnerability in the study area, as these solutions are unaffordable for most residents.

Civil protection agencies must develop low-cost, resilient designs to safeguard communities. The local economy relies heavily on agriculture, horticulture, livestock, and fisheries. Key crops in Charsadda and Nowshera include wheat, maize, sugar cane, tobacco, vegetables, and fruits, while Swat focuses on horticulture, rice production, remittances, and tourism, whereas very little area in DI Khan is fertile either due to lack of water scarcity or salinity. However, these livelihoods are highly susceptible to climatic and non-climatic stresses. Due to its geographical location, the region is inherently vulnerable to hydro-meteorological events such as floods, heavy rainfall, storms, and hailstorms. Climate change compounds these agricultural challenges, leading to increased incidence of crop diseases, reduced yields, and pest outbreaks. As one resident in FGD emphasized:

"I planted wheat and sugar cane, but my harvest was devastated by excessive rainfall. Just as the wheat was ripe, floodwaters inundated my fields for over a week, ruining my crop and leaving me with a significantly lower yield than anticipated."

Local communities in the area have been severely impacted by extreme weather patterns, including prolonged droughts, erratic heavy rainfall, rising temperatures, and intense snowfall, which have collectively disrupted their livelihoods. An interviewee from the Forest Department said:

"Climate change alters weather patterns, disrupting crop cycles and optimal growing conditions. Rising temperatures introduce pests and locusts to mountainous areas, threatening fruit crops and exacerbating food insecurity and economic strain on vulnerable families."

Most farmers in the study area rely on seasonal crop yields and fruit harvesting for their livelihood, a vulnerability that aligns with findings from previous research studies by Ali & Erenstein (2017) and Israr et al. (2016), highlighting climate change and variability as significant barriers to poverty alleviation and food security in Pakistan. Agriculture drives the national economy, employing 43% of the workforce and contributing 20% to GDP. However, farmers face significant challenges, including inadequate storage, exploitative market practices, limited agricultural support, high input costs, and costly transportation. Furthermore, middlemen often exploit farmers by buying products at low prices, exacerbating their economic struggles (Siddiqui, 2017). The study area lacks large-scale industries, with only a handful of small-scale cottage industries operating in carpentry, handloom (producing traditional items like shawls, caps, waistcoats, and woolen coats), jaggery production, and embroidery. These local products have limited market reach, with most sales occurring locally, except for Swat's handloom products, which are supplied nationally. Notably, a sugar mill in one of the sample districts, once employing over 2,000 people, was shut down three decades ago, despite the district's significant sugarcane production. This economic vulnerability exacerbates local communities' exposure and compounds other vulnerabilities. This finding aligns with Sardar et al. (2016) study, which explored the relationship between disasters and Pakistan's economic growth.

Factors of Physical Vulnerability

In addition to social vulnerability, physical vulnerability plays a critical role in exacerbating disaster exposure for local communities in the study area, with geographic proximity to hazard sources being a key determining factor. Research participants consistently cited several factors contributing to physical vulnerability, including fragile physical environments, inadequate building codes, poor construction practices, encroachment, and ineffective land use planning. Furthermore, the lack of hazard-resistant technology, overexploitation of natural resources, and insufficient basic services such as emergency

response, healthcare, education, sanitation, roads, electricity, and communication networks – compound the risk. These interconnected factors underscore the need for a comprehensive approach to mitigating physical vulnerability and enhancing disaster resilience in the region. An interviewee from the Local Government Department said:

"Malakand division's unique geological and geomorphological characteristics make it highly vulnerable to natural hazards, human-induced disasters, and climate change impacts. Regrettably, a substantial population occupies hazard-prone areas, with housing stock often situated in earthquake-sensitive locations, including fault lines, unstable mountainous slopes, and floodplains."

Our research supports the conclusions drawn by Saleem (2013) in Northern Pakistan and multiple government reports (Government of Khyber Pakhtunkhwa, 2010, 2014, 2019a), which identifies the fragile physical environment and infrastructure as key factors contributing to disaster vulnerability.

The complex physiography and lack of effective land use planning force residents to occupy unsafe locations. This study's results also corroborate Mustafa (1998) research on structural vulnerability to flood hazards in Pakistan. The study area's natural and built environment is exceedingly fragile, having suffered from droughts, floods, landslides, and earthquakes. Despite centuries-long habitation, the area's resilience has been compromised by deforestation and the replacement of traditional wooden structures with concrete buildings, exacerbating local vulnerability. An interviewee from the Communication and Works Department said:

"The region relies heavily on local masonry practices, which are largely uninformed about disaster risk and vulnerability. Untrained masons assume multiple roles, designing, building, and constructing without adherence to safety standards. Government building codes are poorly enforced, primarily applying only to public sector projects. As a result, community buildings and homes lack essential engineering measures, leaving them exposed to hazards."

Substandard construction practices and limited awareness of disaster mitigation strategies prevail in the study area, compounded by the financial inaccessibility of hazard-resistant technology for many residents. These factors have resulted in high damageability of housing units during past disasters. Our findings on structural vulnerability align with studies in the Dominican Republic and Venezuela (Doberstein & Stager, 2013); Sindh Pakistan (Mustafa et al., 2019), and Asef (2008) earthquake vulnerability modeling. Local government departments in the study area face considerable difficulties in implementing and enforcing building codes and land use planning regulations. A research participant in the study area in FGD said:

"Despite knowing the risks of future floods and earthquakes, we lack alternative land and financial resources to rebuild elsewhere, and the government has failed to provide relocation assistance, leaving us in vulnerable conditions."

Relocating entire communities is a complex challenge requiring meticulous planning, encompassing not only the identification of safe sites but also the provision of economic and livelihood opportunities. The strategic selection of construction sites plays a crucial role in safeguarding populations. This study's findings align with research conducted by Wasim &

Khalidi (2018) on Pakistani construction practices. Additionally, Mehmood et al. 2012) emphasize the importance of strict building code enforcement, public awareness, and vulnerability assessments based on earthquake return periods. Moreover, physical vulnerability is exacerbated by faulty construction practices and river encroachment, underscoring the need for comprehensive solutions addressing both structural and environmental factors. A research participant from the local community in FGD said:

"Despite existing laws and regulations prohibiting construction in riverbeds, riverbanks, unstable slopes, and roadside areas, government officials fail to enforce these restrictions, allowing encroachment to occur unchecked"

Field observations revealed that high-rise buildings, including hotels, have been constructed on unstable slopes and riverbanks, despite the risks. Research participants reported that many of these structures were destroyed by previous floods, and rebuilt at the same vulnerable locations again. This highlights the government's inaction in enforcing construction bylaws. Studies by NDMA (2012, 2015) and Khan (2011) validate these findings, identifying encroachments in drainage systems, irrigation channels, and rivers as well as inadequate land use planning, as primary causes of physical vulnerability. Specifically, Khan's research highlighted river encroachment along the Swat and Kabul Rivers are the main reason for exacerbating flood vulnerability in Khyber Pakhtunkhwa. Furthermore, the study area lacks essential services, including emergency response, healthcare, education, and sanitation, leaving residents highly vulnerable. An interviewee from Rescue 1122 said:

"Although Rescue 1122 operates in all districts, its coverage is incomplete, lacking stations in every location, which hinders our ability to meet the government-mandated seven-minute response time. Effective emergency management demands a multifaceted approach, requiring specialized personnel, equipment, and machinery. To enhance public safety, I firmly believe that establishing additional stations and equipping each one with necessary facilities is crucial."

The lack of technically trained rescuers poses a significant threat to public survival during emergencies, both small and large levels. Furthermore, the widespread deforestation in the area exacerbates physical vulnerability, compromising the safety and resilience of local communities. An interviewee from the Forest Department said:

"Deforestation persists despite strict regulations and community engagement, reducing forest cover, increasing soil erosion, and flooding downstream communities."

A community participant in the FGD discussed the lack of forestation and the effect of deforestation on their community and said:

"Our district i.e., DI Khan consists of desert patches. On one side we experience severe flash floods from Dara Pezo and Dara Zinda's sides due to weak forest cover. On the other side, the government is failing to plant species of trees compatible with the local environment."

Another research participant in the same area in another FGD said:

"We hear too much about the tsunami tree project by the government. Pictures are shared on social media about the plantation in our area but I can't see any impact on the

ground. Our area was arid and barren and it is still arid and barren. Wondering where the plantation occurred."

These findings highlight the persistent challenge of deforestation in the research area, despite stringent regulations and community engagement efforts. Deforestation consequences include reduced forest cover, increased soil erosion, and downstream flooding. Notably, community participants emphasized the inadequacy of forestation initiatives, stressing the need for tree species compatible with the local environment. A disconnect between government claims and on-the-ground realities was also evident, with participants expressing skepticism about government-led projects, such as the "Tsunami Tree Project," due to a perceived lack of tangible results. The findings identify key barriers to sustainable land use, including inadequate forestation, incompatible tree species, insufficient community engagement, and discrepancies between government claims and realities. Dense forests and green cover are crucial for mitigating soil erosion, siltation in rivers and dams, and air pollution. The extensive root systems in these areas facilitate groundwater percolation, reducing surface water flow and the likelihood of flash and riverine floods. This, in turn, minimizes soil erosion and siltation, safeguarding water storage capacity and preventing inundation of surrounding areas. Soil erosion, however, can lead to siltation, reducing water storage capacity and causing flooding, which damages livelihoods and housing units in the study area. These results align with research studies conducted in Korea and Indonesia. For instance, Myeong (2014) study found a direct correlation between flood vulnerability and deforestation. Similarly, Rijal et al. (2019) reported that deforestation exacerbates climate change impacts, biodiversity loss, and disaster incidence in Indonesia. To mitigate disaster risk, particularly flash flooding, policymakers should develop context-specific forestation strategies, engage local communities in tree planting and maintenance, ensure transparency and accountability in government initiatives, and monitor project effectiveness.

Furthermore, inadequate communication and transportation infrastructure hinders local access to vital information and impedes the government's ability to efficiently conduct rescue and relief operations. An interviewee from the District Disaster Management Units said:

"Districts Charsadda and Nowshera are easily accessible, but District Swat posed significant challenges. The roads in upper Swat are extremely narrow and winding, making travel difficult. To make matters worse, heavy snowfall in winter and erratic showers in summer often cause landslides or flash floods, damaging roads and disrupting connectivity"

The tragic events of 2018 underscored the urgent need for improved infrastructure in remote areas, particularly after government officials lost their lives attempting to reach local communities during heavy snowfall, highlighting the dire consequences of inadequate road networks. This lack of accessibility not only hampers officials' ability to provide essential services but also jeopardizes the safety of entire communities. In emergencies, responders face significant obstacles in locating and rescuing individuals, exacerbating rescue efforts, while inadequate transportation and communication infrastructure puts lives at risk, making timely access to humanitarian aid difficult. To address these challenges, extending a comprehensive

network of roads to remote areas is crucial, facilitating officials' access and ensuring communities receive vital services and aid when needed. By prioritizing infrastructure development, we can mitigate emergency response risks and safeguard the well-being of both officials and local communities, as emphasized by researchers Richards (2015) and Pelling & Mustafa (2010).

Factors of Attitudinal/Motivational Vulnerability

Attitudinal and motivational vulnerabilities are deeply rooted in the social and economic circumstances of individuals and communities. These vulnerabilities stem from people's perceptions about disaster causes and impacts, influencing their actions and decision-making. Factors such as awareness, religious beliefs, and past crisis experiences shape these perceptions (UNDP, 2017). Research participants identified fatalism, negative perceptions towards change, passivity, hopelessness, and lack of psychological resilience as drivers of attitudinal vulnerabilities. Most residents exhibited a fatalistic attitude toward disasters, attributing them to supernatural forces beyond their control. A participant from the irrigation department noted:

"Through my interactions with local communities during project feasibility studies and river surveys, I consistently encountered a submissive attitude toward flood risks. When asked about the potential consequences of flooding due to their home's proximity to the river, residents often responded with a fatalistic view, attributing floods to divine will, saying: 'Floods are from God, and when it happens, we'll see what happens."

While heavy rainfall is indeed a natural phenomenon beyond human control, the resulting floods and community inundation can be prevented or mitigated. The root cause of flooding lies in the absence of effective measures such as large reservoirs and protective walls. Dams can regulate water flow in rivers, and protection walls can prevent water from entering communities. However, a lack of public awareness often leads to misconceptions about disasters, perpetuating a sense of powerlessness. A research participant from the local community said:

"Although I'm unfamiliar with the scientific basis of earthquakes, I remember a childhood myth. It described the earth resting on two bull horns, with earthquakes occurring when the earth shifts from one horn to the other. This traditional explanation has always captivated me."

The study area's residents, lacking knowledge of plate tectonics and fault line activation, attribute earthquakes to alternative explanations. This finding aligns with Yari et al. 2019) study in Iran, which similarly revealed a fatalistic attitude toward earthquakes. These myths constrain critical thinking and often blind individuals to logical explanations for natural hazards, perpetuating reliance on unsubstantiated beliefs. A research participant from the local community said:

"About a decade ago, a devastating avalanche struck our village, claiming my wife's life and damaging my home. Locals believe the forest is inhabited by supernatural beings, Jinnat. According to traditional belief, when severe weather enrages them, they trigger massive snow

movements, uprooting trees and unleashing avalanches. I vividly recall the avalanche's deafening roar and glimpsing figures within the foggy cloud that enveloped our village."

A prevalent myth exists among Upper Swat's glacier-adjacent communities, particularly nomads. Nevertheless, scientific evidence suggests that snow accumulation and gravitational forces, rather than mystical factors, triggered the avalanche. Another research participant from the community said:

"I was taught to tug on my pajamas during earthquakes to cleanse myself of sins, a habit I still maintain."

Islam does not recognize such concepts, and there is no theological basis for them in published literature. A clear understanding and positive attitude enable individuals to comprehend disaster dynamics and take proactive measures to safeguard themselves and their communities. Having a positive attitude encourages people to translate intentions into tangible actions. An interviewee from PDMA said:

"The government and formal institutions overlooked disaster risk reduction for decades, enhancing public ignorance and myth-based beliefs. Correcting these false perceptions remains a significant hurdle in our consultation efforts."

Before the 2005 earthquake, Pakistan's disaster management approach was largely reactive and ineffective, failing to shift societal attitudes toward vulnerability and risk reduction. This has created significant challenges for government officials and civil society organizations in implementing civil protection programs. Research by McClure (2017) highlights that a fatalistic view of disasters prevails, stemming from a flawed mental model that attributes damage to uncontrollable natural forces rather than preventable human actions.

Discussion

The study's findings underscore the critical role of social vulnerability in exacerbating disaster impacts, highlighting the interplay between unequal community participation, limited access to resources and power, illiteracy, social stratification, and weak governance. These factors, continued by restrictive elite dominance, societal stratification, and gender-based discrimination, intensify vulnerability among marginalized populations. Local social capital and networks, essential for community resilience, are often undermined by exclusionary decisions. Physical vulnerability amplifies disaster exposure in the study area, wherein geographic proximity to hazard sources, fragile physical environments, inadequate building codes, poor construction practices, encroachment, and ineffective land use planning converge to exacerbate risk. Notably, faulty construction practices, river encroachment, and weak enforcement of building codes and land use planning regulations compound physical vulnerability. Additionally, deforestation and the replacement of traditional wooden structures with concrete buildings compromise resilience, while inadequate essential services (emergency response, healthcare, education, and sanitation), communication, and transportation infrastructure inadequacies further heighten vulnerability. This study also highlighted the critical intersection of economic vulnerability and disaster risk, where widespread poverty, limited economic diversification, and

social disparities perpetuate a cycle of vulnerability. The study area's economy is heavily reliant on agriculture, livestock, horticulture, small industries, commerce, foreign remittances, and public services. Poverty drives communities to settle in risky locations, reduces purchasing power, and limits access to essential services, trapping families in debt bondage and malnutrition. Unemployment and unskilled labor face significant challenges, while climate change compounds agricultural vulnerabilities, increasing crop diseases, reduced yields, and pest outbreaks. Besides, fatalism, negative perceptions, passivity, hopelessness, and lack of psychological resilience converge to shape disaster risk perceptions and behaviors, continuing a sense of powerlessness and hindering proactive mitigation measures. The prevalence of fatalistic attitudes, misconceptions, and cultural influences underscores the need for targeted interventions promoting public awareness, critical thinking, and evidence-based understanding. Past crisis experiences reinforce myth-based beliefs, while socio-economic circumstances perpetuate these vulnerabilities. Figure No 05 provides summarized factors of all four types of vulnerabilities.

To effectively mitigate disaster vulnerability, a comprehensive approach is necessary, addressing structural, environmental, social, and economic factors. This involves establishing a culture of inclusive disaster risk reduction, ensuring equitable access to programs, promoting grassroots decision-making, and empowering marginalized groups. Key strategies include enforcing building codes, reforestation, investing in essential services and infrastructure, promoting public awareness and education, economic diversification, poverty alleviation, and climate-resilient agriculture. Additionally, fostering community resilience, psychological resilience-building, and critical thinking are crucial. By prioritizing infrastructure development, environmental protection, education, and community engagement, disaster risk reduction efforts can transition from reactive to proactive, ultimately saving lives and reducing disaster impacts.

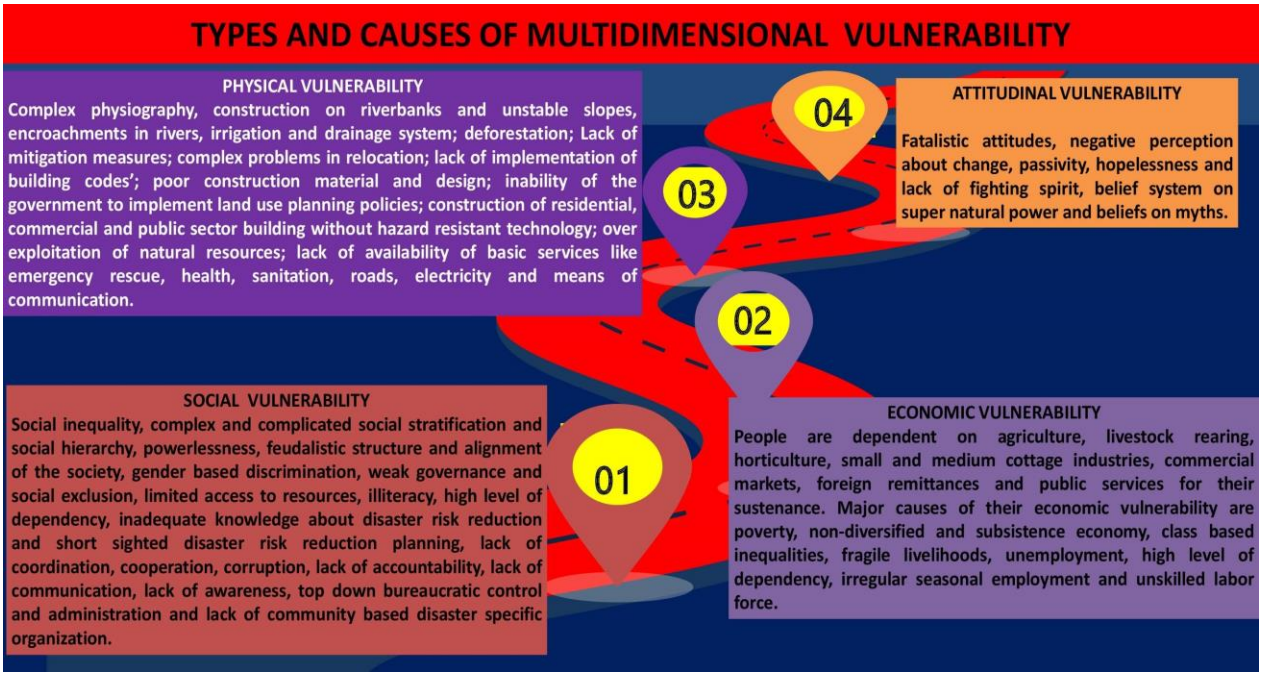

Figure No 05: Factors of Different Types of Vulnerabilities Identified in this Study

Conclusion

The present study contributes to the understanding of disaster vulnerability in Khyber Pakhtunkhwa, Pakistan, highlighting the complex relationship between disasters, vulnerabilities, and sociological factors. Social vulnerability, characterized by entrenched poverty, inequality, and social exclusion, intersects with physical vulnerability, marked by fragile environments and inadequate infrastructure. Attitudinal/motivational vulnerability, influenced by fatalism, misconceptions, and cultural/religious factors, further compounds disaster risk. A comprehensive approach addressing these factors through social protection, infrastructure development, and public awareness is imperative. Policy implications include strengthening institutional capacity, enhancing community engagement, and promoting culturally sensitive strategies. Future research directions include exploring climate change impacts, gendered dimensions, and context-specific frameworks to inform disaster risk reduction efforts, ultimately building resilient communities and promoting sustainable development.

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