FLOOD VULNERABILITY OF YOUNG AND ELDERLY PEOPLE: A CASE STUDY OF RURAL AREAS OF MARDAN, PAKISTAN.

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This thesis is dedicated to my parents, my family, and my respected teachers!

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ABSTRACT

In August 2010, an extreme flood occurred in Pakistan, causing catastrophic havoc in the number of fatalities and economic losses. The study presents the vulnerability of young and elderly people in floods since the elderly people are more vulnerable and have a higher degree of fragility during emergency and evacuation than young people. However, elderly people are often ignored in disaster preparedness, response, recovery, and mitigation. Very few and inadequate research literature is available to assess the vulnerability of elderly and young people in Pakistan. The aim of this study is to assess the vulnerability of both elderly and young people in the context of floods; a flood is one of the most major hazards causing disasters in Pakistan. This study examines the flood risk perceptions of young and elderly people, evaluates the institutional barriers to effective disaster risk reduction of elderly and young people, and suggests an integrated framework for the vulnerability assessment of young and elderly people. The young and elderly both can play a significant role in disaster risk reduction. Questionnaire surveys, in-depth interviews and publications of various national and international disaster management institutions are used for data collection. The outcome of this study can be used by various organizations in Pakistan for effective Disaster Risk Reduction of young as well as elderly people.

Key Words: Vulnerability, Flood risk perceptions, Young and Elderly people, Disaster risk reduction.

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LIST OF ABBREVIATIONS

ISDR	International Strategy for Disaster Reduction
UNDRR	United Nation Office for Disaster Risk Reduction
DRR	Disaster Risk Reduction
WCDR	World Conference on Disaster Reduction
MDA	Mardan Development Authority
TMA	Tehsil Municipal Authority

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CHAPTER 1

1. INTRODUCTION

Due to its unique physical and geographical location, the distribution of population, and the socio-economic condition of Pakistan make it vulnerable to floods (Mustafa, 2003). The relatively poor economic condition of Pakistan limited its citizen ability to prepare, advance, and evacuated from possibly dangerous flood conditions and individuals' ability to cope with the aftereffect of disasters. In Pakistan, the individuals have lessened resources accessible through the time of needs, and the government have fewer technological abilities to warn its citizens in floods (Mustafa, 2003).

In developing countries, most disasters occur, but in the past decade, due to growing threats of a flood, terrorist threat, and air calamities, the preparedness and response to disasters are increasing global attention. The ageing population is growing globally, and a substantial proportion of the elderly population is at risk. Most of the deaths in developing countries, approximately 6000 people in a year die due to disasters, due to lack of poor infrastructure, disease, and endemic poverty (Kennedy, 2009).

According to the 2012 report of UNPF, the population of elderly people across developing countries increases rapidly. There are 15 million people aged 60 years in Pakistan, which is about 7% of the total population and will reach 40 million, almost double by 2050 (*Unfpa-Annual-Report-2012*). In addition to this, Pakistan, the 5th largest young country, comprises 63 % of the youth population aged between 15-33 years (*Annual-Report-2017*). Young and elderly requires special attention to minimize the vulnerability to the

expected threats. The age of young adults is 18-35 years, whereas elderly people age is 55 and above (Petry, 2002).

Climate change and global warming are expected to shift in global patterns, temperature, and intensity of flood events. Thus, it leads to enhance the exposure of people to disaster in developing countries. To avoid potential future risk from these disasters, local capacity to cope with these disaster needs intervention and work to strengthen the communities. This study examines the vulnerability, adaptive capacities, risk perceptions, behaviours, and attitudes of young and elderly people in flood-prone areas. It provides an integrated framework to reduce the impacts of floods.

Recent progress in applied and theoretical research shows the vulnerability and adaptive capacity of people who are more prone to floods in developing countries. The vulnerability of hazards due to the environment can be analyzed from a personal to a societal level (Cutter, 1996). Flooding is the overflow of rivers produce due to prolonged seasonal rainfalls, snowmelts, rainstorms, breaking of dam structures, accumulation of rain-water, lower areas having higher water tables, inadequate rainfall water drainage, and the incursion of seawater on-to the land in cyclones (Handmer et al., 1999).

Excessive precipitation is the main reason for flooding in an area. Variations in semi-predictable seasonal rains cause the rise of yearly monsoonal overflows in tropical regions. Flash floods over small basins were created by these seasonal rains (Cardona et al., 2012). Hazard characteristics of hazard like the speed of onset, duration, frequency, and magnitude are affected by factors like topography, vegetation, soil, river passage variations, land use and urbanization. Urbanization, unlike rural areas, worsens flood due to low absorption of rainwater by ground surfaces, thus increasing the runoff rate (Parker,

1999). There are different forms of flooding, from stagnant water-logging of surfaces after rainfall to a catastrophic flood event that exceeds the communities' coping capacity (Handmer et al., 1999). It is essential to know that there is no difference between severe and mild types of flood. The same events affect households and neighbourhood differently depending upon capacities and resources (Ben Wisner et al., 2004).

The working group report, 1 of IPCC, shows that globally there is an expected increase of 4.4^{o}C in average air temperature from 1990-2100 between 1.4^{o}C to 5.8^{o}C (Houghton et al., 2001). From scientific evidence, nowadays, global warming progressively being realized as truth. Therefore the whole world is now pledged to adapt to climate change (Adger, 1999). It is increasingly believed that climate change is expected to increase and cause flood hazards in many regions across the globe. Climate modelling suggests that precipitation will be increasing in some regions, particularly monsoonal regions, accompanied by variations in frequency and intensity of extremes events (McCarthy et al., 2001). Excessive rainfalls, extreme winds, sea levels rise events along with coast rise flood frequency and magnitude in several regions of Asia, Africa, and Latin America (IPCC, 2001). The weather extremes are connected to El-NINO/LA-NINA phenomena and will be rise by variations in climate patterns (Smith, 2013).

1.1 Problem Statement

As the climate is changing worldwide, the magnitude, frequency and severity of floods are increasing. Most developing countries are more vulnerable to climate change and have fewer resources to counter climate change. According to the latest report of CRI (Climate Risk Index), Pakistan ranks 5th as the most vulnerable nation to climate change. During

the period 1998-2010, Pakistan has witnessed 152 extreme events, due to which it lost 9,989 lives and a financial loss of $3.8 billion (David Eckstein, 2019). The nation of Pakistan is facing more and more losses after the floods strike. In 2010, the total number of districts affected by floods in Pakistan was 78, and the most affected were 29 (The Government of Pakistan, 2011). These floods cause severe damage and affected 20 million people. Most of the rural areas in Pakistan are mostly affected by these floods. There is no proper management of disasters like floods in rural areas and are often neglected in government support assistance. Moreover, in the case of the 2010 floods in Mardan, the city of Khyber Pukhtun Khwa affected many people, their houses, and infrastructures. The support assistance from different government agencies, NGO's (Non-Governmental-Organizations) and private organizations during floods are too late to cover the losses.

Both the elderly and young people were severely affected by these floods due to their higher vulnerability. The people use their resources to minimize the threat imposed by floods. The knowledge, skills, and perceptions of vulnerable populations must be reviewed to develop an integrated system responsible for reducing floods. To reduce the impacts of floods, a comparison between elderly and young people must be carried out to know the problems and issues caused by floods. In addition, the government of Pakistan must take effective measures and actual steps designed for lessening the effects of climate variations and make some strategies at the local, regional, and national level to counter these flood events.

1.2 Research Questions

a. How to assess the vulnerabilities and capacities of elderly and young people in floods?
b. What are the risk perceptions of elderly and young people in floods?
c. What are the institutional barriers that affect the disaster risk reduction of the elderly and young people in floods?
d. What are the strategies and measures required for effective disaster risk reduction of elderly and young people?

1.3 Research Objectives

a) To compare the vulnerabilities and capacities of elderly and young people against rural flooding.
b) To compare flood risk perceptions of elderly and young people.
c) To identify institutional barriers affecting disaster risk reduction of elderly and young people.
d) To suggest strategies, measures, and integrated framework for effective disaster risk reduction of elderly and young people.

1.4 Scope

This study analyses the vulnerabilities and capacities of both elderly and young adults at the national, provincial, and local level. A detailed comparison between elderly and young adults affected by floods was discussed in this research. This study also identifies the legal barriers and lack of institutional capacities to reduce the impacts of floods. This research

will provide valuable information to policymakers to better understand the key issues regarding elderly and young adults during floods. Moreover, this research will suggest some useful strategies to different disaster management organizations in Pakistan, ultimately strengthening the communities and institutions. The outcomes of this study can be merged in National Disaster Risk Reduction Policy 2013 and the social welfare department. In the context of Urban and Regional Planning, effective strategies and policies for the elderly and young adults will result in disaster risk reduction to make them more resilient to natural hazards and ultimately leads to sustainable development.

1.5 Justification

The population of the globe is increasing the population of elderly people simultaneously also increases with time. According to the 2012 report of the UNPF (United Nations Population Fund), the population of elderly people across developing countries increases at a rapid pace. In the context of Pakistan, currently, there are 15 million people aged 60, which is about 7% of the total population and will reach 40 million, almost double by 2050 (Scobie et al., 2015). Besides, Pakistan has 64% of young people aged 30 years compared to the total population (UNPF, 2017). So, the young and elderly population requires special attention to minimize the threat imposed by different disasters. Moreover, there is very less known about young and elderly people in disaster preparedness and response. Also, elderly people are more vulnerable to disasters than young populations as they lack mobility, health issues, and less attention given their specific needs during and after disasters. To minimize the vulnerability of the young and elderly a research will be conducted. According to the Government of Pakistan, 20 million people affected, and

2000 were killed in the 2010 floods. Considering it the most devasted flood in the history of Pakistan as it mostly destroyed the property, livelihood, and infrastructure. Therefore, reducing the threat of disasters is essential. The most important thing is to save both young and elderly people's lives as a major portion of the population in Pakistan is young aged between 18-30 years. The reduction of impacts of floods and other natural hazards will lead to sustainable development.

1.6 Conceptual Framework

Figure 1. Conceptual Framework for achieving Sustainable Development.

CHAPTER 2

2. LITERATURE REVIEW

2.1 Natural Hazard

ISDR defined natural hazard as a natural process that can cause a life loss, injury, damage to property, social and economic life, disruption of services, follows:

"Natural procedure, process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage" (ISDR, 2009).

When there is a considerable loss of human lives, social and environmental systems, a hazard becomes a disaster.

2.2 Disaster

Disaster is a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts that exceeds the ability of the affected community or society to cope using its resources (UNDRR, 2009). Disaster involves three components: exposure of a community to the hazards, the vulnerability of the community, and the capacity to reduce or manage the negative consequences of a hazard. The effects of a disaster include the destruction of infrastructure, damage to property, assets, economic disruption, and environmental degradation. Moreover, it affects human lives in terms of injuries and deaths, causes diseases and other adverse effects on human physical, mental and social well-being

(UNDRR, 2009). In developing countries, the cost of the disaster is far greater than in developed countries. More than 95% of all deaths caused by hazards occur in developing countries. The losses due to hazards are 20 times greater in developing countries than in developed or industrialized countries. The impacts were largely dependent on the physical and socio-economic resilience of a community.

2.3 Disaster Risk Reduction

Disaster Risk Reduction (DRR) is a systematic approach to identifying, accessing, and reducing the risks of disasters. According to UNDRR, the primary purpose of DRR is averting new, minimizing remaining disaster risk, and handling residual risk, which ultimately establishes the resilience of a community and, hence, achieving sustainable development (UNDRR, 2009).

2.3.1 **Progress towards DRR**

Since 1970, disaster thinking and practice has evolved to provide a broader and deeper understanding of why disaster occur, as well as more systematic and holistic approaches to mitigating societal impacts by reducing risk before it happens (DRR, or Disaster Risk Management) and managing impacts after disasters occur (Disaster Management). It is largely assisted by international agencies, governments, disaster planners, and civil society organizations (UNISDR, 2004).

2.3.2 **Climate change and DRR**

The rising temperatures, variations in rainfall patterns, and sea-level changes are all due to climate change. It affects the nature of hydrometeorological disasters like droughts, floods, and cyclones. In 2012, Intergovernmental Panel on Climate Change (IPCC) issued

a report on “managing the risks of extreme events and disasters to advance climate change adaptation (CCA)”, stating that climate changes lead to changes in frequency, intensity, and duration of extreme weather and climate events. Accordingly, the economic losses also increase due to weather and climate-related events. In 2018, according to insurance giants Swiss Re., there has been approximately $ 165 billion in economic losses worldwide (Sigma, 2019). Therefore, it is important that both in policy and practice, DRR and CCA should be integrated.

The components of DRR were not clear, and there has been a growing trend that the concepts and components of DRR require clarity. Also, the indicators which progress towards achieving the resilience of communities must be clarified. To achieve the specific goals of DRR and resilience of communities, the international community in Kobe, Japan, in 2005, hold a meeting at the UN’s World Conference on Disaster Reduction (WCDR) only some days after the 2004 Indian Ocean earthquake. The WCDR started pushing the international communities, agencies, and governments towards setting clear goals and commitments for DRR.

2.3.3 **Hyogo Framework for Action (2005-2015)**

The first internationally accepted framework for DRR is the Hyogo framework for action (HFA) and is adopted in 2005. The main objective of HFA is to build the nations and communities resilient to disasters and reduce losses of disasters by the year 2015 substantially. It means minimizing the loss of lives and social, economic, and environmental assets when a disaster strike.

2.3.4 **Sendai Framework for DRR (2015-2030)**

It is an international document; adopted by United Nation's member states in 2015 at WCDR held in Sendai, Japan. The successor agreement to the HFA, which had been the most encompassing international accord to date on DRR. The Sendai Framework sets four specific priorities for action:

i. Understanding disaster risk
ii. Strengthening disaster risk governance to manage disaster risk.
iii. Investing in disaster risk reduction for resilience.
iv. Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation, and reconstruction.

2.4 Geographical location of Pakistan

The geography of Pakistan comprises coastline, river plains and mountainous regions, which extends 100 of kms in the south along the Arabian Sea (Figure 2). Pakistan is in a region that has resource-rich nations in the West and resources-rich economies in the East. The majority population in Pakistan lives in lower elevation areas and is adjacent to the major river system. Pakistan prime watershed relates to the Indus river, and the equivalent grasslands of the Indus River comprised roughly 1/3rd of the state area (Tariq & Van De Giesen, 2012). Pakistan periodically experiences precipitation creating weather systems such as tropical storms and mid-latitude cyclones, and is correspondingly exposed to monsoon rainy seasons throughout the month of July-September (Hashmi et al., 2012). During the summer season, in higher elevations, snow melts, and heavy monsoon rains,

regions near the Pakistan main river system will most likely face catastrophes and floods (Tahir, 2007).

The western and northern parts of Pakistan cover a wide range of mountainous regions where thunderstorms occur with greater frequencies throughout the year (Rashid, 2000). Steep elevation slope/gradients in mountainous areas have largely donated to numerous flash flood events in the previous years and several regions, including KPK and Baluchistan (Siddiqui & Rashid, 2008). The southern parts of Sindh and Baluchistan may sometimes face flooding because of tropical cyclones that style rainfall from the Arabian sea (Fatima & Safdar, 2011).

Pakistan climatologically is situated in the arid area of the Globe (Fatima & Safdar, 2011). In the past, the arid regions worldwide faced a higher risk of flooding when subjected to excessive rainfall (Critchley et al., 1991). A technique called ‘sealing’ or ‘capping’ refers to the features of dry topsoil particulates being driven down into next soil voids by huge rain drive during excessive rainfall events. This process leads to a thick surface ground layer that first forbids water entrance to the lower soil depth and increases surface runoff and gives rise to flooding (Cheema et al., 2012). Pakistan is home to approximately 210 million people and has an area size of 796,000 km^2. In the northern and eastern part of Pakistan, the most populous regions are situated near Ravi, Indus, and Jhelum river basins. Thus, the geographical distribution of Pakistan is that most populated regions are comparative to the state’s main water feature. Therefore, a large number of people are exposed to severe flooding in heavy rainfall events.

2.5 Flooding

Flooding occurs due to long periods of rains, snowmelts, and a short duration of concentrated rainfall (Sweet et al., 2020). Floods are characterized by speedy water flows that can carry a large amount of rock, debris, and sediments (NOAA, 2013b). The impacts of these water and sediments can smack a person balance off at a depth of 15 cm, while devastation and destruction of an area are caused by fast-moving water carrying sediments and debris (NOAA, 2013a).

Figure 2. Topographic Map of Pakistan includes main river systems and major cities.

There are different types of floods, including river floods, coastal floods, flash flood, rain on snow flood events (Jonkman, 2005). Flash flood event is characterized by excessive rainfall take place over an area comparatively for short time periods. The river flood refers to an overflow of riverbanks, and low-lying areas nearby become inundated (NOAA,

2009). In the past, Pakistan has experienced all flood events, and the main cause of some of the highest flooding disasters is excessive rainfall, tropical cyclones, and landfall in large scale river floods (Ahmad et al., 2011). The vulnerability of natural events is referred to as people lives, personal property, or structures that are potentially exposed to flood events. The socio-economic aspects play an important role to explain that an individual's vulnerability is increasing or decreasing. People with a low level of education will have limited evacuation resources for coping with the effect of natural hazards (Cutter & Finch, 2008).

2.6 Vulnerability

The vulnerability may be characterized by the lack of awareness about hazard events, absence of mitigation strategies of a community to put in place to manage, handle and reduce the negative impacts of hazard events (Cutter et al., 2003). For instance, such impacts of floods in history have adversely affected Pakistan. During severe flooding events, Pakistan failed to manage and control the impacts and losses from 1995 -2010 (Mustafa, 2003; Tahir, 2007). Since 1950, after the earthquake, it has been the 2nd deadliest natural hazard to affect Pakistan. In modern history, Pakistan experiences catastrophic natural events such as the 2005 earthquake, which killed 73000 people (Schorn, 2005). Adding to this, an enormous flooding event hit Pakistan in 2010 and is considered the 3rd deadliest natural disaster event since 1950 (EM-DAT, 2003a). Vulnerability is progressively recognized as a human encouraged phenomenon and is the root cause of severe disaster impacts (Adger, 2006; United Nations, 2004; Ben Wisner et al., 2004). The gaps and weaknesses adopted by the community in reducing or coping strategies. It may

overlap with other concepts like adaptation, resilience, and capacities (S. Balica & Wright, 2009).

2.7 Different aspects of vulnerability

Vulnerability is the degree of loss (from 0 to 100%) resulting from a possibly damaging phenomenon (Handmer et al., 1999). According to Adger (2006), vulnerability is the exposure of people or groups to stress because of social, economic, and environmental changes. However, the term stress denotes unpredicted variations and disruptions to livelihood. Vulnerability is defined as the 'tendency of an individual or group concerning their holding ability to oppose, expect, manage, and mend from the impacts of natural hazards'(Ben Wisner et al., 2004). Adger (200:739) suggest another definition which states as 'the existence or absence of capability to resist stresses and shocks to livelihood'.

Pelling (1999); suggests that people are made vulnerable by their socio-political processes, ultimately resulting in mitigation measures. However, in 2000 Parker suggests that both physical and social environments influence flood risk formation and focus on community aspects.

2.7.1 **Vulnerability and Poverty**

Those people who have low incomes, low financial reserves, limited access to resources, living in fragile houses, the elderly and the sick are the most vulnerable. They could be the slump inhabitants of shattered areas; near drainage channels (Owusu et al., 2019). In developing countries, poverty and vulnerability go side by side. Chan and Parker (1996) state that; both vulnerability and poverty are not always linked, in general, the poor suffers a lot in hazards than the rich. Moreover, the connection between poverty, hazards and

vulnerability is much complex. At the societal level, the poor people live in an area where natural hazards are much severe.

Vulnerability depends on the poverty of people living in rural areas. Generally, the poor and low-income people live in areas that are more prone to hazards. Moreover, Davis and Hall (1999) claim that poor people settle and work in a hazardous location such as uneven shorelines in rural parts. Exposure to floods in built-up regions leads to be focused in peripheral, low lying locations along streams, on floodplains and coastal marshes spots are avoided for better off and frequently poor people lived and settled there for the reason that accessibility or nearness to sources of economic livelihood (Cairncross & Ouano, 1990). The majority of rural-urban migrants are illegally settled near urban flood plains (Chan & Parker, 1996; Penning-Rowsell, 1996).

2.7.2 **Vulnerability as a Social Product**

The vulnerability of the elderly and young people is influenced by poverty and low income. So, the vulnerability to disasters cannot be seen as a product of physical locations and as a social product. The realization of the communal background of vulnerability started to advance in the 1980s and has been accepted in the literature of hazards in the 1990s (Adger, 1999). The models like the 'pressure and release model' and 'access to resources model' developed by (Ben Wisner et al., 2004) determines the economic and political root causes of vulnerability. Few (2003) added more to this point:

Now it is important to know that vulnerability of people is linked with political and economic positions. Therefore, it is necessary to distinguish that vulnerability is limited to exposure of hazards. Still, the main factors of distribution of assets and power should

be added to the vulnerability of people. Wisner (2000) suggest that the vulnerability of people in the prone areas of floods and landslides was much influenced by the economic and political problems like distribution of land and public expenditure cuts. The key insights from the body of literature are that non-physical factors like income-poverty are not enough to measure vulnerability (Christoplos et al., 2001). Cardona (2001) states that vulnerability is influenced by multi-dimensional factors like social, political, institutional, economic, and cultural. Different factors influence vulnerability as 'access to information and knowledge, access to political power and representation and beliefs and customs (Cutter et al., 2003). Pelling (1999) examined that the neighbourhood most vulnerable to flooding in Georgetown, Guyana, tended to be those with low household incomes, poor housing qualities, and a low level of community organizations. Maskrey (1999) also sees that the causes of community vulnerability are multi-dimensional. He further added that the capacity of a community to absorb to impacts of a hazard event and to recover from it is determined by its geographical location, the ability of its physical structures and infrastructures, its economic capacity expressed in terms of assets, reserves and rights to access loans, its level of social cohesion and organizations, its cultural vision of disasters and many other factors. Although there is no precise and standardized method exist which measures the multi-dimensional aspects of vulnerability (Rana & Routray, 2018). Bhatt and Ingleton (1999) criticize the tendency to view hazard victims as homogenous regarding vulnerability and generalizable terms of their needs. Maskrey (1999) determined that communities are not homogenous and point to variations in vulnerability within communities connected with their socio-economic status, gender, age, ethnicity, and political or religious affiliations.

2.8 The Conceptual framework for identifying and understanding vulnerabilities

In environmental sciences, vulnerability frameworks are used to identify the impacts of natural hazards on human. Disasters are regarded as a direct outcome of natural hazards like floods, earthquakes, and droughts. Still, this definition was undermined by the realizing that not every hazard event results in disaster and not every person or group suffers equally in a disaster (Benjamin Wisner, 2000). The critical link between hazard or external threat and disasters was identified from the vulnerable population. To understand the reasons for occurring bad outcomes from the disasters, it is necessary to analyze both the environment and population at risk (Prowse, 2003). Chambers (1995) defines vulnerability as 'the exposure to contingencies, stress, and difficulty coping with them'. According to Chambers, *exposure* is that not every subject is equally at risk to a given threat. *Coping* is that *something about* the nature and actions of a person makes him less or more susceptible. 'Vulnerability can be classified into two sides, the external side of risk, shocks, and stress to which an individual or household is subjected; and an internal side which is defenselessness, meaning a lack of ability to manage without harm or loss.' (Chambers, 1995). To distinguish between exposure, threats, coping, and outcomes, a framework was developed closely related to chambers definition (Figure 3).

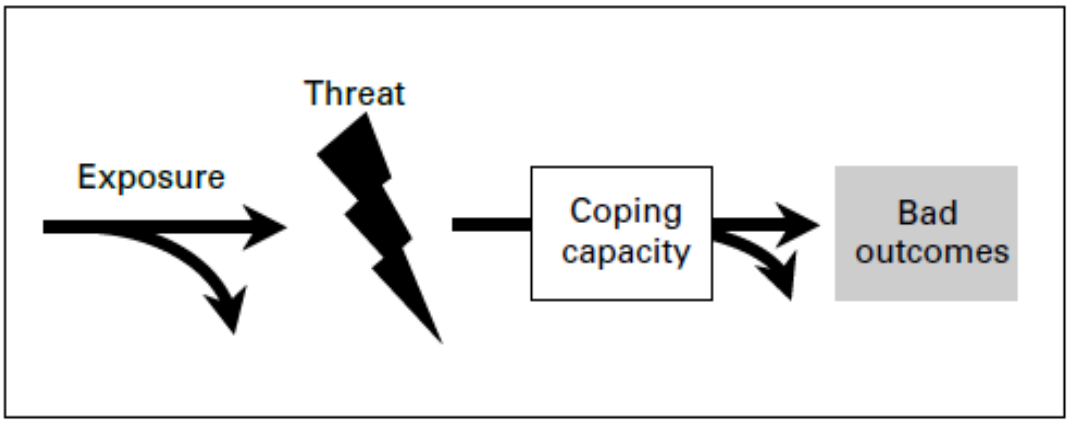


Figure 3. A framework for understanding vulnerability.

2.9 Elderly perceptions and response to Floods

In any society, there are groups of people who are vulnerable to disaster events in any condition. Women, children, the poor, the homeless, disabled people, and the elders are at high risk after a disaster strike. Recently, older people are nowadays emerging as a high-risk group. Primarily, there is an increase in the number of older people. There is also an increase in awareness of older people's needs, which ultimately results in older people being more vulnerable and at high risk than other groups. From 2006-2050, the predictions are that the number of aged people will increase from 650 million to 2 billion people, almost increasing three times (Bodstein et al., 2014). According to the 2011 report of the world health organization, in France, the elderly people aged 65 and over will take 100 years to rise from 7% to 14%, whereas societies like Brazil, China, and Thailand follow the same demographic change path in two decades. In future, the prediction is that in low-income countries, there will be 80% of elderly people by 2050 (Bodstein et al., 2014). Presently, for every three-elderly people, two of them are living in developing countries.

In addition to this, elderly people have faced mobility problems, chronic medical conditions, and inadequate resources, which ultimately increases their vulnerability to natural hazards. In 2004, Sri Lanka faced a tsunami in which 40,000 people were dead, and over 80,000 people became homeless (Karunarathne & Lee, 2020). But a very little is known about the thoughts and opinions of elderly people in disasters, even though the elderly people constitute a substantial amount of risk in humanitarian crises (Duggan et al., 2010).

2.10 Young adults in disaster

Among all people, young adults especially need to be concerned about environmental threats to a sustainable future (Denniss, 2004). The managers of tomorrow are the young adults. Their perceptions are important since they are responsible for advancing technological developments and building the future (Cvetković et al., 2019). They are neglected in disaster research, although their concerns and needs are remarkable (Overton, 2014). Greenberg and his colleagues (1993) found that people who developed constructive coping mechanisms are most likely to manage fears of disasters in a socially acceptable way, such as overcoming or dealing with fears. While some individuals have high levels of fears of disasters, deny the existence of threats, dismiss the hazards information, and use other undesirable coping mechanisms that lead to self-destruction (Becker et al., 2013).

2.11 Young adults' mobility and adaptability

Young adults easily adapt and move more quickly in risky situations (Elinder & Erixson, 2012). Therefore, giving them a higher probability of survival as compared to elderly people. Moreover, in several studies, young adults feel less afraid of natural hazards (Roder et al., 2016). Another study was conducted in the US after Hurricane, which demonstrates that young adults typically have strong parental support, ultimately translating into enhanced worries about the parents during disaster situations (Kaniasty & Norris, 2000). As an individual age is growing, his mobility and other health-related issues are also growing. Some studies suggest that young adults move more quickly in risky situations and their chances of survival are higher than elderly people. While other studies suggest that elderly people have accurate risk perception as they experienced flood and other natural hazards (Loke et al., 2012). The accurate perceptions of elderly people from their experiences with natural hazards ultimately minimize their vulnerability to natural hazards. More generally, people tend to interpret risk based on what they have already known and have experienced.

2.12 Coping Capacities

The ability to manage a disaster is progressively realized as an important element of a community and household vulnerability. For Pelling (1999), 'vulnerability has three components: exposure, resilience, and resistance. These components are the product of socio-economic and political structures and the capacity of social institutions and individual actors to adapt to the hazard stress.

Exposure refers to the risk of floodwater incursion into 'living spaces', and resistance and resilience refer to the human capacity to reduce the impacts of that incursion through some type of adaptation. Blaikie et al. (1994) determine those coping strategies comprise preventive, impact-minimizing, or post coping actions.

2.12.1 **Resources, Rights, and Assets**

Adaptation to environmental hazards such as flooding, households and communities use different resources to minimize the impacts. In the literature of floods and hazards, there has been increasing attention paid to such attributes. Anderson and Woodrow (2019) determined three aspects: physical/material resources, social/organizational structures, and motivational/attitudinal factors. Morrow (1999) sees risk as a socially constructed phenomenon: starting with economic and material resources, the argument is extended to include human or personal resources (such as education, family), social resources (such as a network of reciprocity), and political resources (such as autonomy and power). Adger (1999) emphasis on access to rights, resources and make a theoretical link between susceptibility and capitals. The various features that determine vulnerability can be expressed as a set of privileges: the style of these privileges support both safety and susceptibility.

Moser (1998) highlighted the linking between susceptibility and the possession of properties: 'the more the resources people have, the less exposed they are.' The larger the destruction of people's properties, the bigger their uncertainty.

2.12.2 **Local-level interventions**

There is limited success in flood prevention in major technological interventions (Ben Wisner et al., 2004) and the gauge of future flooding threat. Thornes (2002) determine that the poor's assets should be designed to resist the shocks and minimize the human burden from floods (Sanderson, 2000). Actions intended to strengthen the communities' resilience and resistance to flood hazards must be taken locally. It is increasingly important in situations where risk administration measurements of the administrative organization are weak (Chan, 1997). Certainly, for near authorities, the level of achievement is the key, only by delaying the largely and huge untapped potential of susceptible societies to reduce and manage risks at the resident level and provide backing to their energies. It is likely to look onward to a much maintainable upcoming in the following period (Maskrey, 1999). Moreover, vulnerability decrease is a difficult and affluent task to implement but is comparatively easy and inexpensive to implement if included in expansion schemes.

2.13 Risk perceptions

Risk states the probability of adverse impacts resulting from an activity or event. Risk perception is a concept used for assessing the tendency of individuals to undertake preparedness measures. To understand risk reduction, the degree of vulnerability and risk perceptions should be assessed properly. The risk perceived can be quantified (Slovic, 1987). For analyzing and understanding perceptions, various factors like age, gender, education, income, past experiences with hazards, accessibility to information, past destruction and degree of affiliations with faith (Khan et al., 2020). However, there is no

comprehensive method for evaluating vulnerability and disaster risk reduction dimensions at present. Assessing, measuring risk perception and its components related to hazards is the study's contribution to current disaster risk science. The components of risk perception involve fear and worry regarding natural hazards, behaviour and attitude adopted by individuals during and after the disaster, awareness about threats of natural hazards, and trust in different disaster management authorities. Therefore, this study assesses the perceptions of young and elderly people in floods.

The studies related to risk perceptions are essential for decision-makers to understand how people comprehend natural hazards. This raises the questions for appropriate quantification and measurement of risk perceptions. However, accurate and complete measurements of risk perception are complex and difficult (Rana & Routray, 2018). The consideration of factors like fear, attitude, and sensitivity to some extent measures the risk perceptions of an individual (Sjöberg, 1998). The risk perception components are associated with a feeling of fear and anxiety of individuals (Wolff et al., 2019). However, this study analyzes risk perception through fear, behaviour, awareness and knowledge, and trust.

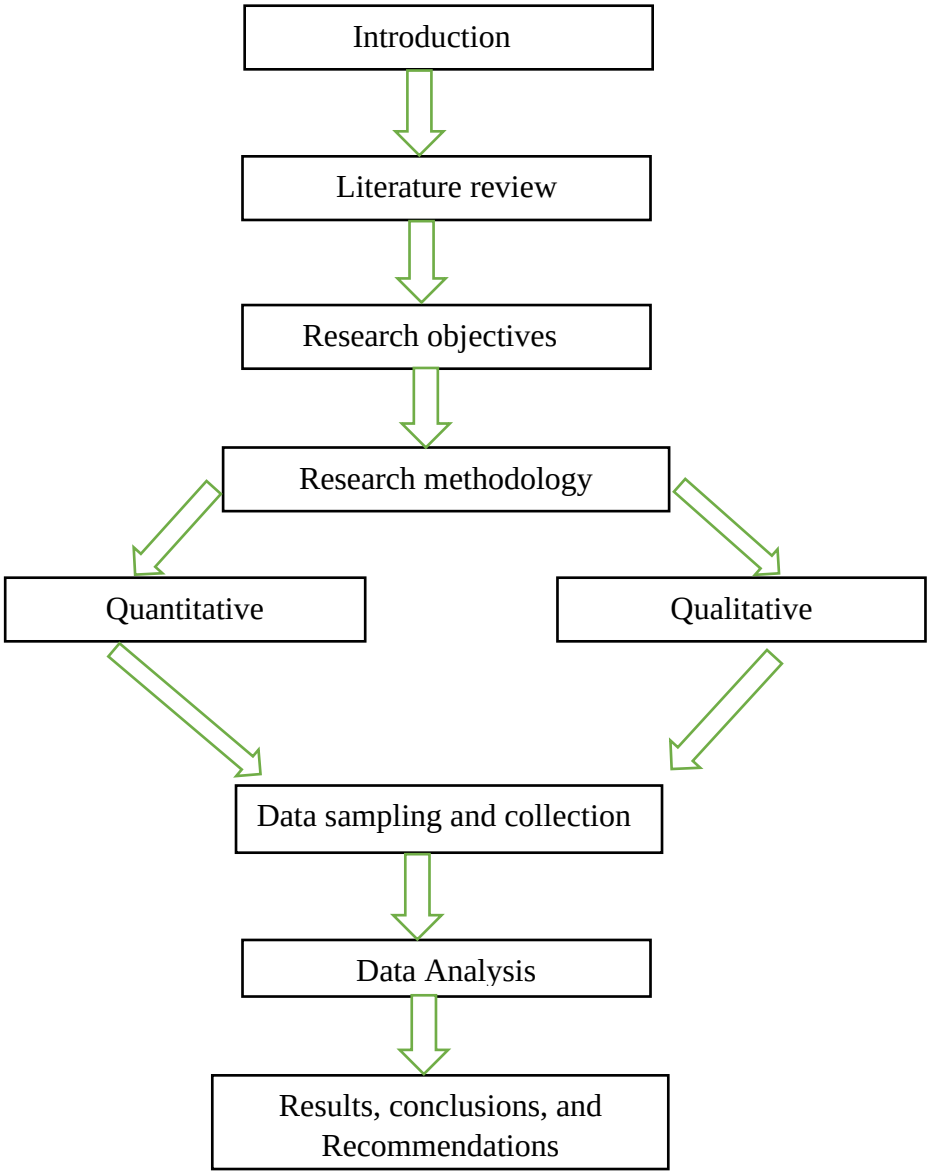
Fear is an emotion or feeling of an individual experienced in anticipation of a threat or natural hazard. Sometimes, fear and worry are used as synonyms of risk perception and are critical and important component of risk perceptions (Sjöberg, 1998). The experience of individuals with natural hazards may have strong fears (Slovic, 1987). The feelings and past experiences of people play a vital role in determining the perceived probability of events (Miceli et al., 2008). Hence, the fear can enable individuals to seek out

precautionary measures before a natural hazard occurs. Risk perception and attitude influence the behaviour of individuals (Birkholz et al., 2014). Specific behaviours of individuals may increase or reduce the vulnerability to natural hazards (Rohrmann, 2008). In risk and emergencies, people adopt unresponsive behaviours mainly due to poor risk perceptions (Armaş & Avram, 2009). The knowledge and awareness of an individual about natural hazard may determine the coping ability (Sullivan-Wiley & Gianotti, 2017). Better knowledge of risk or threat increases the capacity of individuals to deal better with natural hazards. The component trust also plays an important role in determining risk perceptions. Trust in different disaster management organizations may leads to minimize the threats imposed by natural hazards. An individual or a community which trust the disaster management organizations also trust their source of information, which ultimately results in immediate evacuation.

CHAPTER 3

3. METHODOLOGY

This chapter describes the research design, type of data collection, sample size, methodology to conduct the research and different types of data collection techniques that help to obtain the research objectives.



3.1 Research Design

The current study is based on mix research design. It involves both type of research (Qualitative and Quantitative). The approaches used for the collection of data include questionnaire survey technique and in-depth interviews from different government institutions.

3.1.1 **Qualitative Research**

Qualitative research is used to collect data through open-ended questionnaires and conversational communication techniques. In-depth interviews and focus group discussions are based on this research method.

3.1.2 **Quantitative Research**

This research type consists of inquiry of phenomena by collecting quantifiable data and performing statistical techniques to generalize it between individuals or describe a phenomenon. For data analysis, an index-based approach is used, which is obtained through questionnaires, and further, these questionnaires are based on the indicators used in this research.

3.2 Study Area

Mardan is the second most populous city of KPK after Peshawar. According to the 2017 census, the population of Mardan is 23,73,061, while in the 1998 census, the total population of the city is 295,128 (KPK Bureau of Statistics). Moreover, the city lies in zone 2B and is prone to natural hazards like Earthquakes and Floods (Figure. 4 & 5). Mardan is prone to earthquakes and floods, is selected for the study area.

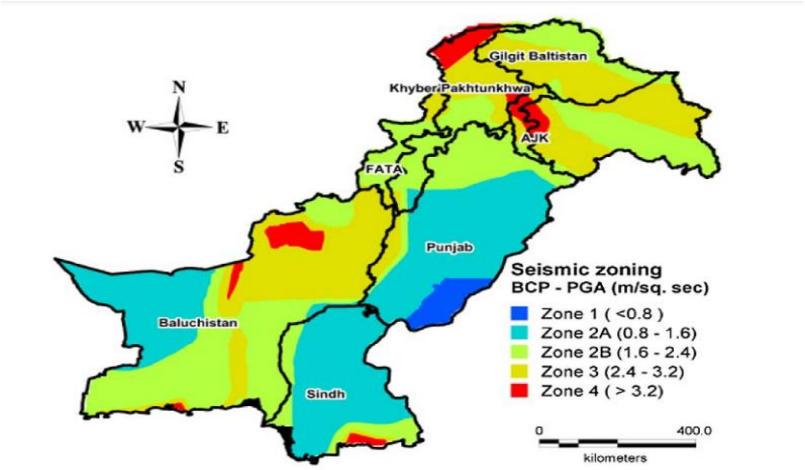


Figure 4. Seismic zoning map of Pakistan according to Building code of Pakistan (BCP 2007).

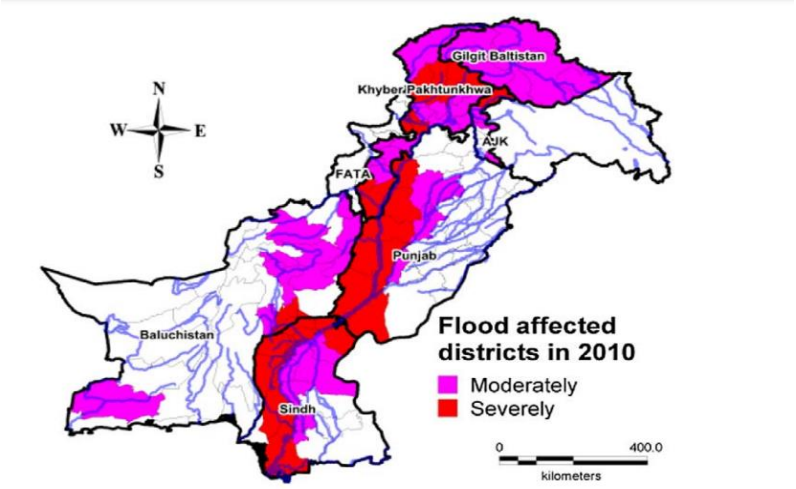


Figure 5. Flood affected districts of Pakistan in 2010.

3.3 Data sampling and Collection

The collection of data for this study consists of literature reviews, questionnaire survey techniques, and in-depth interviews.

3.3.1 **Primary Data**

The collection of primary data was done through a questionnaire survey and in-depth interviews from different government institutions.

3.3.2 **Sample size**

Slovin's formula was used to determine the sample size. It is computed as $n= N/ (1+Ne^2)$.

Where N= total population, e= margin of error

Using the confidence level of 95%, e= 5%= 0.05

$n= 23,73,061/ (1+23,73,061 (0.05)^2)$

n= 399.63

So, a sample size of 400 was chosen for the questionnaire survey. According to the 2017 census, the total population of the Mardan district is 23,73,061. The urban population of the Mardan district is 4,39,325, while the rural population is 19,33,736 (Census, 2017).

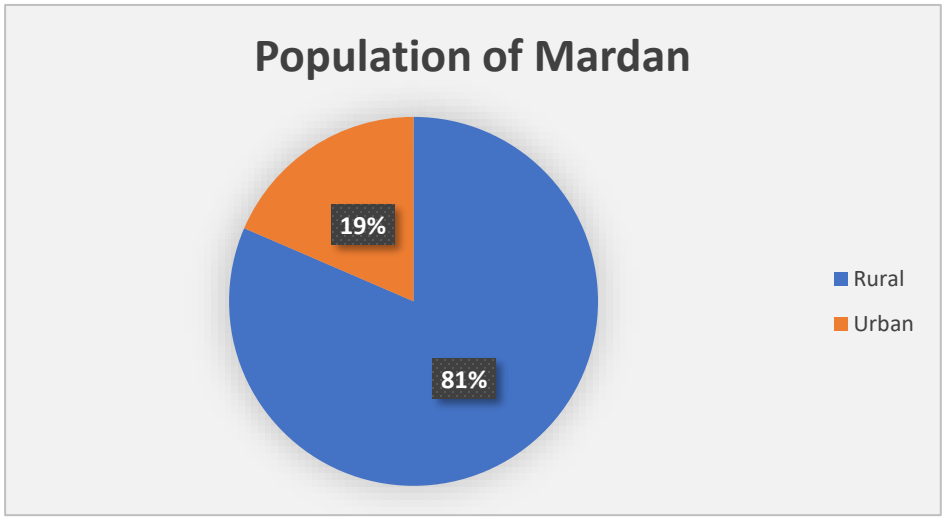


Figure 6. Population of Mardan (Census 2017).

The sample size of 400 is divided into three tehsils of the Mardan district.

Table 1: The Population of Mardan district (Census 2017).

Mardan District			
Sr. No.	Tehsil	Populations	Sample size
1	Mardan tehsil	1044790	200
2	Katlang tehsil	545802	100
3	Takht Bhai tehsil	626523	100

The sample of each tehsil was further divided into different regions.

Table 2: Selected sample size of Mardan Tehsil.

Mardan Tehsil (200)		
Sr. No	Regions	Sample size
1	Dang Baba	70
2	Faqir Abad	65
3	Bibi Abay	65

.

Figure 7. Satellite map of Dang Baba, Bibi Abay, and Faqir Abad, Mardan.

Table 3: Selected sample size from Takhtbhai Tehsil.

Takht Bhai Tehsil (100)		
Sr. No	Regions	Sample size
1	Lund Khwar	50
2	Seri-Bahlol	50

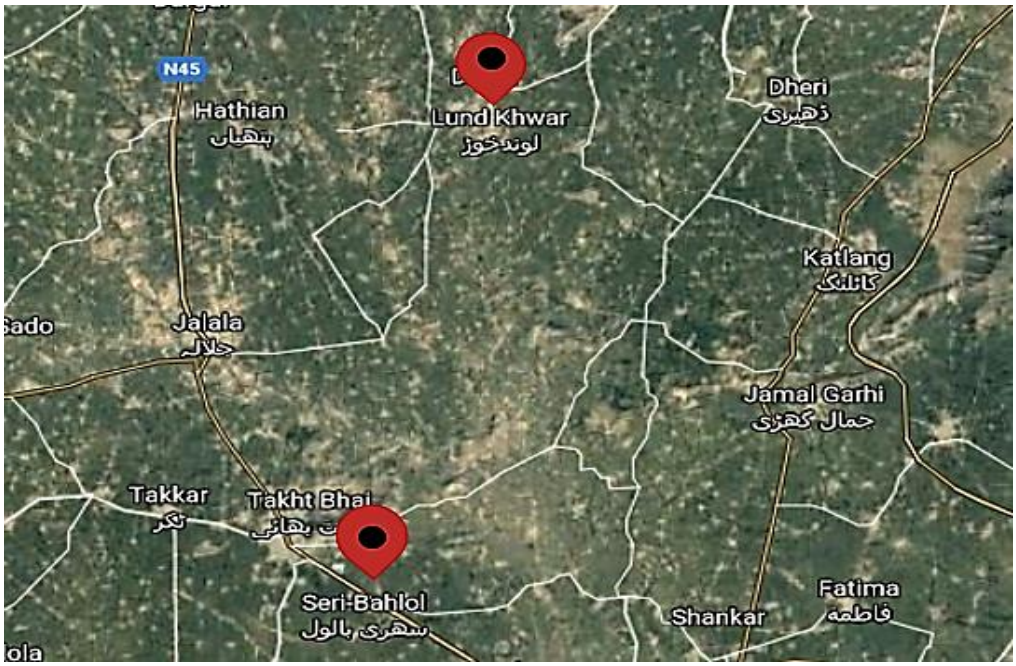


Figure 8. Satellite map of Lund Khwar and Seri-Bahlol. Takhtbhai.

Table 4: Selected sample size from Katlang Tehsil.

Katlang Tehsil (100)		
Sr. No	Regions	Sample size
1	Dheri Likpani	50
2	Jamal Garhi	50

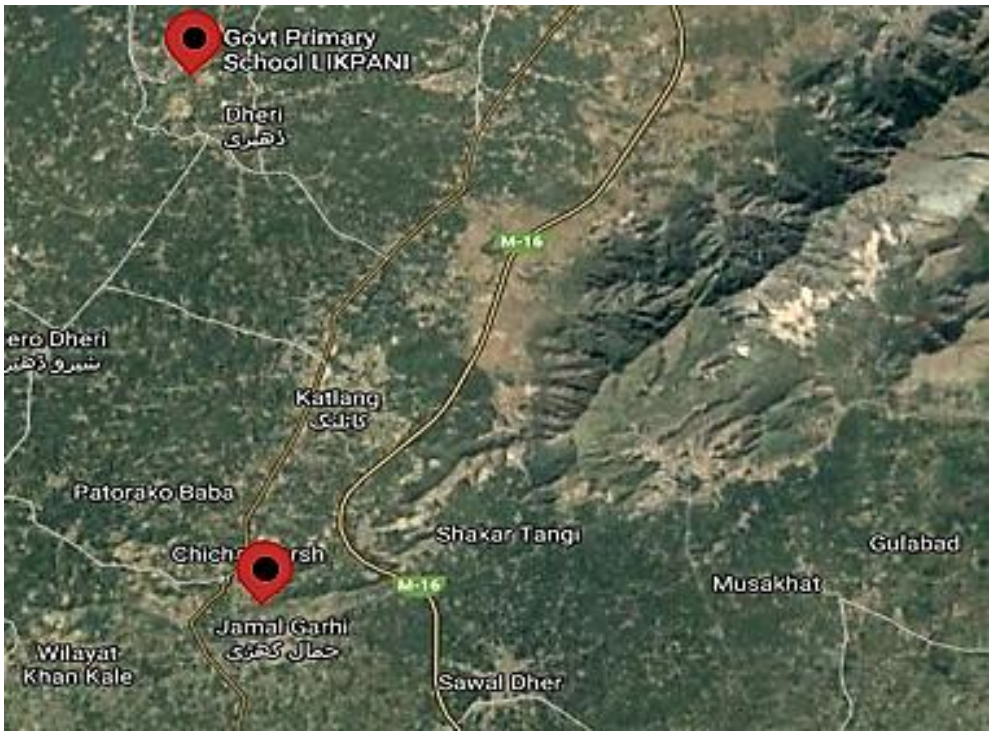


Figure 9. Satellite map of Jamal Garhi and Dheri Likpani, Katlang.

3.3.2.1 Questionnaire Design

The questionnaire designed for this study involves three major sections. The first section consists of general information, the second section consists of various aspects of the disaster, and the third section consists of capacity information of institutions and the public. Some questions were based on a binary (Yes/No) structure, and the others were based on a Likert scale designed to score from (1-5). After conduction and feedbacks from the pilot study, the questionnaire was finalized.

3.3.3 **Secondary Data**

The secondary data were collected by reviewing existing literature using online scientific databases and deeply reviewing the online publications and journals of national and international organizations related to natural hazards and disasters.

3.3.3.1 Indicator Selection

Indicators were selected by a thorough and detailed literature review of each dimension of vulnerability, capacity, and flood risk perceptions. The indicators were examined and selected by viewing the local conditions and then modified accordingly.

3.4 Data Analysis

3.4.1 Index-based Approach

In many fields, including disasters and hazards, indices are often used to easily summarize the indicators (Shah et al., 2018). In poverty and deprivation, human development, disaster preparedness, vulnerability, social capital, quality of life, and disaster resilience (Birkmann, 2006). A single value can easily present the more complicated data called an index (Cutter et al., 2003). In this study, the assessment of vulnerability and capacity of the young and elderly was determined by an index-based approach.

3.4.2 Formulation of Multidimensional Vulnerability index

This study assessed three dimensions of vulnerability social, economic, and institutional vulnerability of young and elderly, was done through an index-based approach. In this study, subjective weighting was used to assign values to classes of phenomena for each indicator and formulates indices based on Eq. I.

$CI= (W_{1+}W_2+W_3+….+ W_n)/n$

$$CI = \sum_{i=1}^{n} \frac{Wi}{n} \qquad \text{Eq. I.}$$

where; CI is the composite index, W_1-W_n are the transformed values given to indicators, and n is the number of indicators used for calculating the composite index.

Following this general principle, the Social Vulnerability Index (SVI), Economic Vulnerability Index (EVI), and Institutional Vulnerability Index (IVI) were calculated. The Multidimensional Vulnerability Index (MVI) for each household in the study area was determined using Eq. II.

Social Vulnerability Index (SVI) = $\sum_{i=1}^{5} \frac{SWi}{n}$ (n=5)

Economic Vulnerability Index (EVI) = $\sum_{i=1}^{6} \frac{EWi}{n}$ (n=6)

Institutional Vulnerability Index (IVI) == $\sum_{i=1}^{5} \frac{IWi}{n}$ (n=5)

Multidimensional Vulnerability Index (MVI) = $\frac{SI+EI+II}{3}$ Eq. II.

For measuring the purpose of the indices, values of each indicator have been transformed to 0-1 based on the vulnerability level. The values closer to 0 represent low vulnerability, whereas values closer to 1 signify higher vulnerability. Depending on the characteristics, each variable was further divided into different classes. In two classes, the values were given 0 and 1. Indicator with three classes, the values were 0.33, 0.67, and 1. Similarly, for four classes, the values were 0.25, 0.50, 0.75, and 1. Indicators with five classes the values were given as 0.2,0.4,0.6,0.8, and 1.

CHAPTER 4

4.1 PROFILE OF RESPONDENTS

The selected sample size was collected from three tehsils of district Mardan namely Mardan, Takhtbhai, and Katlang, comprising young and elderly people. The young aged 18-33 while the elderly aged 57 and above. Table. 5 shows the descriptive statistics of the sample population with 50% young and 50% elderly respondents. Descriptive statistics display that the average age of young adults was 24.5 and 64.6 for elderly people.

4.1.1 **Age**

Table 5: Age-wise distribution of Mardan, Takhtbhai, and Katlang Tehsil.

Region	Age											
	Young= 200						Elderly =200					
	18-22		23-27		28-33		57-64		65-74		>74	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Mardan	49	24.5	35	17.5	15	7.5	95	47.5	6	3	0	0
Takhtbhai	8	4	12	6	30	15	21	10.5	22	11	7	3.5
Katlang	21	10.5	28	14	1	0.5	19	9.5	25	12.5	6	3
Mean	24.31						64.6					

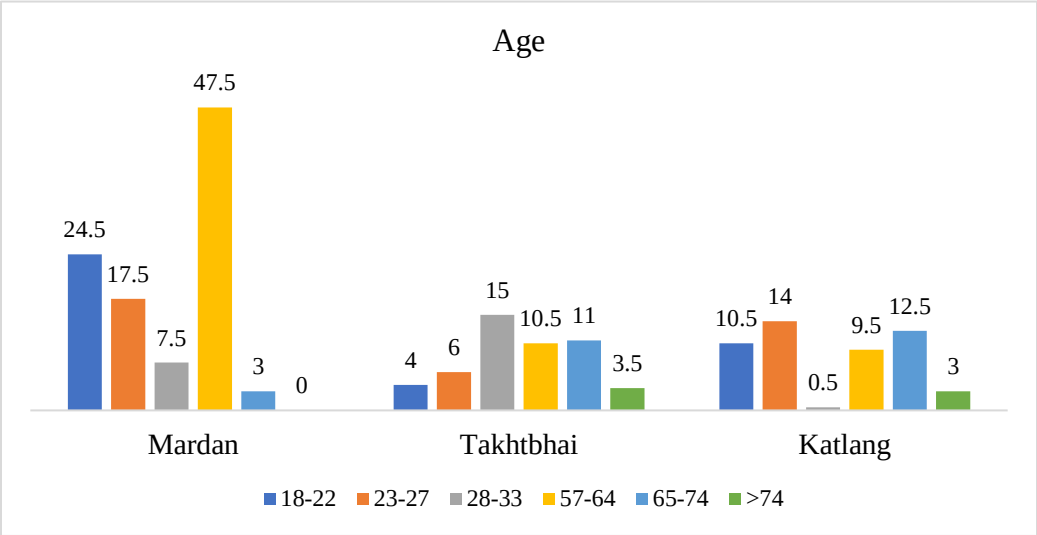


Figure 10. Age-wise distribution of Mardan, Takhtbhai, and Katlang Tehsil.

This graph shows the percentages of surveyed young and elderly people from Mardan, Takhtbhai, and Katlang. Those respondents aged 18-33 were young, whereas 57 and above were referred to as elderly people.

4.1.2 **Gender**

Table 6: Gender wise distribution.

Region	Gender			
	Male		Female	
	Frequency	%	Frequency	%
Mardan	168	84	32	16
Takhtbhai	66	33	34	17
Katlang	86	43	14	7

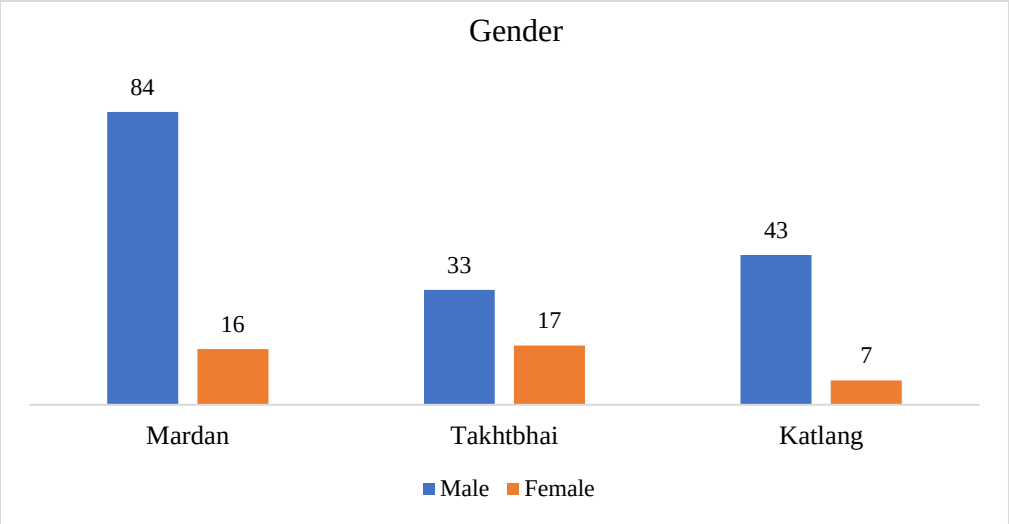


Figure 11. Gender wise distribution.

This graph shows the gender classification of three tehsils. In Mardan tehsil, 84% of the respondents were male, while 16% were female respondents. In Takhtbhai tehsil, the percentage of male respondents was 33%, while female respondents were 17%. In Katlang tehsil, the percentage of male respondents was 43%, while 7% were female respondents.

4.1.3 **Education**

Table 7: Education level of respondents.

Region	Education level									
	No schooling		Primary		Secondary		Intermediate		graduate	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Mardan	61	30.5	41	20.5	37	18.5	46	23	15	7.5
Takhtbhai	34	34	29	29	15	15	15	15	7	7
Katlang	53	53	11	11	24	24	9	9	3	3

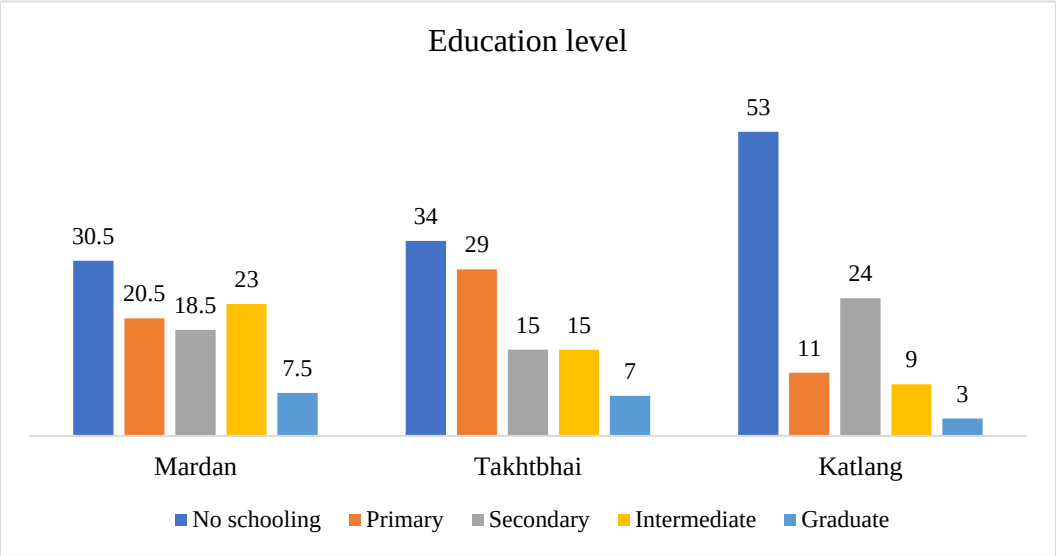


Figure 12. Education level of respondents.

This graph shows the education level of respondents in three tehsils. The total number of respondents surveyed in Mardan Tehsil was 200. Among 200 respondents, 30.5% of the respondents have no schooling, 20.5% of the respondents have primary education, 18.5% of the respondents have secondary education, 23% of the respondents have intermediate education level, while 7.5% of the respondents were graduates. In Takhtbhai tehsil, the total number of respondents is 100. Among the 100 respondents, 34% of the respondents have no schooling, 29% of the respondents have primary education, 15% of the respondents have secondary education, 15% of the respondents have intermediate education level, while 7% respondents were graduates. In Katlang tehsil, the total number of respondents is 100. Among the 100 respondents, 53% of the respondents have no schooling, 11% of the respondents have primary education, 24% of the respondents have secondary education, 9% of the respondents have intermediate education level, while 3% of the respondents were graduates.

4.1.4 **Income**

Table 8: Income of respondents.

Region	Income										
	<10,000		10,000-19,999		20,000-39,999		40,000-59,000		>60,000		
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	N
Mardan	66	33	32	16	29	14.5	60	30	13	6.5	200
Takhtbhai	72	72	4	4	15	15	8	8	1	1	100
Katlang	80	80	12	12	1	1	7	3.5	0	0	100

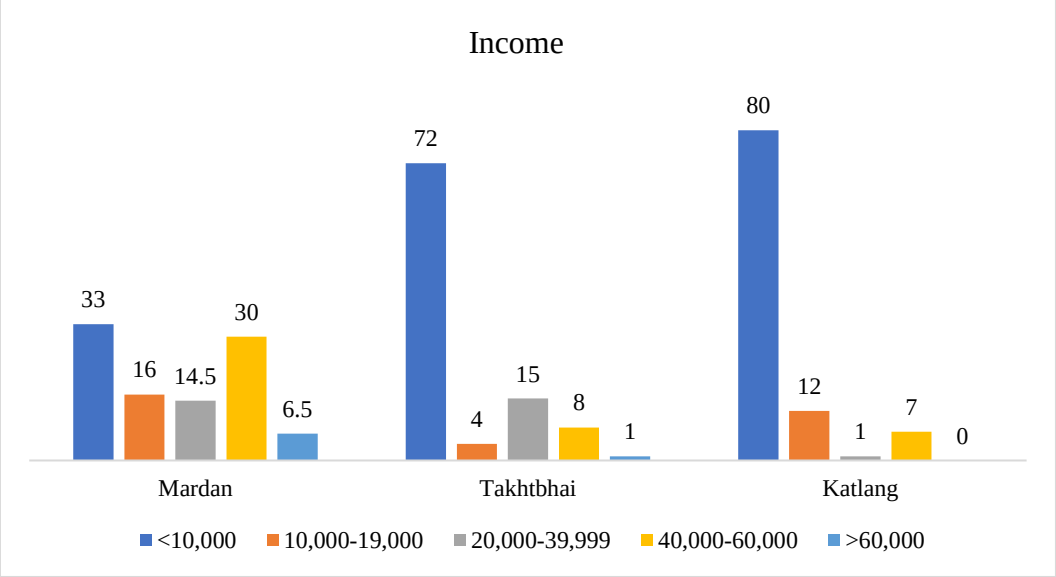


Figure 13. Income of respondents.

This graph represents the average monthly income of respondents. The incomes were first grouped, and then the frequencies of respondents were calculated.

4.1.5 **People with disabilities**

Table 9: People with disabilities.

Mardan				Takhtbhai				Katlang			
People with no disabilities		People with disabilities		People with no disabilities		People with disabilities		People with no disabilities		People with disabilities	
Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
170	85	30	15	73	73	27	27	81	81	19	19

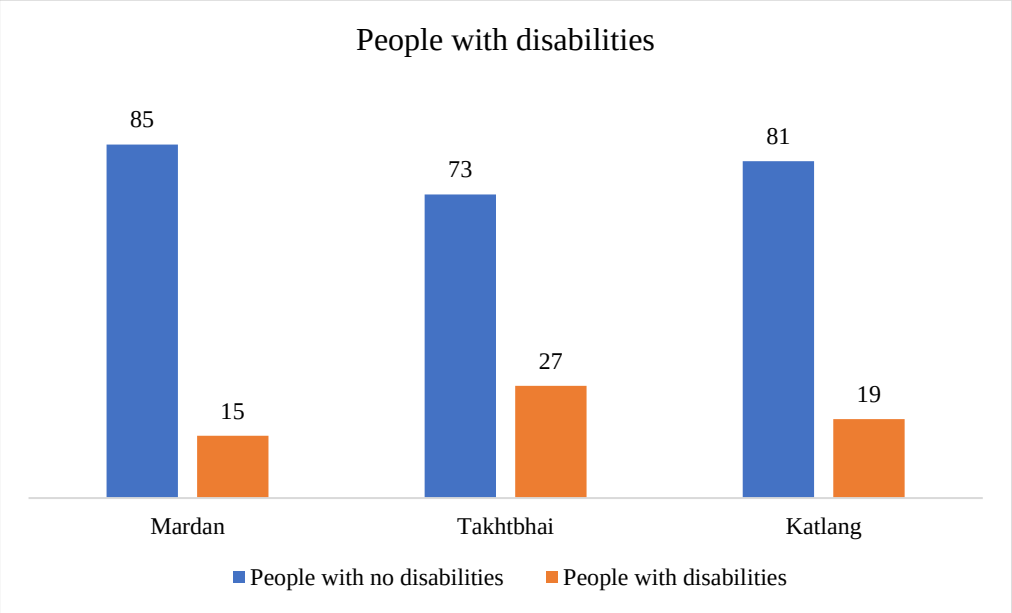


Figure 14. People with disabilities.

This graph shows the percentage of people with disabilities. In Mardan tehsil, about 15% of the people with disability, whereas 85% of the people with no disability. In Takhtbhai tehsil, 27% of the people with disability, while people with no disability were 73%. In Katlang tehsil, 19% of the people with disability, while the people with no disability were 81%.

4.1.6 **Respondents conducted safety exercises/drills**

Table 10: Respondents conducted safety exercises.

Region	Safety exercises			
	Safety exercise conducted		Safety exercise not conducted	
	Frequency	%	Frequency	%
Mardan	40	20	160	80
Takhtbhai	10	10	90	90
Katlang	5	5	95	95

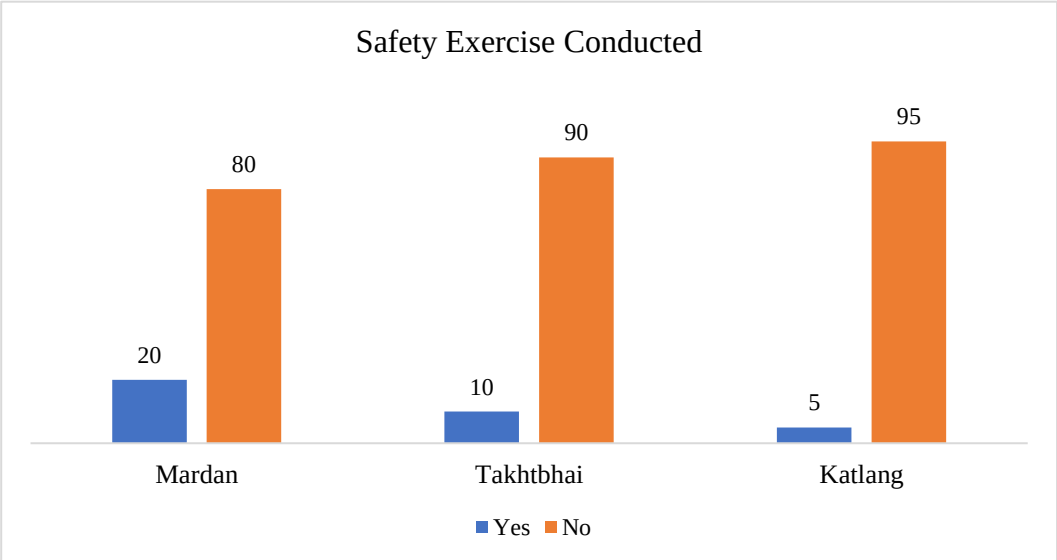


Figure 15. Respondents conducted safety exercises

This graph shows the safety exercises conducted by respondents in three regions. In Mardan tehsil, about 20% of the respondents conducted safety exercises, whereas 80% of

the respondents said that they had not conducted the safety drills. In Takhtbhai tehsil, around 10% of the respondents conducted safety exercises, while 90% of the respondents did not conduct any safety exercises regarding natural hazards. In the case of Katlang tehsil, only 5% of the respondents conducted safety exercises while 95% of the respondents do not conducted the safety exercise.

4.1.7 **Past Experience with floods**

Table 11: Respondents past experience with floods.

Region	Past Experience with floods			
	Experienced		Not experienced	
	Freq.	%	Freq.	%
Mardan	86	43	114	57
Takhtbhai	57	57	43	43
Katlang	46	46	54	54

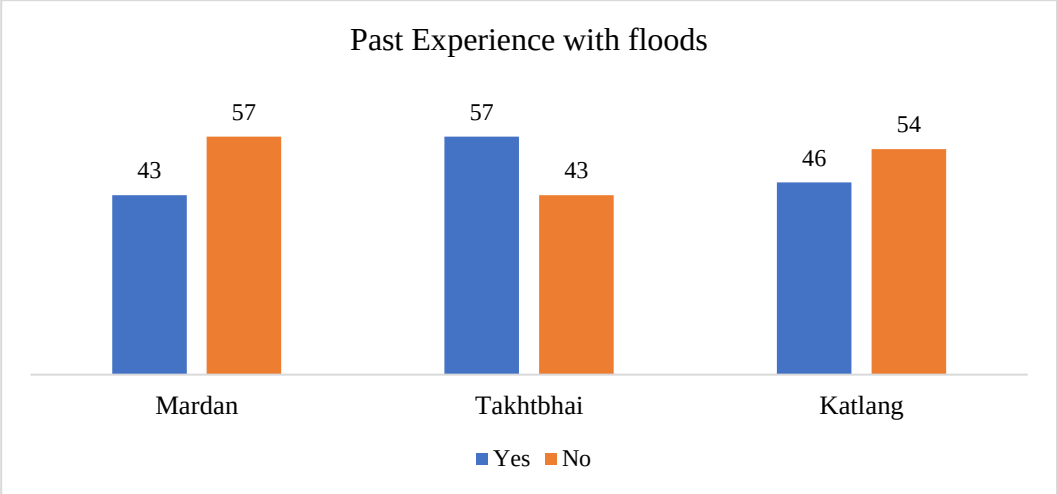


Figure 16. Respondents experience with floods

This graph shows the percentage of respondents who had experienced floods. In Mardan tehsil, about 43% of the respondents experienced floods, while the rest 57% did not experience floods. In the case of Takhtbhai tehsil, 57% of the respondents had experienced floods, whereas 43% of the respondents did not experience floods. In Katlang tehsil, 46% of the respondents experienced floods, whereas 54% of the surveyed respondents did not experience floods.

4.1.8 **Urdu language Understanding**

Table 12: Respondents Urdu language understanding.

Region	Urdu language Understanding			
	Knows the Urdu language		I do not know the Urdu language	
	Freq.	%	Freq.	%
Mardan	123	61.5	77	38.5
Takhtbhai	53	53	47	47
Katlang	41	41	59	59

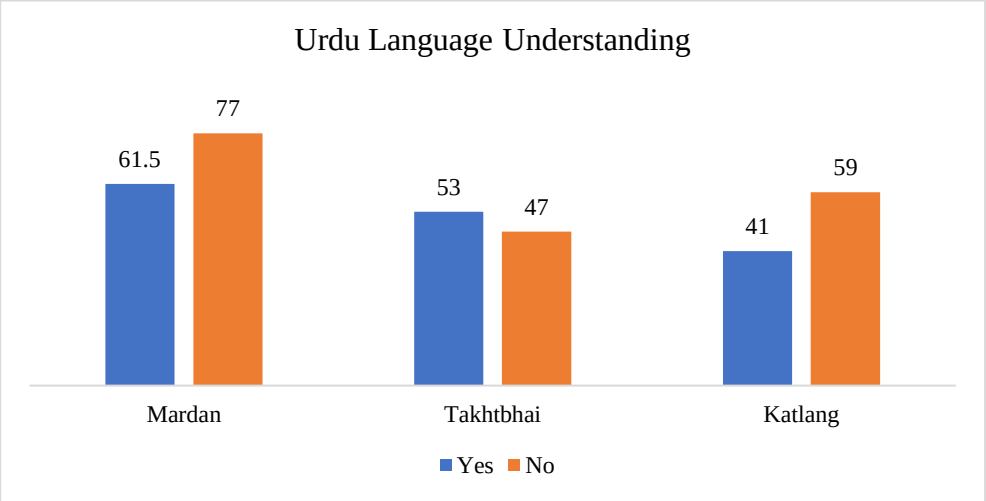


Figure 17. Respondents Urdu language understanding.

This graph shows the percentage of respondents who understand the Urdu language in three regions. In Mardan tehsil, about 61.5% of the respondents understand the Urdu language, while 38.5% of the respondents did not understand the Urdu Language. In Takhtbhai tehsil, 53% of the respondents understand the Urdu language, while 47% of the respondents did not understand the Urdu language. In Katlang tehsil, 41% of the respondents understand the Urdu language, whereas 59% of the respondents do not understand the Urdu language.

4.1.9 **Swimming skills**

Table 13: Respondents swimming skills.

Region	Swimming Skills			
	Skilled		Non-skilled	
	Freq.	%	Freq.	%
Mardan	71	35.5	129	64.5
Takhtbhai	21	21	79	79
Katlang	33	33	67	67

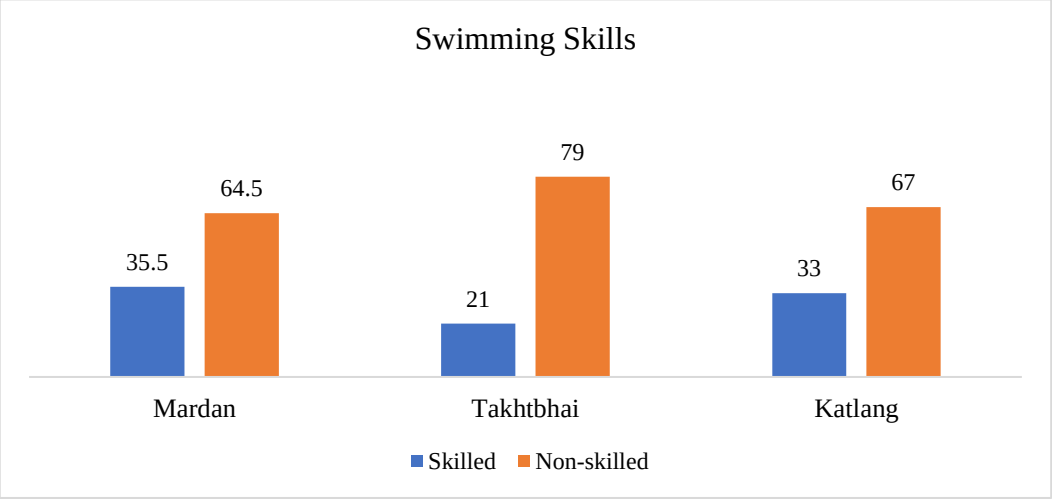


Figure 18. Respondents swimming skills.

This graph shows the percentage of respondents who have swimming skills. In Mardan tehsil, 35.5% of the respondents have swimming skills, while 64.5% of the respondents do not have swimming skills. In the case of Takhtbhai tehsil, 21% of the respondents have the skills of swimming, while 79% of the respondents do not have swimming skills. In Katlang tehsil, 33% of the respondents having swimming skills, while 67% of the respondents do not have swimming skills.

4.1.10 **Early warning systems**

Table 14: Respondents received Early warning systems.

Region	Early Warning Systems			
	EWS received		EWS not received	
	Freq.	%	Freq.	%
Mardan	96	48	104	52
Takht bhai	33	33	67	67
Katlang	34	34	66	66

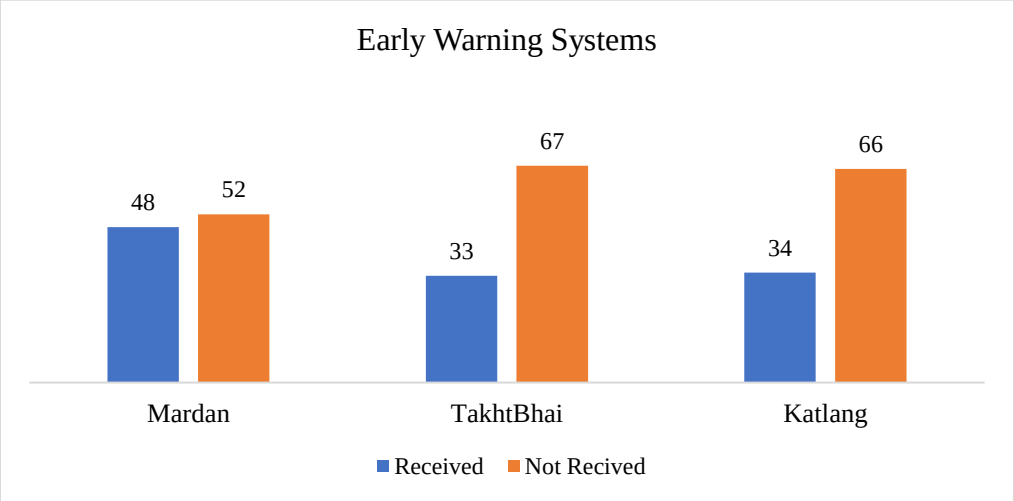


Figure 19. Respondents Early warnings received.

This graph shows the early warnings of flood received by respondents in three tehsils. In Mardan tehsil, 48% of the respondents received early warnings of the flood, while 52% of the respondents did not receive early warnings of flood. In the case of Takhtbhai tehsil, 33% of the respondents received early warnings of flood, while 67% of the respondents did not receive any warning before the flood occurs. In Katlang tehsil, 34% of the respondents received an early warning, while 66% of the respondents did not receive any warning regarding floods.

4.1.11 **Emergency shelter**

Table 15: Respondents awareness of emergency shelters.

Region	Emergency shelter			
	Aware		Not Aware	
	Freq.	%	Freq.	%
Mardan	78	39	122	61
Takht bhai	24	24	76	76
Katlang	15	15	85	85

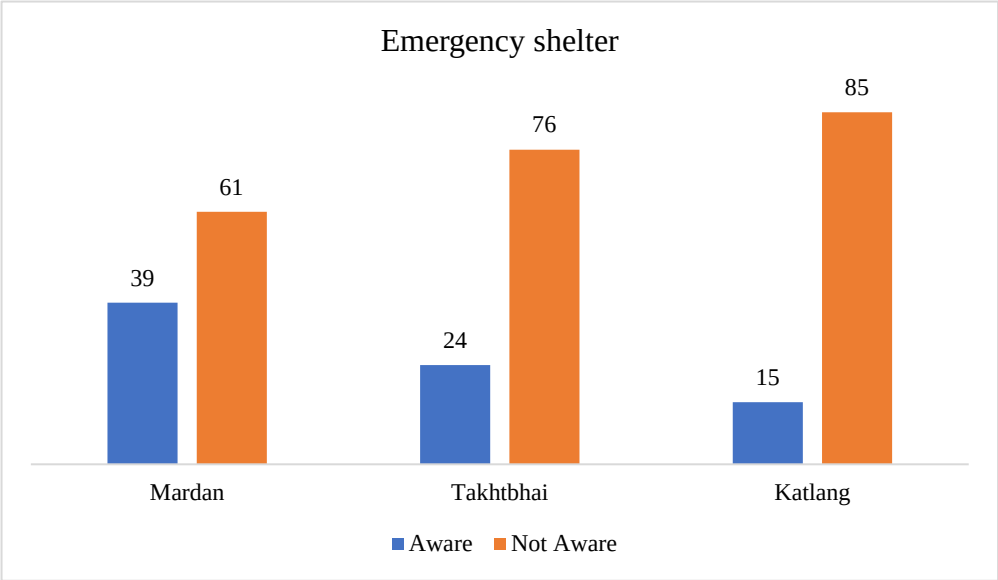


Figure 20. Respondents awareness regarding emergency shelters.

This graph shows the awareness level of the emergency shelter of respondents in three tehsils. In Mardan tehsil, 39% of the respondents were aware of the emergency shelter, while 61% of the respondents do not know about emergency shelter. In Takhtbhai tehsil, 24% of the respondents were aware of emergency shelter, while 76% of the respondents do not know about emergency shelter. In Katlang tehsil, only 15% of the respondents know emergency shelters, while 85% of the respondents do not know about emergency shelters regarding flood.

CHAPTER 5

5. VULNERABILITY AND CAPACITY ASSESSMENT

5.1 Social Vulnerability

In three communities, the households surveyed mainly had 5-10 members (64%). Almost (47%) of the households surveyed had experienced floods. Among the three communities, around 19% of the surveyed households suffered from physical disabilities, which increases the vulnerability. A significant difference (x^2 = 29.8, p-value = 0.000) was observed regarding the education level of household among the three communities. The majority of the households, around 37%, were illiterate among the three communities, but most of the households surveyed were primary to secondary schooled. This lack of education ultimately results in higher vulnerabilities and can make them unaware of the early warnings of natural hazards. In Mardan tehsil, most of the young adults surveyed were secondary to intermediate schooled while most of the elderly people surveyed were primary to no schooled. In Takhtbhai tehsil, most young adults were primary to secondary schooled, while most elderly people were primary to no schooled. Whereas, in Katlang tehsil, most young adults were secondarily schooled while most of the elderly people surveyed were illiterate or no schooled.

In Mardan tehsil, the social vulnerability index for young adults varied from 0.41-0.73, whereas for elderly people, it varies from 0.31-0.80. In Takhtbhai tehsil, for young adults, the social vulnerability index varied from 0.37-0.80, while for the elderly people, it is 0.38-0.81. In Katlang tehsil, the social vulnerability index varied from 0.35-0.73 for young

adults, while for the elderly people, it is 0.45-0.80. In terms of overall social vulnerability, a significant difference (F=3.254, p-value= 0.041) was observed among the three communities (Table. 17). The average values of overall social vulnerability in Mardan, Takhtbhai and Katlang tehsil are 0.59, 0.58, and 0.62, respectively. In terms of surveyed young adults in three regions, around 24%, 24% and 48% were highly vulnerable in Mardan, Takhtbhai, and Katlang tehsil, respectively. In contrast, for the elderly people, around 28%, 10%, and 20% were highly vulnerable in Mardan, Takhtbhai and Katlang, respectively. The higher vulnerability of Katlang tehsil young adults can be credited to limited past experience with floods. Overall social vulnerability with respect to three regions around 30% of the young adults, whereas around 22% of elderly people were highly vulnerable.

Table 16: Indicators and transformed values for the dimension of vulnerability.

Sr. no.	Indicators	Classes	Transformed values	Explanation	Empirical evidence
	Social Vulnerability				
1.	Mobility	Yes No	0 1	Mobility influences vulnerability. The higher the mobility of a person, the lesser will be the vulnerability.	(S. Balica & Wright, 2009; Hahn et al., 2009)
2.	Family size	<5 5-10 >10	0.33 0.67 1	Larger family size might result in higher vulnerabilities.	(Birkmann, 2006; Hahn et al., 2009)
3.	Disability	Yes No	0 1	The special needs of a person during an emergency reduces his/her mobility.	(S. F. Balica et al., 2012; Hahn et al., 2009)

Table 16 continued.					
Sr. no.	Indicators	Classes	Transformed values	Explanation	Empirical evidence
4.	Education level	No schooling Primary Middle High College/university	1 0.8 0.6 0.4 0.2	Having no education increases the vulnerability of a person by limited access to information and communication.	(Armaș & Avram, 2009; Hahn et al., 2009)
5.	Past experience with floods	Yes No	0 1	People having past experience with floods will predict impacts and losses.	(Birkmann, 2006; Rana & Routray, 2018)
Economic Vulnerability					
1.	Dependency	Yes No	1 0	Elderly people are more vulnerable as compared to young adults because of their dependency and mobility.	(Gain et al., 2015; Pandey & Jha, 2012)
2.	Average monthly income	<10000 10000-19999 20000-39999 40000-60000 >60000	1 0.8 0.6 0.4 0.2	Low income may result in higher vulnerability.	(S. Balica & Wright, 2009; Cutter et al., 2003)

Table 16 continued.					
Sr. no.	Indicators	Classes	Transformed values	Explanation	Empirical evidences
3.	Employment	Yes No	0 1	An employed person has a lower vulnerability as compared to an unemployed person.	(Armaş & Avram, 2009)
4.	Individual took out a loan in last 10 years	Yes No	1 0	Individuals who take out a loan in the last 10 years could be economically vulnerable.	(Hahn et al., 2009)
5.	Household having land/property outside flood-prone area	Yes No	0 1	Having property outside reduces vulnerability.	(Ben Wisner et al., 2004)
6.	Household with means of transportation	Yes No	0 1	Car ownership reduces the vulnerability of a person. The vehicle helps in immediate evacuation.	(Mazumdar & Paul, 2016)
	Institutional Vulnerability				
1.	Warning about the last flood received by an individual.	Yes No	0 1	A household that did not receive a warning in the last flood indicates the inefficiency of institutions.	(S. Balica & Wright, 2009)

Table 16 continued.					
Sr no.	Indicators	Classes	Transformed values	Explanation	Empirical evidences
2.	Understanding the national warning system.	Yes No	0 1	A household that does not understand the national warning system represents the inability of institutions to convey a proper early warning.	(Gain et al., 2015)
3.	Awareness regarding the emergency shelter.	Yes No	0 1	Lacking awareness regarding emergency shelters shows the incapacity of institutions.	(S. Balica & Wright, 2009)
4.	Support Assistance	Yes No	0 1	Support assistance not arrived on time shows the incapacity of institutions.	(Hahn et al., 2009; Rana & Routray, 2018)
5.	Safety exercise conducted	Yes No	0 1	Safety exercise not conducted by household shows the inability of institutions and hence increases institutional vulnerability.	(Birkmann, 2006)
	Capacity				
1.	Contact of Emergency Helpline	Yes No	1 0	Knowing an emergency helpline increases the capacity to reduce the impacts of any disaster.	(Mythili & Shalini, 2016)

Table 16 continued.					
Sr no.	Indicators	Classes	Transformed values	Explanation	Empirical evidences
2.	Swimming skills	Yes No	1 0	Having swimming skills reduce the impacts of floods.	(Victoria, 2009)
3.	Evacuation Route	Yes No	1 0	Knowing evacuation routes help in sudden evacuation and increase the capacity of a person.	(S. Balica & Wright, 2009)
4.	Disaster Supply kit	Yes No	1 0	A person having a disaster supply kit during an emergency have a higher capacity.	(Heagele, 2016)
5.	Means of communication (mobile phone)	Yes No	1 0	Having a cell phone or telephone increases the capacity of an individual.	(Mazumdar & Paul, 2016)
6.	Language Proficiency	Yes No	1 0	Understanding other languages than native languages increase the capacity of an individual.	(Uekusa, 2019)
7.	Rescue Communication	Yes No	1 0	Rescue communication helps in evacuation and increases the capacity of an individual.	(S. Balica & Wright, 2009)

5.2 Economic Vulnerability

The surveyed young adults were more dependent as compared to elderly people in three regions. A significant variation (x^2= 93.69, p-value =0.000) was observed regarding the monthly average incomes between the three regions. This is because the majority of the surveyed young adults were dependent on their parents.

The dependency for young adults in Mardan tehsil as compared to elderly people is high. Almost 53% of the young adults were unemployed in Mardan tehsil. The young adults were dependent on their parents as most of the surveyed young adults were acquiring education. Their parents were the sole earners in Mardan tehsil. The elderly people in Mardan tehsil were middle to high incomes, and around 35% have property outside the area of living. In Takhtbhai tehsil, most young adults were low income, while the surveyed elderly people were mostly dependent on their families for support. In Katlang tehsil, the surveyed young adults and elderly people were poor and low income, and their economic vulnerability is higher than Mardan and Takhtbhai tehsil.

The economic vulnerability index for young adults in Mardan tehsil varies from 0.13-0.83, while for the elderly people, it is 0.03-0.83. The economic vulnerability for young adults in Takhtbhai tehsil varied from 0.27-0.83, while for the elderly people, it is 0.03-0.83. The economic vulnerability index for young adults in Katlang tehsil varied from 0.29-0.84, while for the elderly people, it is 0.07-0.83. Regarding overall economic vulnerability, a significant difference (F=44.84, p-value= 0.000) was observed among the three communities in district Mardan (Table 18). The average values of economic vulnerability for Mardan, Takhtbhai, and Katlang are 0.45, 0.65, and 0.69, respectively.

In Mardan tehsil, 53% of the young adults and 10% of the elderly were economically vulnerable, while in Takhtbhai tehsil, 40% of the young adults and 66% of the elderly people were economically vulnerable. In Katlang tehsil, 44% of young adults, while 78% of the elderly people were highly vulnerable. In terms of overall economic vulnerability, 47% of young adults, while 41% of elderly people are highly vulnerable in three regions.

5.3 Institutional Vulnerability

Efficiency and reach of early warning systems, emergency planning and risk communications are all included in institutional vulnerability. A significant difference was observed (x^2 = 15.226, p-value=0.004) regarding the safety exercise conducted by surveyed households. In most surveyed households, around 60% did not receive any early warning before the flood occurs, which shows the institutes' inefficiency. About 56% of the surveyed respondents did not receive support assistance from government departments during floods. Almost 70% of the surveyed households were unaware of the emergency shelters among the three communities.

The institutional vulnerability index for young adults in Mardan tehsil varies from 0.15-0.91, while for the elderly, it is 0.20-0.93. For Takhtbhai tehsil, the institutional vulnerability index for young adults varies from 0.2-0.9, whereas for the elderly people, it was 0.20-0.97. In Katlang tehsil, the institutional vulnerability index varies from 0.23-0.93, whereas for the elderly people, it was 0.21-0.97. For overall institutional vulnerability, a significant difference (F= 11.937, p-value=0.000) as shown in (Table.18) was observed among the three regions. The average values for institutional vulnerability in Mardan, Takhtbhai, and Katlang are 0.58, 0.67, and 0.70, respectively. In Mardan tehsil,

18% of the young adults and 28% of the elderly people were institutionally vulnerable. In contrast, in Takhtbhai tehsil, 44% of the young adults and 50% of the elderly people were institutionally vulnerable. In Katlang tehsil, 21% of the young adults, while 50% of the elderly people were highly vulnerable. In terms of overall institutional vulnerability, 49% of the young adults, while 78% of the elderly people are highly vulnerable in three regions.

5.4 Multidimensional vulnerability

The results obtained from the previous sections show the three dimensions of vulnerability and focuses on the factors that influence these dimensions. In the three communities, different dynamics affect flood vulnerability. A significant variation (F=40.75, p-value= 0.000) was observed among the three regions (Table.20). Around 16%, 32% and 44% of young adults and about 14%, 60%, and 62% of elderly people were highly vulnerable in Mardan, Takhtbhai, and Katlang tehsil, respectively.

Overall, findings show interesting understandings of each dimension of vulnerability. Small variations were observed among the three dimensions of vulnerability in Takhtbhai and Katlang tehsil. Still, it shows a high variation in the economic and institutional dimension of vulnerability concerning Mardan tehsil (Figure 21).

In terms of overall vulnerability between young and elderly people, a paired sample T-test was performed. However, in social vulnerability, there was no significant difference (t-value=1.68, p-value=0.094) observed among young and elderly people (Table. 21). A significant difference (t-value=5.242, p-value=0.000) was observed between young and elderly people regarding economic vulnerability. In terms of institutional vulnerability, a

significant difference (t-value = -4.672, p-value= 0.000) was observed between young and elderly people. In overall vulnerability, there was no significant difference observed (t-value=1.418, p-value= 0.158) among the young and elderly people.

5.5 Capacity Assessment

Among the three tehsils, namely Mardan, Takhtbhai, and Katlang a significant variation (F= 74.47, p-value= 0.000) was observed among the young and elderly people (Table. 22). This shows that young adults have higher capacities than elderly people regarding floods. Overall, around 60 % of the surveyed young adults have swimming skills, while only 3% of the elderly have swimming skills. Around 70% of the surveyed young adults know evacuation routes during emergency situations, while 40% of the surveyed elderly people know evacuation routes. In terms of rescue communication, 36% of the young, while around 16% of the surveyed elderly people have contacted the local authorities for help. In terms of overall capacity, 28% of the young adults, while 18% of the elderly have higher capacities against floods.

Table 17: Overall social vulnerability of tehsil Mardan, Takhtbhai, and Katlang.

Tehsil		Classes	Very low	Low	Moderate	High	Total	Descriptive Statistics	ANOVA
	(Young)	Range	<0.49	0.49-0.57	0.57-0.65	>0.65		Minimum=0.41	F=3.254
		No. of HHs	11	13	52	24	100	Maximum= 0.73	df=2
Mardan		%	11	13	52	24	100	Mean=0.61	p-value=0.041
								SD= 0.08	
	(Elderly)	Range	<0.43	0.43-0.55	0.55-0.67	>0.67		Minimum= 0.31	
		No. of HHs	9	38	25	28	100	Maximum= 0.80	
		%	9	38	25	28	100	Mean=0.57	
								SD= 0.12	
	(Young)	Range	<0.47	0.47-0.57	0.57-0.67	>0.67		Minimum=0.37	
		No. of HHs	13	9	16	12	50	Maximum=0.80	
Takhtbhai		%	26	18	32	24	100	Mean=0.58	
								SD=0.12	
	(Elderly)	Range	<0.48	0.48-0.59	0.59-0.69	>0.69		Minimum=0.38	
		No. of HHs	4	20	21	5	50	Maximum=0.81	
		%	8	40	42	10	100	Mean=0.59	
								SD=0.09	
	(Young)	Range	<0.44	0.44-0.53	0.53-0.62	>0.62		Minimum=0.35	
		No. of HHs	6	6	14	24	50	Maximum= 0.73	
Katlang		%	12	12	28	48	100	Mean=0.62	
								SD= 0.09	
	(Elderly)	Range	<0.53	0.53-0.61	0.61-70	>0.70		Minimum= 0.45	
		No. of HHs	2	33	5	10	50	Maximum= 0.80	
		%	4	66	10	20	100	Mean= 0.62	
								SD= 0.09	
Total	Young		30	28	82	60	200		
	%		15	14	41	30	100		
	Elderly		15	91	51	43	200		
	%		7.5	45.5	25.5	21.5	100		

Table 18: Overall economic vulnerability of tehsil Mardan, Takhtbhai, and Katlang.

Tehsil		Classes	Very low	Low	Moderate	High	Total	Descriptive statistics	ANOVA
	Young	Range	<0.30	0.30-0.48	0.48-0.65	>0.65		Minimum= 0.13	F=44.8
		No. of HHs	10	36	1	53	100	Maximum= 0.83	df=2
Mardan		%	10	36	1	53	100	Mean=0.6	p-value=0.000
								SD= 0.21	
	Elderly	Range	<0.23	0.23-0.43	0.43-0.63	>0.63		Minimum= 0.03	
		No. of HHs	28	48	14	10	100	Maximum= 0.83	
		%	28	48	14	10	100	Mean=0.30	
								SD= 0.22	
	Young	Range	<0.41	0.41-0.55	0.55-0.69	>0.69		Minimum=0.27	
Takhtbhai		No. of HHs	9	7	14	20	50	Maximum=0.83	
		%	18	14	28	40	100	Mean=0.63	
								SD=0.20	
	Elderly	Range	<0.23	0.23-0.43	0.43-0.63	>0.63		Minimum=0.03	
		No. of HHs	2	6	9	33	50	Maximum=0.83	
		%	4	12	18	66	100	Mean=0.63	
								SD=0.20	
	Young	Range	<0.41	0.41-0.55	0.55-0.69	>0.69		Minimum= 0.29	
		No. of HHs	4	8	16	22	50	Maximum= 0.84	
Katlang		%	8	16	32	44	100	Mean=0.67	
								SD= 0.17	
	Elderly	Range	<0.26	0.26-0.45	0.45-0.64	>0.64		Minimum= 0.07	
		No. of HHs	5	3	3	39	50	Maximum= 0.83	
		%	10	6	6	78	100	Mean= 0.71	
								SD= 0.22	
Total	Young		23	51	31	95	200		
	%		6.5	25.5	15.5	47.5	100		
	Elderly		35	57	26	82	200		
	%		17.5	28.5	13	41	100		

Table 19: Overall institutional vulnerability of tehsil Mardan, Takhtbhai, and Katlang.

Tehsil		Classes	Very low	Low	Moderate	High	Total	Descriptive statistics	ANOVA
Mardan	Young	Range	<0.34	0.34-0.53	0.53-0.72	>0.72		Minimum= 0.15	F= 11.397
		No. of HHs	12	31	39	18	100	Maximum= 0.91	df=2
		%	12	31	39	18	100	Mean=0.54	p-value= 0.000
								SD= 0.19	
	Elderly	Range	<0.38	0.38-0.56	0.56-0.74	>0.74		Minimum= 0.20	
		No. of HHs	17	18	31	28	100	Maximum= 0.93	
		%	17	18	31	28	100	Mean=0.62	
								SD= 0.21	
	Young	Range	<0.37	0.37-0.54	0.54-0.72	>0.72		Minimum=0.2	
		No. of HHs	5	16	9	22	50	Maximum=0.9	
Takhtbhai		%	10	32	16	44	100	Mean=0.61	
								SD=0.21	
	Elderly	Range	<0.39	0.39-0.58	0.58-0.77	>0.77		Minimum=0.20	
		No. of HHs	3	6	16	25	50	Maximum=0.97	
		%	6	12	32	50	100	Mean=0.73	
								SD=0.18	
	Young	Range	<0.40	0.40-0.57	0.57-0.75	>0.75		Minimum= 0.23	
		No. of HHs	8	9	12	21	50	Maximum=0.93	
Katlang		%	16	18	24	42	100	Mean= 0.65	
								SD= 0.22	
	Elderly	Range	<0.40	0.4-0.59	0.59-0.78	>0.78		Minimum= 0.21	
		No. of HHs	2	10	13	25	50	Maximum= 0.97	
		%	4	20	26	50	100	Mean= 0.74	
								SD= 0.18	
Total	Young		25	56	60	59	200		
	%		12.5	28	30	29.5	100		
	Elderly		22	34	60	78	200		
	%		11	17	30	39	100		

Table 20: Multidimensional vulnerability of Mardan, Takhtbhai, and Katlang tehsil, district Mardan, Pakistan.

Tehsil		Classes	Very low	Low	Moderate	High	Total	Descriptive statistics	ANOVA
Mardan	Young	Range	<0.47	0.47-0.58	0.58-0.69	>0.69		Minimum= 0.36	F= 40.75
		No. of HHs	12	28	44	16	100	Maximum= 0.80	df=2
		%	12	28	44	16	100	Mean=0.58	p-value= 0.000
								SD= 0.092	
	Elderly	Range	>0.36	0.36-0.51	0.51-0.66	>0.66		Minimum= 0.21	
		No. of HHs	20	31	35	14	100	Maximum= 0.83	
		%	20	31	35	14	100	Mean=0.50	
								SD= 0.14	
	Young	Range	<0.46	0.46-0.58	0.58-70	>0.70		Minimum=0.34	
		No. of HHs	7	12	15	16	50	Maximum=0.82	
Takhtbhai		%	14	24	30	32	100	Mean=0.60	
								SD=0.13	
	Elderly	Range	<0.38	0.38-0.53	0.53-0.68	>0.68		Minimum=0.24	
		No. of HHs	3	2	15	30	50	Maximum=0.83	
		%	6	4	30	60	100	Mean=0.67	
								SD=0.13	
	Young	Range	<0.43	0.43-0.56	0.56-0.68	>0.68		Minimum= 0.31	
		No. of HHs	2	4	22	22	50	Maximum=0.81	
		%	4	8	44	44	100	Mean= 0.65	
Katlang								SD= 0.10	
	Elderly	Range	<0.44	0.44-57	0.57-0.70	>0.70		Minimum= 0.31	
		No. of HHs	3	4	12	31	50	Maximum= 0.84	
		%	6	8	24	62	100	Mean= 0.69	
								SD= 0.12	
Total	Young		21	44	81	54	200		
	%		10.5	22	40.5	27	100		
	Elderly		26	37	62	75	200		
	%		13	18.5	31	37.5	100		

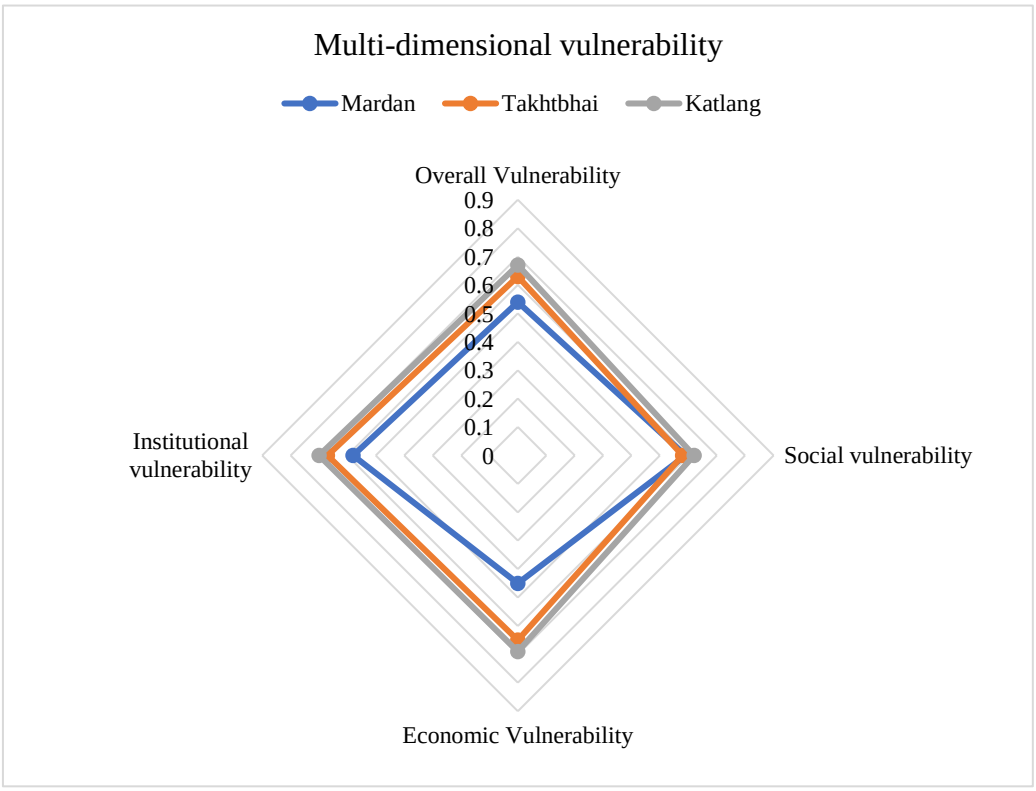


Figure 21. Multidimensional vulnerability to Rural flooding in Mardan, Takhtbhai, and Katlang tehsil.

Table 21: Multidimensional vulnerability of Young and Elderly people.

Paired sample T-Test	Young	Elderly
	t-value	p-value
Social Vulnerability	1.68	0.094
Economic vulnerability	5.242	0.000
Institutional vulnerability	-4.672	0.000
Overall vulnerability	1.418	0.158

The negative value denotes that the latter group (elderly) is more institutionally vulnerable than the former group (Young).

Table 22: Overall capacity of Young and Elderly people in district Mardan.

District		Classes	Very low	Low	Moderate	High	Total	Descriptive statistics	ANOVA
		Range	<0.32	0.32-0.50	0.50-0.69	>0.69		Minimum=0.13	F=74.47
Mardan	Young	No. of HHs	30	33	81	56	200	Maximum=0.88	df=1
		%	15	16.5	40.5	28	100	Mean=0.542	p-value=0.000
								SD=0.20	
	Elderly	Range	<0.22	0.22-0.44	0.44-0.66	>0.66		Minimum=0	
		No. of HHs	96	34	33	37	200	Maximum=0.88	
		%	48	17	16.5	18.5	100	Mean=0.33	
								SD=0.28	
Total	Young		30	33	81	56	200		
	%		15	16.5	40.5	28	100		
	Elderly		96	34	33	37	200		
	%		48	17	16.5	18.5	100		

CHAPTER 6

6. RURAL FLOOD RISK PERCEPTIONS

To examine flood risk perceptions of district Mardan, 400 questionnaires were filled face to face by the researcher, and the young and elderly people of three tehsils, namely Mardan, Takhtbhai, and Katlang, were compared. The indicators were clustered to form a category describing the thematic area of few indicators. By doing so, the categories of risk perception were identified. They were: Fear and worry, Awareness, Behavior, and Trust.

6.1 Fear and worry

It is essential to know the component of fear and worry (Sjoberg, 1998). In Mardan tehsil, around 42% of the surveyed young adults were afraid, while 39% of the surveyed elderly people were afraid of floods. However, a significant difference (X^2=63.3, p-value=0.000) between young and elderly people was observed concerning the perceived fear of floods. In terms of Takhtbhai tehsil, about 18% of young adults, while 60% of elderly showed a higher degree of fear, with a significant difference (X^2=31.1, p-value=0.000) between them. In the case of Katlang tehsil, about 12% of the young, while 64% of elderly people showed fear, with a significant difference (X^2=30.1, p-value=0.000) observed between them. The study shows that elderly people perceive more fear than young adults, and the difference in perceived fear may affect the preparedness activities.

6.2 Behaviour and Attitude

Another component of risk perception is behaviour and attitude, and it tries to predict the actions of individuals against a natural hazard. The perceived capacity to deal with floods shows how young and elderly people will behave during and after flood strikes. In the case of Mardan tehsil, no significant difference was observed between young and elderly people regarding perceived capacity to deal. Regarding Takhtbhai tehsil, a significant difference (X^2=15.40, p-value=0.004) was observed regarding perceived capacity to deal. Moreover, in Katlang tehsil, a significant difference (X^2=20.40, p-value = 0.000) was observed regarding perceived capacity to deal.

Table 23: Risk perception indicators and transformed values.

Sr No.	Indicators	Classes	Transformed Values	Explanation	Empirical evidences
	Risk Perception				
1.	Fear and Worry	Not afraid	0.2	A higher level of fear and worry increases preparedness and making way to accurate perceptions.	(Armaş & Avram, 2009; Miceli et al., 2008; Rana & Routray, 2018; Sjöberg, 1998)
		Slightly afraid	0.4		
		Neutral	0.6		
		Afraid	0.8		
		Very much afraid	1		
2.	Behaviour and attitude	Very well prepared	1	Behaviours and actions taken against flood increase adaptability and capacity.	(Rana & Routray, 2018; Sullivan-Wiley & Gianotti, 2017)
		Somewhat prepared	0.8		
		Somewhat un-prepared	0.6		
		Not at all prepared	0.4		
		Cannot judge	0.2		
3.	Awareness and knowledge	Not aware	0.2	Familiarity and experiences improve risk perceptions	(Alshehri, Rezgui, & Li, 2013; Ho et al., 2008; Rana & Routray, 2016; Renn & Coates, 2010)
		Less aware	0.4		
		Neutral	0.6		
		Aware	0.8		
		Very much Aware	1		
4.	Trust	Yes	1	Trust in different sources or information from disaster management agencies reduces the impacts of floods.	(Slovic, 1987; Sullivan-Wiley & Gianotti, 2017)
		No	0		

Table 24: Flood risk perceptions of young and elderly people in three communities.									
Flood risk perceptions Indicators	Mardan			Takhtbhai			Katlang		
	Young	Elderly	X^2	Young	Elderly	X^2	Young	Elderly	X^2
Fear and worry about floods									
Perceive extent of worry	0.64	0.88	63.3**	0.72	0.89	31.1**	0.70	0.88	30.1**
Behaviour and attitude towards flood									
Capacity to deal	0.63	0.54	7.37	0.62	0.40	15.40*	0.60	0.38	20.40**
Awareness and knowledge about floods									
Perceived extent of familiarity	0.38	0.44	10.96*	0.38	0.39	6.80	0.39	0.38	4.02
Trust									
Trust in disaster management institutes	0.52	0.39	3.40	0.48	0.30	3.41	0.42	0.38	0.167

* level of significance at 0.05, **level of significance at 0.000.

6.3 Trust and confidence

Trust of individuals in different disaster management organization has a greater effect on risk perceptions. Trust in different disaster management agencies and their policies related to risk reduction show evacuation measures to individuals in emergencies. Also, this trust eradicates the hesitance of individuals in seeking help from different disaster management institutions. A significant difference regarding all three regions (X^2=5.89, p-value= 0.015) was observed between young and elderly people. Around 49% of the young and 37% of

the elderly people trust disaster management institutions. In terms of comparing each tehsil, no difference was observed between young and elderly people.

6.4 Overall flood risk perceptions

In Mardan tehsil, the average value of fear was 0.64 for the young and 0.88 for the elderly, showing that elderly people were more afraid than young (Figure. 22). In the behaviour and attitude component, the average value for the young was 0.63 and 0.54 for the elderly. In the case of knowledge and awareness, the average value for the young adults was 0.38, and for the elderly, it was 0.44. For the trust component, the average value for young was 0.52 and 0.39 for elderly people. However, for overall flood risk perception, the average value for young was 0.54, and for elderly people, it was 0.56 in Mardan tehsil.

For the Takhtbhai region, the average value of fear was 0.72 for young and 0.89 for elderly, showing that elderly people were more afraid than young in case of floods. The behaviour and attitude component value for young was 0.62 and 0.40 for elderly people. In the case of knowledge and awareness, the average value for young adults was 0.38, and for the elderly, it was 0.39. For the trust component, the average value was 0.48 and 0.30 for elderly people. However, for the overall flood risk perception of Takhtbhai tehsil the average value for the young was 0.55, and for the elderly, it was 0.50.

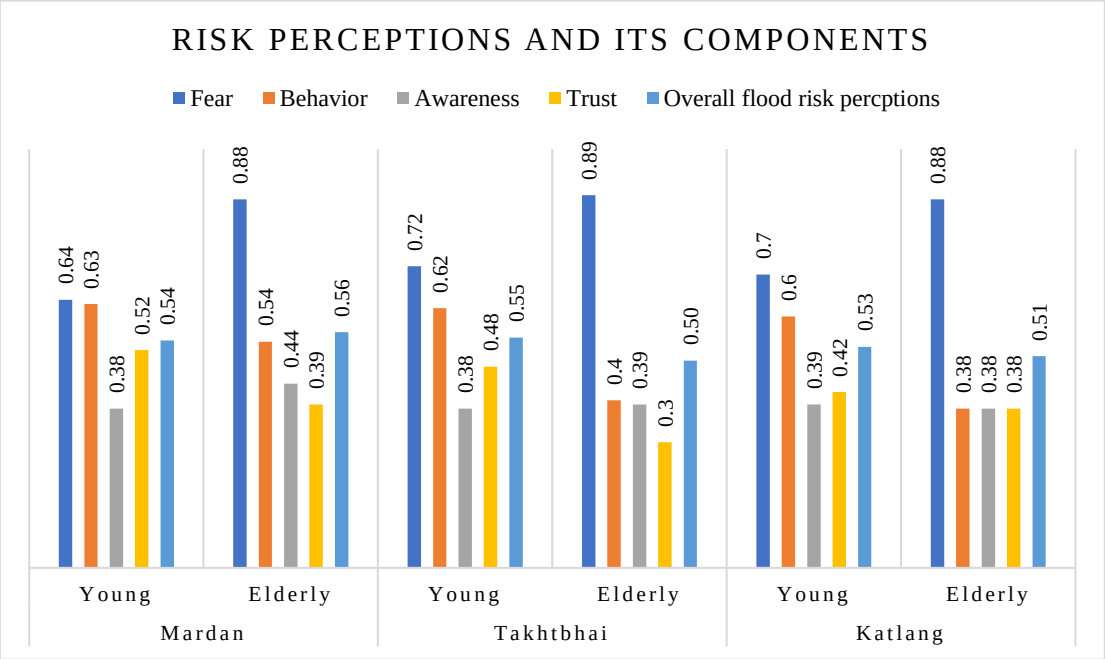


Figure 22. Risk perception and its components

In the context of the Katlang region, the average value of fear was 0.70 for the young and 0.88 for the elderly, showing that elderly people were more afraid than the young. The behaviour and attitude component value for the young was 0.60 and 0.38 for the elderly. In the case of knowledge and awareness, the average value for young adults was 0.39, and for the elderly, it was 0.38. For the trust component, the average value was 0.42 and 0.38 for young and elderly people, respectively. At the same time, for the overall flood risk perception, the average value for the young was 0.53, while for the elderly, it is 0.51 in Katlang tehsil.

Table 25: Components of risk perceptions						
Paired sample T-test	Young		Elderly		Sample paired T-Test	
	Mean	SD	Mean	SD	t-value	Sig. (2-tailed)
Fear and worry	0.67	0.22	0.88	0.16	-10.75	0.000
Behavior and attitude	0.62	0.27	0.46	0.28	5.77	0.000
Awareness and knowledge	0.38	0.20	0.40	0.25	-1.06	0.290
Trust	0.48	0.50	0.36	0.48	2.59	0.010
Risk Perception Index	0.54	0.17	0.53	0.18	0.62	0.531

Overall findings reveal interesting insights into flood risk perceptions and their components. Fear and worry are a vital and important component of risk perception, and it contributes significantly to improve the risk perceptions. It can also motivate a person in seeking precautionary measures against threats or dangers of natural hazards. The fear component between young and elderly was relatively higher than the other components of risk perceptions. However, based on t-test the average value of fear for the young was 0.67 and 0.88 for the elderly with a significant difference (t-value = -10.75, p-value = 0.000). This shows that elderly people were more afraid than young in case of floods. The behaviour and attitude component showed an average value of 0.62 for the young adults

and 0.46 for the elderly, with a significant difference (t-value= 5.77, p-value=0.000). In the case of awareness and knowledge, the average value for the young was 0.38, and for the elderly, it was 0.40. Regarding the trust component, the average value for the young was 0.48 and 0.36 for the elderly. Here again a significant difference was observed regarding trust (t-value= 2.59 ,p-value=0.010). Awareness of natural hazards and trust in government institution scored low between different components of risk perceptions. This shows that these two components require improvements. The low and moderate average values of the different component also show poor-risk perceptions among young and elderly people.

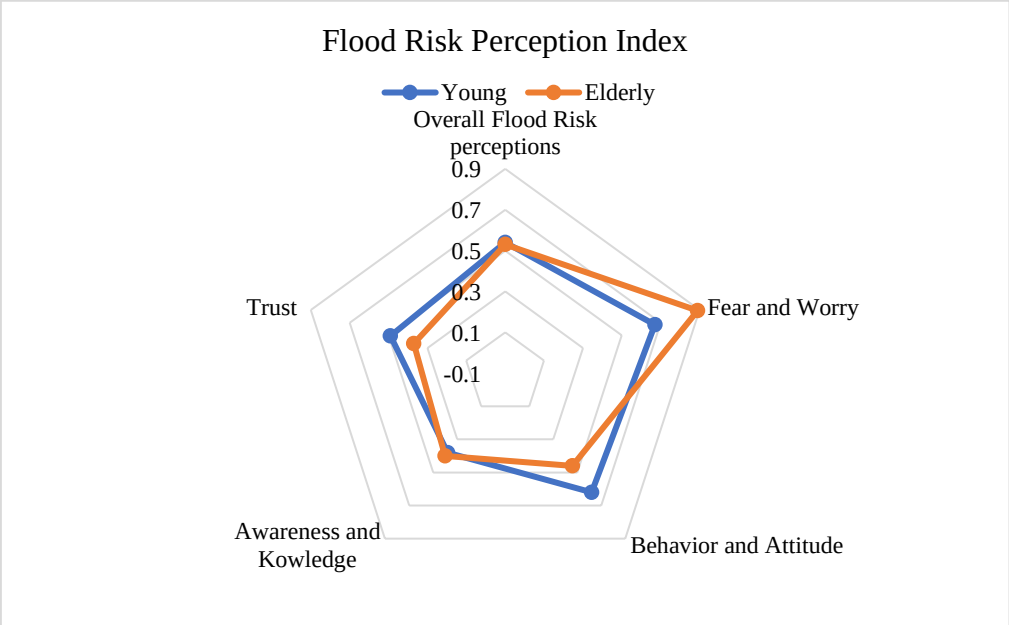


Figure 23. Overall Flood Risk Perception of Young and Elderly.

CHAPTER 7

7. INSTITUTIONAL CHALLENGES IN RURAL FLOOD RISK REDUCTION

A questionnaire was designed to understand the institutional barriers in rural flood risk reduction in district Mardan. Three institutes were selected, namely MDA, TMA, and Rescue 1122.

7.1 Mardan Development Authority (MDA)

7.1.1 **Lack of Planning**

The main function of the Mardan Development Authority is to provide housing facilities in urban areas neglecting the rural areas in the district. However, it only focuses on all development schemes in Sheikh Maltoon township. The zoning and land use plans did not cover the flood-prone areas of the district. The authority is limited to construction in only one town. They should consider the areas which are prone to floods. The development authority also makes supervision of buildings constructed along the riverside and consider it illegal.

7.1.2 **Professionalism**

The assistant director of MDA said a lack of professionals and experts in the department resulted in houses in flood-prone areas.

7.1.3 **Authority**

The assistant director of the Mardan development authority further said that we have no authority to remove the construction from floodplains. It is the responsibility of Tehsil

Municipal Authority Mardan to remove the construction from flood plains. It means that the departments have no coordination and works in isolation.

7.1.4 **Corruption**

The majority of the government departments involves in corruption. The assistant director said that a lack of the right person for the right job ultimately resulted in corruption. The development authority can stop construction activities in flood plains, but they cannot stop the community from building houses.

7.2 Tehsil Municipal Authority (TMA)

7.2.1 **Untrained Staff**

According to the Assistant Tehsil Officer of Tehsil Municipal Authority, the staff of the department is not well trained to overcome the problems of the people during and after floods. Moreover, the staff cannot remove the waste from drains and canals, resulting in environmental pollution and floods.

7.2.2 **Utilization of funds**

The funds given to the department is utilized inefficiently. The people affected were neglected in the distribution of funds. The funds were distributed mainly to those people who were not affected. In the 2010 floods, the affected people use their resources to mitigate the impacts of floods.

7.2.3 **Planning and execution**

There were no future plans developed for young and elderly people by Tehsil Municipal Authority Mardan to mitigate the impacts of floods. The majority of the population lives in rural areas and are prone to floods. The flood causes huge destruction and destroys the

crops and property of people living nearby. The plans were made, but there is no execution.

7.2.4 **Community Resistance**

Presently, the big challenge which the department faces is community resistance. The community shows resistance to government institutes in removing the settlements. The main reason for this resistance is that people do not trust the government institutes and cannot make new homes outside areas.

7.2.5 **Raising Awareness among communities**

The majority of the people in rural areas were not educated, so to give them education and knowledge about floods and climate change, they denied our claims and told us that all these floods and other disasters are the indignations of God. This is a big challenge that the TMA officials and staff face in reducing the impacts of floods.

7.3 Rescue 1122

7.3.1 **Fake Calls**

According to the Disaster Rescuer of rescue 1122, the big challenge which the department faces right now is the fake calls. Sometimes the people call the department, but no incident occurs at that place. This illiteracy and lack of awareness result in distrust among the departments and the community. The non-responsive attitude of the public ultimately results in building distrust among the community and the department, which further leads to destruction when an incident occurs.

7.3.2 **Non-responsive attitude of Public**

The non-responsive attitude of the public is a big challenge to Rescue 1122 in reducing the disaster risk. In case of emergency, the public gathers around the victim, and our team cannot move forward to the victim for recovery.

7.3.3 **Financial Problems**

The capacity of Rescue 1122 is limited, and it faces financial problems. The department resources fulfill the requirements of the certain people affected. The department will not prevent all people in case of disasters due to budget constraints.

7.3.4 **Traffic Problems**

The traffic problem is also a big hurdle to the Rescue 1122 department. In case of emergency heavy traffic, and many speed breakers on roads increase the time to reach the exact location.

7.4 Policy Recommendations

The main reason for floods is heavy rainfall in the monsoon season, starting from July to September every year. Due to improper drainage and sanitation system, a flood occurs. The majority of the drains in urban and rural areas are connected with the river nearby. As heavy rainfall occurs these rivers are full of water. Hence, the water of the rivers flows backwards in these drains, which ultimately result in floods. So, to reduce the impacts of floods, the capacity of the river to store water should be increased, obstruction and waste in the river channel should be removed. Also, the drainage system should be covered from all sides, as the open drains have low capacity and the water overflows. The riverbanks

should be concreted or filled with mountainous rocks so that floodwater should flow in the river and not damage the surrounding areas.

Media also plays a vital role in reducing the impacts of floods, while false media hype could adversely affect flood response and relief. The false media hype result in distrust among the community and government agencies. The majority of the people in KPK do not understand the Urdu language, so television channels should be broadcasted in all languages. It will help the population to understand what is happening. Also, the government agencies convey the message to different areas that are prone to floods through Mosques.

Community awareness centres should be developed in rural areas that are prone to natural hazards like floods. Local government bodies must promptly convey the message to the community to evacuate before the flood arrives. The majority of the people living in rural areas were poor and had limited capacity for knowledge and information, increasing the impacts of floods. Community awareness centres should be integrated with government agencies; to receive the message from different government agencies and convey it to those people who have no media gadgets through Mosques. The floods become disastrous when a large number of people were not aware.

The majority of the elderly people have problems in evacuation, so it should be the government responsibility to provide wheelchairs to the families that have disabilities.

7.4.1 **Improving Institutions**

For an effective DRM system, a harmonized institutional structure is required. The majority of the institutions in Pakistan have an overlapping mandate, but their chain of

command is different, which should be addressed by improving the legal and organizational framework. Combining all other existing laws into single law regulating the whole framework by forming a single authority responsible for the whole spectrum of disasters. the roles and responsibilities of each institute should be clarified so that the confusion should be resolved. The best example of harmonized institutional structure for disaster risk management is FEMA (USA) and NEMA (Korea).

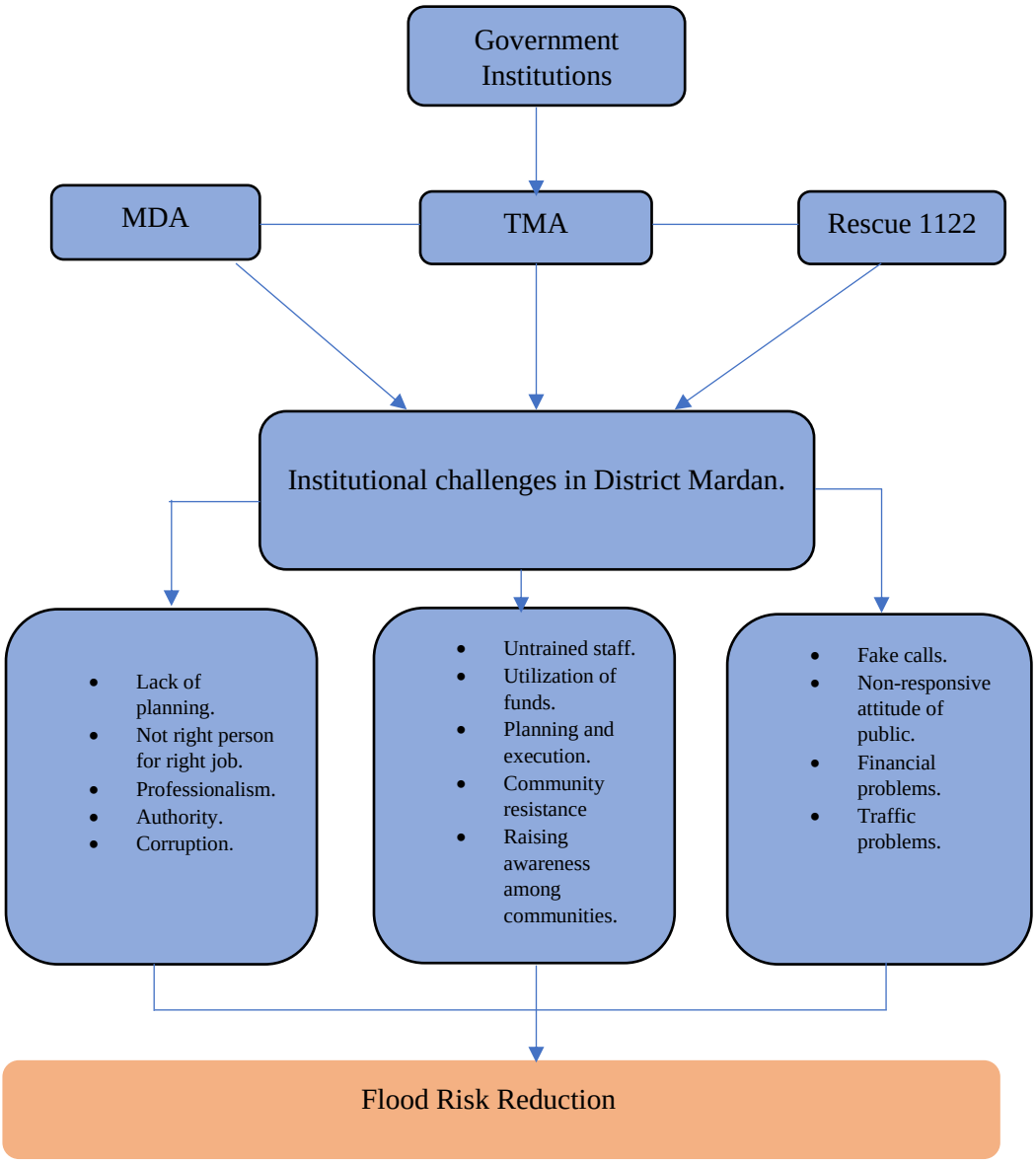


Figure 24. Institutional challenges in Flood Risk Reduction, District Mardan.

CHAPTER 8

8. CONCLUSION AND RECOMMENDATIONS

This study uses a clear methodology for measuring the vulnerability and risk perceptions of young and elderly people. It can also help policymakers, local administrations, and disaster managers to reduce the losses done previously by natural hazards. The floods in 2010 devasted the Mardan district and revealed major policy gaps in managing the impacts of natural hazards on young adults and elderly people. The people of the Mardan district were not aware of this high magnitude flood that occurred in 2010. This study analyzed the vulnerability of people based on their age. The analysis of the study revealed a clear and concise bifurcation in flood vulnerability, where elderly people seemed to be more vulnerable compared to young people. Also, young adults have higher capacities for floods as compared to elderly people. This study primarily focuses on the vulnerability of young adults aged 18-33 and elderly people aged 57 and above in district Mardan. The three dimensions of vulnerability i-e social, economic, and institutional, were covered in this study. This research assessed the vulnerability of young and elderly people, which were further analyzed based on selected indicators used under each vulnerability dimension. The risk associated with floods should be upgraded by integrating the vulnerability of communities within. It is concluded that the people of the three communities in the Mardan district could restore their living status by using their resources to mitigate the impacts of floods. Among the three communities, the elderly people were highly vulnerable as compared to young adults. The young adults were highly vulnerable to social and economic vulnerability than elderly people in the Mardan district.

However, elderly people show institutional vulnerability compared to young adults. This indicates that local government institutions cannot inform the elderly people before the flood arrives. The idea of vulnerability assessment to the disaster has gained significant importance in the last few decades, helping the practitioners and policymakers to identify the vulnerabilities and weaknesses of specific populations endangered by floods (Walters, 2015).

Moreover, this study presents a multidimensional model of vulnerability that is limited to identifying the vulnerable population and the exact dimension of vulnerability that makes the population vulnerable. The values assigned to each indicator help in finding the causal factors responsible for enhancing vulnerabilities. This research has seen a significant variation in three dimensions of vulnerability between young and elderly people of district Mardan. However, this study also assesses the flood risk perception of young and elderly people in district Mardan. In this research, different components of risk perceptions were analyzed for young and elderly people. The results associated with risk perception reveals that elderly people are more fearful than young adults.

To reduce the vulnerability of young and elderly people, more indicators and other dimensions of vulnerability can be added. More indicators and dimensions of vulnerability can be added to ultimately reduces the vulnerability of people. Lack of rescue communication, early warning systems and awareness about emergency shelters is an issue of different government agencies in Pakistan.

Different government departments were interviewed during the conduction of this research. MDA, Rescue 1122, and TMA Mardan were selected and interviewed during

this study. The main issue is that there is a lack of coordination between these government departments. These departments work in isolation which is a big hurdle in mitigating and managing the adverse impacts of natural hazards. Similarly, different government departments investigated during this study cannot counter the effects of natural hazards. The 2nd largest city of KP after Peshawar do not possess any disaster management authority. Training and mock drills should be introduced in Mardan district communities to increase awareness and capacities of people to reduce the threat posed by these natural hazards.

8.1. Contribution to studies

This study analyses the vulnerability assessment of young and elderly people in terms of floods to identify the factors which influence the vulnerability. This first part of the study contributes to the literature by developing a multidimensional vulnerability model for young and elderly people. The second part of the study proposed a risk perception index that shows how perception differs across young and elderly people. This study can have implications on the way risk is communicated across young and elderly people. The last part deals with the safety of people from an institutional viewpoint, highlighting the relationship between different institutes, and paved the way to prevent, prepare and mitigate the risk posed by natural hazards.

8.2. Limitations

This study only analysed the three dimensions of vulnerability and did not focus on other dimensions of vulnerability. This study is limited only to three regions; however, more regions were severely affected by floods in Pakistan. Moreover, this research was based

on a specific age of young and elderly people. Besides, the data was collected from a limited sample, and a more diverse sample may lead to comprehensive information on the matter.

8.3. Future Research

The future areas of research can also be about multi-hazards that occurred in a region. Moreover, this study can also be used to explore the vulnerability of people for anthropogenic hazards like terrorism etc.

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ANNEXURE

Questionnaire #_____ QUESTIONNAIRE SURVEY

This questionnaire survey is a part of research that is being conducted by the Department of Urban and Regional Planning, National University of Sciences and Technology, Islamabad. The purpose of this research is **to assess the vulnerability of elderly and young adults. The data collected will not be used for any other purpose than the stated purpose.**

SECTION 1. GENERAL INFORMATION

1. Age (in years) _____ 2. Gender _____ 3. Family size _____
4. Income _____
5. Are you suffering from any disability (such as listening, speaking, hearing, walking or any other disability)?
   Yes ☐ No ☐. If yes, name of the disability: _____

SECTION 2. EDUCATIONAL INFORMATION

6. What is your level of education?
   Primary ☐ Secondary ☐ Intermediate ☐ Graduate ☐ No schooling ☐
7. Have your school/institute conducted any safety exercises/drills about disaster?
   Yes ☐ No ☐
8. Are you aware of the disaster safety plan of your area?
   Very much aware ☐ Aware ☐ Neutral ☐ Less aware ☐ Not aware ☐
9. Do you understand the Urdu language? **Yes ☐ No ☐**

SECTION 3. ECONOMIC INFORMATION

10. Have you taken any loan in recent years? **Yes ☐ No ☐.** If yes, In which year?
    Year: _____
11. Do you have sufficient money to deal with emergency situations? **Yes ☐ No ☐**
12. Are you dependent? **Yes ☐ No ☐.** If yes, name any relative/organization: _____
13. Do you have any property/assets outside the area you living in? **Yes ☐ No ☐**

SECTION 4. DISASTER EXPERIENCE

14. Have you ever experienced any disaster (such as Floods)? **Yes ☐ No ☐**
15. If you have experienced floods, then answer the following from I- IV?
    I. Are you able to move to a safe area? **Yes ☐ No ☐**
    II. Do you have enough food to survive for next week? **Yes ☐ No ☐**
    III. Did your neighbors/ relatives help you in disasters? **Yes ☐ No ☐**
    IV. Did the government agencies supply you with any shelter and food?
    Yes ☐ No ☐

16. Did you receive any message from Disaster Management Authority before the flood occurs? **Yes ☐ No ☐**
17. How much reliable is the information you received from different sources?
Very much reliable ☐ Reliable ☐ Moderate ☐ Less reliable ☐ Very less reliable ☐
18. How much you agree/disagree with government agencies/ institutions?
Strongly agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree ☐

SECTION 5. DISASTER PREPAREDNESS INFORMATION

19. How much are you afraid of floods?
Very much afraid ☐ Afraid ☐ Neutral ☐ Slightly afraid ☐ Not afraid ☐
20. Do you think that floods can occur because of human intervention? **Yes ☐ No ☐**
21. How well are you prepared for future floods?
Very well prepared ☐ Somewhat prepared ☐ Somewhat unprepared ☐ Not at all prepared ☐ Cannot judge/Do not know ☐
22. Do you know about Early Warning Systems for a flood? **Yes ☐ No ☐**
23. Do you have access to the following facilities?

i) Electricity	**Yes ☐ No ☐**	v) Clean Water	**Yes ☐ No ☐**
ii) Sanitation	**Yes ☐ No ☐**	vi) TV	**Yes ☐ No ☐**
iii) Mobile phone	**Yes ☐ No ☐**	vii) Radio	**Yes ☐ No ☐**
iv) Telephone	**Yes ☐ No ☐**	viii) Car / Motorcycle	**Yes ☐ No ☐**

24. How much do you trust in Disaster Management agencies dealing with flood hazards?
Strongly trustful ☐ Trustful ☐ Neutral ☐ Untrustful ☐ Strongly untrustful ☐
25. Do you trust disaster management policies? **Yes ☐ No ☐**

SECTION 6. CAPACITY INFORMATION

26. Do you have a disaster supply kit (containing water, food, battery-powered or hand-crank radio, flashlights, prescription medications)? **Yes ☐ No ☐**
27. Are you a good swimmer? **Yes ☐ No ☐**
28. Do you know the contact of any family of your member? **Yes ☐ No ☐**
29. Do you know any emergency helpline? **Yes ☐ No ☐.** If yes, name of helpline: _____
30. Do you contact the emergency helpline in case of floods? **Yes ☐ No ☐**
31. Is there any evacuation route you think will help me out during flood? **Yes ☐ No☐**
32. Do you have any assets/resources to cope with floods? **Yes ☐ No ☐**

SECTION 7. INSTITUTIONAL VULNERABILITY

33. Did the government agencies support assistance to arrive on time? **Yes ☐ No ☐**
34. Do you understand the National Warning System? **Yes ☐ No ☐**
35. Did the government institutions/agencies warn you about floods? **Yes ☐ No ☐**
36. Are you aware of the emergency shelter? **Yes ☐ No ☐**

SECTION 8. INSTITUTIONAL RESPONSE TO FLOOD RISK REDUCTION

	Questions asked from different government institutions
1.	What are the barriers which prevent government institutions/agencies from delivering support to the affected population?
2.	How your job responsibilities relate to Disaster Risk Reduction?
3.	What are the challenges your organization/department faces in handling/managing the impacts of young adults and elderly people?
4.	In your opinion, which aspects should be improved in your department? I. Technical II. Financial III. Planning and execution IV. Governance
5.	In your opinion, what are solutions for reducing the impacts of floods for young and elderly people?

ANY SUGGESTIONS