COST OF FLOOD AND ITS MITIGATION STRAT EGIES: A CASE STUDY OF DISTRICT CHAR SADDA KHYBER PAKHTUNKHWA

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CERTIFICATE

This is to certify that this thesis entitled: **"Cost of Flood and Its Mitigation Strategies: A Case Study of District Charsadda Khayber Pakhtunkhwa"** submitted by **Mr. Muhammad Isa Khan** is accepted in its present form by the PIDE School of Economics, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree of **Master of Philosophy in Environmental Economics**.

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Author's Declaration

I Muhammad Isa Khan hereby state that my M.Phil. Thesis titled COST OF FLOOD AND ITS MITIGATION STRATEGIES: A CASE STUDY OF DISTRICT CHARSADDA KHYBER-PAKHTUNKHWA is my own work and has not been submitted previously by me for taking any degree from Pakistan Institute of Development Economics or anywhere else in the country/world.

At any time if my statement is found to be incorrect even after my Graduation the university has the right to withdraw my M.Phil. Degree.

Date: 03/02/2022

Muhammad Isa Khan

Dedication

All dedications go to my father, mother and siblings

My inspiration, my world!

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First of all a special gratitude and special appreciation goes to Allah the almighty; without His blessings I would not be able to think of completing this work. After that, I offer my admirations and respect from the core of my heart to the Holy Prophet Muhammad (Peace be upon him) who urges his followers to “Seek knowledge from cradle to grave”. I would also like to pay my humble thanks to my beloved parents, who prayed for me a lot and always encouraged me and guided me in a proper way and advised me not to lose heart. They helped me through thick and thin every time I needed them. Gave me the true purpose of life and the reason to feel pride after so many hurdles and fears to conquer.

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Abstract

Floods are one of the most devastating natural disasters, which takes down houses, schools and other infrastructures and life as a whole. The research area of the study was district Charsadda which is highly vulnerable to floods. In Charsadda, floods have caused a significant amount of losses to the households and businesses. The objective of the study is to determine what factors affect mitigation measures and cost of flood at household's level. A hypothesis was laid down that age, gender, education, distance, ownership, house type, family size and value of assets has significant effect on mitigation strategies of flood. Also that cost of flood has association with education, distance, ownership, house type, family size and value of assets. The study was conducted using the primary data, which were collected through questionnaires from dwelling units, along the side of river banks. A sample of 160 households was collected from four villages of district Charsadda and analyzed through Poisson and OLS regression models. Mitigation measures varies from 1 to 8 whereas on average three mitigation measures have been adopted by households. For paved house 1 is used and zero is used for unpaved houses. 51% of the houses are paved. The average distance from river bank is 231 meters. 33% of houses were owned while 67% were rented. Education level; was poorly low across the region, on average 6 years of schooling was recorded. Among mitigation measures mostly used were elevated ground floor and canals and drainage cleaning which were 73.24% and 88% used by households respectively. The average cost of dikes by a household were Rs.3534 and average upscale of ground level height were Rs.0.259465 million. Poisson results indicate significant positive relationship of paved house owners, male household heads, increase in distance from river and higher education level with mitigation measures against flood. Whereas OLS shows significant positive relationship of cost of flood with value of assets, distance and education level in the region. The study found that situating houses on banks of rivers will cost significant losses to the household economy. The study found that paved house structured households have faced less damages and lower cost against floods hits.

Keywords, *Floods, coping strategies, vulnerable, precautionary, assemble, safeguard, mitigation measures and household*

Contents

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

Background of the study

Floods are the most frequent natural disasters which are frequently occurring as a result of sea level rise and heavy precipitation, both of which are due to the result of climate change (I.P.O.C.C, 2007). Floods can also be caused by anthropogenic factors such the lifestyle of dwellings besides rivers. The intensity and frequency of these floods, particularly in the region of south and south-east Asia have accelerated in the previous several decades (Mushtaq, 2008) and have caused catastrophic losses, mainly because of excessive vulnerability and exposure of inhabitants and their homes to these floods (Rahman et al., 2013).

Human being's exposure and vulnerability to floods has been accelerated over time. It has been predicted that the numbers of people exposed to the deadliest natural disasters will be doubled by 2050 (Brenes, 2014). Estimates show that the frequency and depth of flooding, mainly in south and Southeast Asia have extended during the Last several decades ((Mushtaq, 2008). According to a world disaster report published in 2000, casualties were 8408 globally from floods and almost 186,894 people were affected from these natural disasters in the shape of flood. Disasters worldwide have increased, particularly the hydro-meteorological disasters (Krausmann & Mushtaq 2008, Rahman & Khan 2011, Kellens et al. 2013, Qasim et al. 2015).

The economic costs of flood management are increasing over the years due to frequently occurring floods and lack of economic resources to manage it (Masozera, 2007). Floods have caused significant amount of losses to developing countries because lower quality of infrastructure and low level of income does not allow them to fight against floods (Changnon 2005, Ali 2007).

1.1 Introduction

Asia is also called the supermarket of natural disasters because India, Srilanka, Bangladesh and Pakistan, all the developing countries have faced disastrous floods during the past two decades (Mirza 2003, Vuren et al. 2005). Pakistan became one of the most vulnerable countries to floods, within the last two decades, Pakistan has faced a number of floods causing a lot of damages. The country has faced 22 disastrous floods since it came into being in 1947 (FFC, 2014). Floods are re occurring phenomenon in Pakistan and cause huge losses to standing crops, properties and indeed human lives (Qasim et al, 2015). During August 2010, Pakistan experienced floods that affected 20 million people in 78 districts, also had killed 1800 people in Khyber Pakhtunkhwa, among these statistics, 60% casualties were due to floods. Since our nation's independence till 2010, Pakistan has faced a loss of $10 billion due to floods.

As per Damage Need Assessment (DNA), a report of ADB and World Bank, the floods affected area is 160,000 km2 in Pakistan, which is almost one fifth of the country area, also 1,985 lives had been affected due to these floods, damaging around 1.5 million houses and more than 17 million acres of cropland has been damaged, about 20 million people have been displaced due to occurring of floods. During the last few decades a cumulative economic loss of 38.06 billion USD$ has been materialized to the economy of Pakistan (FFC, 2014). In Pakistan, the Floods are entered through the proximities of Kabul, Indus and swat rivers (Ahmad et al., 2011). The occurrence of floods became a part of daily life in Pakistan.

People have started adopting with frequently occurring floods and also mitigation measures by households and overall community is significantly helpful to provide security against floods (Few 2003, Wisner 2004, Routray 2010, Islam 2012, Mavhura et al. 2013). Both the structural and nonstructural flood coping measures which are used in Pakistan are helpful to deal with

flood hazards (Ran and Budic, 2016). Through government measures these flood risks can be tackled by establishing fundamentally sound policies and educating people how to deal with these floods. The training and guidance for people of flood prone communities have shown effective and economical efficient reallocation results to safeguard against flood consequences (Abbas et al., 2015).

The Khyber Pakhtunkhwa province is at excessive risk of flooding due to its topography and climate trade (Atta-ur-Rahman & khan 2013, Qasim et al. 2015). Historical statistics display that floods have affected the densely populated districts of Charsadda, Noshera and Peshawar almost each year (khan et al. 2013, Sabir et al. 2013, Qasim et al. 2015). District charsadda people have faced significant economic losses due to the occurrence of floods and they also have invested

in protection measures to minimize or mitigate the consequences of floods in these regions. This study undertakes the task to explore the influencing factors of mitigation measures used by households to safeguard against floods and cost of flood at household level. The study is based on primary data, collected through questionnaires. Mitigation measures are important for the protection from the effects of floods but each mitigation measure has a cost, which makes it restricted for the poor segment of the society to adopt such flood mitigation policies, which if not adopted can lead to severe damages for households and societies. There is also a need to know the consequences of such floods. So in order to recommend or introduce a policy for households, it should be based upon the significance of the damages related to floods for such regions. Based on such policies coping measures are adopted which better suit households.

1.2. Area of the study

Area of the study is District Charsadda which lies in the north-western part of Peshawar city. It is 17km from Peshawar city, with 46 union councils overall. Topography of district Charsadda comprises a surrounding belt of high lying land, which traverses down from the foothills and the central plains, namely “Doaba” and “Hashtnagar” all of them are under irrigation and are richly cultivated. The riverine area lies close to the river Swat and river Kabul and river Jindi. Charsadda has been continuously on the receiving end of variations of floods almost every year.

These floods vary in intensity but roughly on average after every 3 to 4 years flood comes in the region. These floods cause agricultural damages, damages to houses, shops, mosques, health, lives, poultry farms and most importantly the prosperity of local peoples in the region. Three rivers flow across the district of Charsadda i.e. river Jindi, river swat and Kabul River. In 1996 the flood washed away 498 houses, crops of 490 acres were damaged and the area cost approximately 6520000 cost. Whereas in 1999, 91 houses were damaged, 401 acres of crops were damaged and a total of 7,570,000 cost was borne by the area. A thickly populated village resides along the river which in case of flood intensifies the magnitude of flood and its damages. Filling of its bed with sediments and structural misadministration also trigger the flood during floods. The River causes damage to houses, poultry farms, crops, shops, lives, mosques, lands and animals. Floods over the years have caused a lot of loss and damages in the region.

1.3. Integrated approach to cope with floods

Physical prevention of floods through technological means is most likely to create serious threats to the sustainability of flood plain ecology and sociocultural resources. Total risk of floods cannot be eliminated through only public flood protection measures. Therefore, private mitigation is necessary to safeguard against flood risks. It is well accepted universally that involvement of

local inhabitants has an efficient and effective role in the management of flood risks(Bubeck 2012, Hylton 2014). Those policies which involve the inclusion of locals and communities and their concerns, those policies are more effective in comparison to other policies based on mere perceptions and assumptions instead of inclusion of local peoples (Lopez-Marrero and Yarnal 2010, Birkholz 2014, Osberghaus 2014). Those communities where flooding is low and their socio-economic backgrounds are strong, are more resilient to floods in comparison with those areas where floods are more frequent and also their socio-economic backgrounds are weak. Indigenous knowledge systems are an indispensable component of natural disaster resilience building (Emmanuel Mavhura et al, 2012). Indigenous knowledge has been a component of traditional disaster management. Flood has a disastrous impact on people's socioeconomic conditions and the environment in particular that supports them.

The impact of these floods not only depend upon the magnitude of the floods but also on variables like income, awareness, education etc. and the mitigation measures adopted by individuals. Combination of geographic location, social physical infrastructure, with an economically backward country and a socially vulnerable environment can turn a flood into a flood disaster(Custers 1992, Haque and Zaman 1993, Wescoat and Jacobs 1993, Paul 1997, Hutton and Haque 2004).

1.4. Problem statement

The region has been flooded almost every year on average. Due to lack of proper government actions and policies, the locals are facing huge agricultural, economic and social damages. Such floods affect the livelihood, infrastructure, health and overall lifestyle of the local peoples. The structural and nonstructural system in Charsadda region is not well established due to which the households in the region largely depend on their own flood coping strategies. But due to lack

of resources, knowledge about floods and socioeconomic problems, the dwellers don't have much potential to fight against flood risks. Also there are no regulations regarding land management and most of the houses are built under flood prone zones.

1.5. Hypothesis of the study

To achieve objective of the study following hypothesis have been developed.

- A. H0.There is no significant effect of age, gender, education, distance, ownership, house type, family size and value of assets on mitigation strategies of flood.
- H1. There is significant effect of age, gender, education, distance, ownership, house type, family size and value of assets on mitigation strategies of flood
- B.H0.The cost of flood has no significant effect on education, distance, ownership, house type, family size and value of assets.
- H2.The cost of flood has significant effect on education, distance, ownership, house type, family size and value of assets.

1.6. Significance of the study

Great amount of work has been done worldwide about floods and its mitigation strategies. In Pakistan and specifically Khyber-Pakhtunkhwa a great deal of work has been done in the likes of Qasim.et al., (2017), Baqir et al., (2012), Rayhan et al., (2012), (Shah et al., 2020). But no work have been done at household level in district Charsadda about the impact of floods. The study will contribute to existing literature by determining mitigation strategies and cost on these mitigation strategies adopted by households. Based on this study policies will be recommended which will be helpful to safeguard against floods in future.

1.7. Objectives of the study

Investigated the influencing factors of the mitigation strategies adopted by households.

Investigated the influencing factors of cost on mitigation measures by the households.

1.8. Research questions

1. What are the determinants of mitigation strategies against floods at household level?
2. What cost is associated with mitigation measures adopted against floods and its influencing factors at household level?
3. What will be the possible policy recommendations according to results of the study?

CHAPTER 2

LITERATURE REVIEW

2.1 Background

Before going into details, it is important to analyze the nature of disasters and its implications in different regions of the world. This section therefore compiles the literature review under three sections. First section discusses the general background, the extent of damages and frequency of events globally followed by coping strategies adopted and then by determinants of coping measures and cost.

Lugeri et al., (2010), studied the spatial distribution of river flood risks in Europe in monetary terms. The results were in terms of yearly average damages that highlights those areas whose economies are under threat to river floods. Annual average flood related damages were estimated and were in absolute monetary terms and in percentage of Gross domestic product. With change in climate the damage from floods tends to increase due to an increase in population exposure to such floods. Poor communities don't tend to prioritize natural hazards over economic concerns as poverty pushes them towards flood prone regions. Therefore climate extreme variations are expected to fall disproportionately on the poor. Mitigation in such risks can be done at micro level through households and community involvement

Dorosh et al., (2010), study elucidate Asian countries' challenges in handling with the 2010 floods These challenges include funding channeling, a lack of cooperation between federal and provincial agencies, flood damage restoration issues, political inconsistency, capability and delivery issues, the lack of early warning systems, and mainstreaming concerns for women and youth. Market and trade policies; institutional framework and sources of financing; livelihood programs

to assist and welfare transfers; and agriculture and infrastructure reconstruction are among the study's lessons learned from South Asian disasters.

Shahzad et al., (2014), Disasters have a significant negative impact on the gross domestic product of Asian countries, according to a study. Furthermore, due to its geographical location, the Asian nation is regarded as a disaster-prone nation. Floods and monsoon rains have always had the potential to damage Asian countries. According to the study, a disaster might have a negative impact on the gross domestic product, resulting in a drop of US$ two.38×106.

Brouwer et al., (2007), poorer people, according to this theory, live closer to the stream, are more exposed to flooding, and hence are more vulnerable. Flooding levels are also higher in impoverished houses. As a result, larger degrees of exposure are linked to greater differences in endless access to land. Difference additionally results in increased flood damage, corroborating the premise that unequal financial gain distribution adds to socioeconomic vulnerability identified in the literature. In relative words, the impoverished suffer more, but not in absolute terms. As a result, increased government participation is plainly required to provide either more flood protection or direct disaster relief. Furthermore, programmers promoting financial equality may be effective.

Pakistan is one of the most vulnerable countries associated with natural disasters. 60% of the nation’s land is flood vulnerable. The country faced the worst flood in human history affecting 20,356,550 people with a death toll of 1802 and injuries sustained 2994. Infrastructure was damaged, the flood causing both direct and indirect losses’ (Hague et al., 2011)tried to identify Causes, impacts and evaluation of 1998 flood to adjust in mitigating flood hazards. There is Need to encourage villagers to identify best possible ways to safeguard themselves along with their crops, livestock through improved measures of flood management and preparedness.

(Kronstadt et al., 2010)According to a study of the 2010 floods, three.3 million hectares of standing crops, including rice, maize, cotton, sugarcane, fruit, orchards, and vegetables, have been broken or lost completely as a result of flooding, with about 1.3 million hectares affected within the four worst-affected provinces. This is the cropped portion of the whole space in 2008 for Bastille Day. Agriculture is the backbone of Pakistan's economy. It accounts for about a third of the country's gross domestic product, employs about a third of the working class, and generates about an hour of the country's export earnings. Crops, livestock, fisheries, and biological science, respectively, account for sixty-five percent, 31 percent, and four-dimensional of Pakistan's agricultural GNP. Around 80% of people in the flood-affected area rely on agriculture to make a living. Although assessments of the medium and long term repercussions on Pakistan's agricultural sector are still ongoing, the populace who have experienced serious losses in the form of crop, livestock, and grain stock. Floods have wreaked havoc on Asian countries' densely populated stock areas. In 2006, the nations' stock population was estimated to be 217 million animals, including buffalo, sheep, oxen, goats, donkeys, and poultry. According to estimates, almost 1.2 million cattle and a half-million chickens have been slaughtered.

Due to the government of Pakistan's continuous failure to deal with the flood situation, their occurrence occurs to be a regular phenomenon due to which the country is facing floods and indeed left the nation in a vicious cycle of international relief assistance and facing declining economic growth. The nation experienced the worst flood in 2010, displacing fifty million people and submerging 50,000 square km land. Robert Looney, (2011) aims to study the Economic costs of floods in Pakistan. These costs are categorized depending on their nature, these costs are direct, indirect and reconstruction costs.78 districts were impacted with 1980 casualties, 70 percent of infrastructure were disturbed, 1.6 million houses, 10,000 schools and 500 hospitals were damaged.

The flood resulted in disturbing services, flow of economic services, revenue, and production flow and caused an increase in costs of production. Expansion in entrepreneurial efforts by Robert looney would help to increase trade liberalization which will help to boost the country's economy and result in a sustainable economy to fight against floods.

Since Khyber Pakhtunkhwa exists on a weak tectonic zone, the province has experienced eight mega floods in the span of previous 25 years, among them 2010 flood was most dangerous, which affected overall 25 districts of Khyber Pakhtunkhwa. Vulnerability and resilience of households to flood disasters in district Charsadda and Nowshera was analyzed by (Shah, 2018). The study findings revealed that Nowshera households were more vulnerable and less resilient in contrast to Charsadda. Provincial and local authorities can play a vital role in reducing flood impacts through capacity building, training, preparedness, and awareness about coping with floods damages.

Qasim.et al., (2017) Study objective was measuring the vulnerability of the communities living in the flood prone area of KP province. For this purpose Primary data was collected from 280 households of three villages and the director of the center for disaster preparedness and management. Subjective assessment techniques used to allocate weights to selected indicators of vulnerability. Overall vulnerability as well as composite vulnerability for the locations were very high. Through socio economic uplift the adaptive capacity of the communities should be enhanced.

Baqir et al., (2012), Following the 2010 floods in Khyber Pakhtunkhwa, a survey revealed the medical specialty of seven diseases. Diarrhea, skin and eye infections, malaria, hepatitis, and metastatic infections are all caused by these diseases. According to lunatic's (2012) assessments, the 2010 floods severely harmed Pakistan's economy, with both short- and long-term conse-

quences. Impacts in the short term Measurement of agricultural, as well as manufacturing, refugees, state, and commercial company deficit stress, as well as long-term consequences Inflation, a redoubled economic situation, and supply limits are all factors to consider. Mistreatment of these conventions has resulted in a total loss of $10.056 billion, which comprises direct (64.6%) and indirect (35.4%) damages caused by the floods. Half of the injuries occurred in the agriculture sector (50.2%), followed by housing (15.8%), transportation and communications (13.2%), and other sectors (13.2%) can even have a densely packed. At the end of the 2010–2011 fiscal year. A more accurate picture of the flood's impact has emerged. The floods appear to have had a limited effect on the economy as a whole, with a two-percentage-point increase in gross domestic product. In 2010–2011, the agricultural industry grew at a moderate rate of 1.2 percent, compared to a target of three.8 percent. The devastation of major crops, particularly rice and cotton, has led to a four-dimensional semiconductor diode in main crops. Rice production has fallen to four.8 million tons, the lowest level since 1994–1995. For 40 kilograms of wheat, the price has more than doubled, from 425 to 950 rupees (4.9 to 11 dollars). The cost of procuring various types of rice has more than doubled, and the cost of cot-tons has more than quadrupled. In 2010–2011, growth in large-scale manufacturing fell to 1% from 4.9% the previous year. The tumultuous impacts of the floods, no doubt, contributed more to inflation than would have been the case in a normal situation. Inflation increased to 15.7% in September 2010 from 12.3% in the previous month of the Gregorian calendar. Unfortunately, the people who are most seriously impacted are mostly small farmers and unskilled la-borers. They are Asia's most vulnerable people, with the majority living on or around the national poverty line. According to preliminary estimates from the United Nations Development Program, the floods put an additional four dimensional of Pakistan's population below the

calorie-based poverty line, primarily in rural areas. According to the World Bank, about two families control roughly one-fifth of the total territory. Giant farmers have also monopolized water and agriculture subsidies, with the current system primarily influenced by rural economic conditions.

Qasim et al., (2016) Study aims to Measure community resilience of flood prone areas of KPK. Both primary and secondary were used to analyze the resilience in such areas. Resilience was very low for all three sites. Preparedness, awareness and structural and nonstructural measures would help to enhance the resilience of such areas against flood risks. The study focused on changing the attitude of such regions through seminars and workshops as they believe flood comes due to God's will. Warning system needs to be improved. Also opportunities should be provided to reduce poverty.

2.2. Coping strategies

Shah et al., (2016), study aims to reveal the Post flood effects and mitigation strategies by households. The Probit model was used for estimating the factors affecting the choice of different flood mitigation strategies by households. Among various socioeconomic factors, financial means, land use planning and flood warning systems were major constraints in flood risk mitigation. Elevated ground floor, construction of houses with reinforced material, precautionary savings and foundation strengthening were the major adaptation measures at household level.

(Islam et al, 2012), has explored local people’s survival strategies and variation in people’s ability to deal with floods and soil erosion has been assessed through primary and secondary data. People’s ability to cope with floods depends on their social situation and environmental conditions. From drinking water availability to loss to earnings, assets and food availability has been affected by floods in the area. People's coping measures involve placing barriers around their houses, their

house platforms are raised, reduction in meals per day, reliance on inexpensive meals and relief, assets selling and borrowings. The study found that with sound early warnings, integration of local mitigation techniques with new technology and also socio economic condition improvement could significantly reduce the loss from floods and erosion from rivers.

Heidi Kreibich et al., (2010), investigates recent changes in the flood preparedness in Germany among businesses and households after 2002 and again after the 2006 flood in Elbe through primary data. Rise in flood losses in 2002 was due to increase in economic development and residential development. Where significant differences were found after the 2002 floods. Due to lack of experience in 2002 both business and households were not prepared which then after tackled by undertaking precautionary measures such as planning, maintenance efforts and cost based measures such as flood insurance, water barrier shields against flood, flood adapted building use etc. and some other emergency measures such as safeguard documents and valuables, putting contents upstairs, drive vehicles to safe areas. Through technology the physical prevention of floods is likely to create threats to floodplains sustainability so therefore indigenous knowledge and mitigation measures of the locals should be promoted.

Haque et al., (1993), examined the Causes, impacts and evaluation of 1998 flood to adjust in mitigating flood hazards. Hence there is a need to encourage villagers to identify best possible ways to safeguard themselves along with their crops, livestock through improved measures of flood management and preparedness.

Tod et al., (1998), study focused on Mitigating flood losses in the active floodplains of Bangladesh. To analyze impact of floods and potential use of flood proofing to reduce vulnerability of peoples Primary Data were taken from households. There has been very minimal government

support and households have developed their own flood coping strategies among them three mitigation were more cost effective i.e. provision of boats in floods, house rising and interest rates at low rates along with local relief flood shelters. These measures are dependent on their local conditions. There has been a need for technical assistance and government commitment along with resources to improve living conditions of active flood plains. Almost 8408 people lost their lives globally and 186,894 were affected by 2010 floods according to the 2011 world disaster report 2011.

Sultana et al., (2012), study aims to find what coping strategies are followed by flooded houses and how? Primary source of data was used and Tobit model was used. The study showed that the highest ratio was borrowing food and cash to cope with floods. Almost 75% of households used saving as a coping mechanism. Whereas coping strategies are divided into three categories i.e. current adjustment, unsaved and secured borrowings by peoples. Private flood mitigation is required as public flood measures can't eliminate the total risk of floods. Private mitigation is an essential part of flood risk management.it helps to reduce the damages associated with such natural hazards and is also cost effective. The household uses many coping measures among them are adapted use, structural measures, information seeking etc. private flood mitigation depends mostly on the socioeconomic status of the households along with flood experience, damage expectations, moral hazard etc.

According to (Bubeck et al., 2012), the study aimed to provide an explanation to weak relationships found empirically between risk perceptions and precautionary behavior. An integrated approach is required that should focus on both prevention from floods and the alleviation of its impacts. Fatalism is among few barriers towards such mitigation behavior. Although floods can be coped with the help of risk management, there is need for improvement regarding mitigation

measures improvement which can be enhanced through household flood coping strategies introduction.

Kreibich et al., (2011), studied the Efficiency of precautionary measures taken by households against floods. The study found that Investments should be based upon the risk associated with flood proneness. There should be mandatory precautionary measures for people already residing in the area, legislations to stop further construction in the region and households should be motivated to undertake mitigation measures and are to be financed by the government.

The work done by (Kreibich, 2010), is subject to analyze the difference in flood damages due to undertaking precautionary measures by households after 2002 floods in Elbe, Germany. Households were interviewed through telephones in two villages of Germany. Precautionary measures by households have a significant impact to minimize flood damages. Although these measures have contributed to damage reduction up to 53% to buildings and contents in 2005 and 2005 Elbe floods. Various measures were adopted by households to safeguard against floods among them were flood insurance, information collection, shifting to safe places, putting utilities upstairs, elevated configuration shielding with barriers of water.

Ghorpade et al., (2012), identifies three different types of coping strategies:

1) Methods for decreasing risk - to get financial gain through smoothing or secured sources.

2) Insurance – include asset disposal in order to mitigate environmental shocks.

3) Risk-sharing methods – include procedures for sharing risks among a group of people at regular intervals.

Hamid R.et al., (2020), used instrumental variables to assess the long term effect of floods on food security based on Afghanistan data from national risk and assessment surveys. It is also estimated how floods can affect the per capita income of households and their poverty status. The study shows that flood has strong and significant relationship with the quality and quantity of low diet, also with the engagement in smoothening of consumption coping strategies. The findings of the study put an emphasis on the need for specific micronutrient supplementation in disaster relief and food aid even then after the natural disaster emergency.

Dasgupta et al., (2007), early flood warning systems are recommended as the best technique for reducing flood damage. The study focuses on pre-flood migration, house flood insurance, and insufficient resources as coping mechanisms for stream floods.

Ninno et al., (2002), create a flood exposure index to indicate the intensity of floods suffered by various households This is typically fresh and reasonable work, as in the past, ancient indicators such as fatalities and damages were commonly used to determine the severity of floods. Based on the concept of this index, the study divides homes into three categories based on their level of flood exposure: not exposed, moderate, severe, and really severe. Borrowings, loans, dynamical consumption behaviors, and support commercialism are all self-reported coping methods discovered in this study. It also uses the Logit model to examine the relationship between cope methods and flood exposure index, which is highly important in the case of borrowing and the most often used cope live.

Motsholapheko et al., (2011), analyzed household's access to forms of capital necessary for enhancing capacity to adapt to floods and impact of floods on their livelihoods. Household's capacity to adapt to extreme flooding depends on the availability of access to natural capital which due to increment in population, changes in land uses, shifting of policies, global economic changes

and climate change associated variations in floods is threatened. Results have mentioned that livelihood disturbed due to floods is 11% whereas households displaced were 18% and 53% contributed towards crop damage. Among labor shifting towards other activities, short term local mobility and government relief was household's major coping and adaptive techniques It is summarized from the literature that the Various regions have different coping strategies and areas depending upon their circumstances and situations and also dependent upon the socioeconomic factors and the damages occurred as a result of these floods. These coping measures are now adopted by the sound economies of the world as they have shifted towards an integrated approach to deal with flood hazards. There are various factors which were revealed in the studies that the coping measures are most likely dependent upon income level, education, insurance, fate, relief and funds, loans, distance from flood prone area, livelihoods and physical endowments etc. The studies also showed the determinants of cost sustained by households such as loss to agriculture, human lives, health, vehicles, infrastructure etc.

Paul et al., (2010), explored local knowledge of peoples for survival and variations in their ability to cope with floods. People's coping strategies are dependent upon various factors such as household income, education, occupation, assistance, flood characteristics, distance from river. Indigenous knowledge of peoples helps them to cope with flood hazards. There is a need for assistance from the government to better fight against floods.

Mavhura et al., (2013), explore people's indigenous survival strategies and variations in people's ability to cope with floods coping strategies reduces vulnerability and also there is need for proactive settlement planning, disaster management policy in compliance with indigenous knowledge. Geographical location, social physical infrastructure and backward economy turns a

flood into a flood disaster. Nonstructural measures are not economically suitable and environmentally friendly.

Frankenberger's et al., (1992), study reveals that when faced with a shock such as flooding, households employ a variety of coping strategies. Cope strategies are the procedures that people use when their usual means of satisfying their desires don't work. Households' primary strategy is to reduce risks and manage losses in order to ensure a minimum level of survival, whereas their secondary strategy is to dispose of assets. This research illustrates that first and foremost, assets are repurposed as productive assets. Promoting productive assets makes it more difficult for the house to return to its pre-crisis status. Finally, the house or person is obliged to relocate.

Shah et al., (2013) Study aimed to find causes, remedial measures and effects of floods in the district Charsadda. The region experiences floods on average every 3-4 years. The study area is rural with most of the people associated with agriculture. The floods not only have an impact on agriculture but also the living environment overall. The primary reason behind such floods are due to water exceeding channel capacity and structural measures mismanagement and anthropogenic factors. The area was being badly affected by floods in 1996 and 1999 causing damage to the whole region both economically and socially. Due to Hissara drain the region experiences flash floods after heavy rain in the catchment area. Channelization and through embankment village protection and buildings flood proofing would help to get away with such floods intensity.

2.3. Determinants and influencing factors

Poussin et al., (2014), used a regression model to see factors that have influence on flood risk mitigation. 885 households were surveyed through mails in three villages of France to offer flood preparedness decisions to individuals regarding flood risk management. Findings showed

that coping appraisal has an important influence on mitigation. The findings showed that individuals will tend to protect themselves against a specific hazard if the threat is high and also the protective measures available are easy, effective and cost is low. Through improvement in communication campaigns on measures regarding flood damage mitigation and financial incentives will help in mitigation of flood risks. There is a positive connection between resilience to disasters and indigenous knowledge. Such resilience can be enhanced, depending upon socio-economic capabilities, geographical location and exposure to flooding. People with strong economic backgrounds and low flooding are more resilient to floods in contrast to high flooded regions.

Faradiba et al., (2021), used instrumental variable as the model due to endogeneity problems. The study is focused on rainfall effect on disasters such as floods and droughts. The eventually causing material and non-material losses. The results showed that there is positive relationship between rainfall and flood disasters whereas it's negative between rainfall and droughts. Apart from climate factors such as heavy rains, high intense tides and silting of rivers, flood disasters can be triggered by human activities also such as constant mass waterways littering. Whereas droughts can be caused by unavailability of rain for prolonged duration. Same is the cause of Indonesia which is facing both floods and droughts as there are two climate annually. The study indicates that regions with high mobility, interaction and mass population have greater disasters incidence. As this phenomena has been ongoing for last year's therefore there is a need of governmental and community efforts to anticipate such disasters. Hamid R.et al (2020) used instrumental variable to assess the long term effect of floods on food security based on Afghanistan data from national risk and assessment survey. It is also estimated that how floods can affect the per capita income of household and their poverty status. The study shows that flood has strong and significant relationship with the quality and quantity of low diet, also with the engagement in smoothening of

consumption coping strategies. The findings of the study put an emphasis on the need for specific micronutrient supplementation in disaster relief and food aid even then after the natural disaster emergency.

Albala-Bertrand et al., (1993), The study looked at the impact of natural disasters by evaluating twenty-eight major natural disasters in the United Kingdom over a twenty-year period from 1970 to 1990, and used a political economic model to calculate the disasters' impact on GDP. Natural calamities do not seem to be affecting the author's principal output. This analysis reveals that disasters had little impact on GDP and other indicators, but that gross fixed capital creation, public debt, and deficit have all increased significantly as a result of rehabilitation and reconstruction efforts. Natural disasters, according to studies on the economic impact of disasters, can stymie the economic process and trade balances right away.

Popp et al., (2006), study found a link between natural disasters and important economic factors such as investments, business, saving, and trade balances, as well as human, physical, and technological capital. The nature of a disaster and its technique of recovery determine the impact of a disaster. The findings of this study imply that environmental disasters have a negative impact on production growth in the long run, whereas geophysical disasters have a positive impact due to the destruction and reconstruction theory.

Skidmore et al., (2007), The study used data from 151 countries from 1960 to 2003 and discovered that countries with a higher per capita value saw fewer human killings and financial losses than those with a lower per capita value. The degree of openness of economies, education, and financial gain level are tools of development for reducing deaths and damages associated with natural disasters, as they argue that developed countries with higher per capita financial gain would

allocate a larger proportion of the Gross Domestic Product to key safety measures for minimizing the effects of natural disasters.

Raschky et al., (2008), the concept of prudent management for unforeseen state of affairs and for improved installations, according to the study, lowers the impact of natural disasters. The findings of this study suggest that disasters associated with fatalities and damages produced by natural disasters are also dependent on the quality of governance and management systems in order to cope with a tragic situation. They've seen that countries with better disaster management have fewer deaths as a result of natural disasters.

Jonkman et al., (2008), According to the report, flood damage estimates in European countries are based on an integrated framework for measuring direct and indirect economic impacts. According to a study, productivity is harmed as a result of the floods, which resulted in property destruction and the deaths of individuals. The magnitude of flood damage varies greatly, depending on flood-prone areas, coastal regions, and the economics of the country. This study advises that preventive efforts be taken to anticipate future flood-prone areas in Holland in order to reduce the scope of potential damages and avoid a major catastrophe risk.

Noy et al., (2009), the information used in the study of 109 nations for the period 1970-2003 is shown in the study. Natural disasters have a macroeconomic influence, According to the study's findings, financial and property losses have a negative impact on the gross domestic product rate. Developed countries with higher levels of talent, trade openness, foreign reserves, domestic credit, and financial gain have a greater ability to deal with economic disasters.

Habibullah et al., (2009), A study found a link between the economic impact of natural disasters and the economy.They utilised regression analyses on three sets of cross-sec-

tional data from seventy-three countries for the years 1985, 1995, and 2005, and discovered a negative relationship between per capita financial gain and the impact of natural catastrophes. According to research, a person's or a group's vulnerability and exposedness are qualities that determine their ability to foresee, deal with, resist, and recover from natural disasters. Thus, the impact and intensity of such natural catastrophes are determined by three major variables: susceptibility or proclivity to experience loss, exposure of human life, buildings, and other things to danger, and the risk of floods, earthquakes, and other natural disasters. The degree to which someone is vulnerable or exposed is determined by their money, ethnicity, education, gender, and socioeconomicstatus.do less harm in industrialised countries than in developing countries because developed countries take pre-disaster preventive measures. The severity of a disaster is used to determine a country's ability to deal with the aftermath of a disaster, such as the event's potential, associated damages, and hence the people's vulnerability. According to the findings, weak countries with moderate natural disasters experience greater impacts, such as major catastrophes, due to a higher likelihood of socioeconomic fragility among the people. Developed countries experiencing large disasters, on the other hand, have a higher level of preparedness to deal with unforeseen calamities and suffer less damage.The severity of a disaster helps to determine a country's ability to deal with the aftermath of a disaster, such as the potential for occurrences, the damages associated with them, and hence the vulnerability.

(Ahmad et al., 2011), The human response to the 2010 floods in Asian countries, according to a study. The study discovered that people's sensitivity to natural disasters, as well as their socioeconomic fragility, increases the necessity of disaster management. Floods have caused infrastructure destruction as well as the loss of human life. Floods cause direct devastation, which is sometimes referred to as early calamities. Alternative waves of damages, such as the destruction

of homes and the death of individuals who work, are caused by floods as a result of the initial disaster's chain of cause and effect. These are the damages that occur after the initial calamity. Second catastrophes are the term for these kind of losses. To the extent of the magnitude, second disaster is greater than the initial disaster.

Tariq et al., (2012), the flood management and flooding behavior of Asian countries were investigated. Monsoon rain falls are the main source of flooding in the Indus Basin, according to this study. Over time, flood hazard crisis management and institutional framework have been created. However, research indicates that flood damages have not decreased significantly as a result of the flooding. The interrelationship of structural and non-structural interventions with combined potency, according to the study, will optimize for easier flood management.

Through examination by (Ninno et al., 2003), explains how floods have impacted the well-being of households in Asian countries by raising state levels, lowering income levels, reducing food availability, and worsening health. Households have responded to the shock by cutting back on their spending, commercial assets, and borrowing. Their findings demonstrate the inadequacy of government interventions and the exemplary role of the private sector in regulating this shock. The governments of underdeveloped countries have a difficulty of limited resources, which further limits their power to affect the detrimental impacts of disasters.

Paul et al., (2009), suggest that people fight flood risk in different ways depending on their level of exposure and expertise, and that different tactics are utilized in different geology areas. The ability of households to cope differs based on people's socioeconomic circumstances, such as education, financial gain, and occupation, according to the article. Although floods in Asian countries cause economic hardship, people's indigenous coping mechanisms have helped them reduce their vulnerability significantly.

Reusswig et al., (2004), why do some homes take flood-prevention precautions while others do not? Sensory activity elements, such as previous flood experience, concern, and reliance on public flood protection, are found to be more effective in dealing with floods than socioeconomic considerations. Flood exposure, sensitivity, and adaptation are three major factors that influence flood vulnerability and damage. The speed, frequency, water level, and length of a flood are all factors that go into determining the level of exposure.

Cutter et al., (2003), create a vulnerability index that incorporates both biophysical and social factors. Wealth, gender, color, whether rural or urban, job loss, property, occupation, and family structure are all factors that contribute to resilience to environmental and natural hazards, according to the study.

Canon et al., (1994), says that nature provides North American countries with a variety of productive opportunities as well as threats such as floods and earthquakes. According to the findings, different teams of individuals have clear traits (derived from social and economic processes) that cause some to avoid disasters while others do not. Individuals' vulnerability is classified according to their socioeconomic status, gender, race, age, education, and financial situation

Corbett et al., (1988), concludes that the same sort of approaches do not appear to be used consistently across these events, and that not all homes appear to be equally vulnerable to food crises during this event, and that the wealthy rarely go hungry. The financial gain level of households is found to be a critical driver for the adoption of an explicit strategy in the study. The poor and rich households do not have the same options; for example, the poor find it more difficult to obtain credit, have less assets to liquidate, and have unnaturally high dependency ratios. The presence or absence of relief programmers has a greater impact on the effectiveness of those strategies.

Sadia et al., (2013), the study looked into the impact of disaster-related deaths on Pakistan's per capita GDP. They used 1975-2009 maltreatment data from the standard least squares (OLS) model. The findings of this research reveal that disasters have a significant positive influence on per capita gross domestic product in terms of human capital, deaths, and life expectancy.

Rashid et al., (2006), by trial and error, we've discovered that when people suspect a flood is coming, they start borrowing. They gradually begin a divestment strategy, or spending money from savings and commercialism assets, with a large amount of flooding.

Rayhan et al., (2012), study mentioned how people in Pakistan deal with floods. They uses means of borrowing, saving, altering behaviors, and seeking help to mitigate the impact of floods. Shock factors such as height of flood water, length of flood and demographic characteristics are drivers of floods. According to the study income level, family size, gender are determinants of coping measures.

Flood disasters are a more frequent form of natural disasters. The Sendai framework for disaster risk reduction included building of resilience and also fostering adaptive behavior to fight against weather extremes events to tackle vulnerability. (Shah et al., 2020) Investigated household's vulnerability to public health risks in disaster prone areas of Pakistan. Findings of the study pointed out that women, poor, and illiterates are highly flood vulnerable. There is a need for active involvement of all shareholders along with training, capacity building and sustainable mitigation efforts to overcome health and flood vulnerability by households.

George et al., (2019), examine aims to discover that Small and Medium Sized companies (SMEs) are greater prone and ill organized to flash flooding in comparison to their larger counter parts so they're disproportionately laid low with such intense climate occasions. This take a look

at reviews on the outcomes of a quantitative survey of SME owners/ managers and employs quantile regression analysis in a try and shed light on elements affecting resilience boundaries to flash floods. Findings suggest that the impact of organizational size on SME barriers is decreased as obstacles growth. In evaluation, the effect of organizational age is found to be fantastic with low magnitudes whilst barriers are either verylowor significantly excessive in contrast to terrible consequences whilst limitations are at moderate tiers. A fantastic influence of the commercial association at all barrier degrees is also recognized. Previous enjoy with flash flooding activities as well as the impact of profitability are located to have poor effect in most levels of analysis. The assessment highlightsthe want for centered interventionand help tothe various segmentsofthe SME zone via customized steering and/or advert hoc regulation bywayof specializingin factors explaining boundaries to resilience.

Daniel et al., (2014), Public flood safety can't cast off absolutely the threat of flooding. As a result, personal mitigation measures which proactively protect houses from being flooded or lessen flood damage are an important a part of present day flood threat management. This take a look at analyses personal flood mitigation measures amongst German families. The final data set covers extra than 4200 families from all parts of the USA, including flood plains in addition to areas that are generally not at an excessive danger of riverine flooding. The results recommend that the propensity to mitigate flood damage will increase i.e. with beyond harm enjoy and damage expectations for the future. The latter impact can be interpreted as a 'climate variation sign' within the flood mitigation behavior. All other factors final same, a robust notion in a weather-alternate-brought on boom of personal flood harm within the subsequent many years correlates with an boom of the probability of flood mitigation by extra than 10 per-

cent points. Furthermore, empirical evidence for ethical threat in the flood mitigation behavior can't be found. Residence-holds watching for coverage insurance do no longer reduce their mitigation efforts. Likewise, the expectation of government alleviation payments hinders mitigation simplest for a few businesses of families.

Mehebub et al., (2021), Sundarban Biosphere Reserve (SBR), an ecologically sensitive and dynamic region, is vulnerable to cyclones, floods, hurricane surge and sea stage upward thrust. Multi-threat occasions inside the Re-serve have critically affected the coastal panorama and increased the importance of various losses to the groups during the last ten years. Losses inclusive of damage to houses, asset loss, land loss and farm animals deaths have largely happened because of multi-danger events. This newsletter makes a try to verify socio-financial losses occurred because of multi-risks. We amassed facts regarding socio-economic losses from 570 sampled families thru area survey the use of questionnaire. Poisson regression was used to envision the relationship between losses and multi-chance activities. Pear-son correlation became additionally utilized to observe the relationship among losses and government remedy furnished to the sampled households. effects found out that of the nineteen blocks (administrative divisions of the district), Namkhana and Sagar have been observed to be the maximum inclined blocks to the multi-danger as most losses of residence, cattle, land and asset of the sampled households befell in those blocks. Patharpratima additionally suffered all forms of losses except asset loss. Kultali and Basanti suffered from asset loss whilst Gosaba and Hingalganj suffered from farm animals losses. Susceptible housing shape, loss of early loss warning device, inadequate relief, loss of fundamental amenities, coastal erosion and place to the coast have been the primary elements for persistent vulnerability to losses in those blocks. Hence, those blocks accord excessive precedence for lessening multi-risks vulnerability.

Bimal et al., (2016), study was based on Bangladesh. Which is highly vulnerable to recurrent and devestating flooding, which badly affects the country's economy and society and also causes fatalities. Because of their recurrent nature and severe impacts, floods have gained significant attention from hazard researchers. However national scale wise only few better attempts have been made to identify what actually affects flood fatalities. This paper examines the determinants of flood deaths in Bangladesh for the 1972–2013 period. Secondary data was used in the study. Poisson regression is used in the study which reveals the extent of the area flooded, the number of people which were affected by the event, flood duration and frequency, and the interactions of these factors have a significant effect on flood deaths. The study findings would be helpful for management of disasters in Bangladesh.

The above literature concluded that flood causes significant amount of damages globally. It causes damages to houses, buildings infrastructure, agriculture crops and is threat to human lives. The study mentioned the various drivers behind the occurrence and magnitude of its damages. Comprehensive amount of literature were studied to find out its impact on other countries, its most importantly its impact on Pakistan. Impact of such floods on agriculture sector and living of people in the research area were studies, which causes significant amount of losses to residential buildings, shops, mosques, overall business and agriculture has been noticed. Studies about the region were also studies to find out the reason of its frequent occurrence and its magnitude of damages.

Coping strategies used by different economies and cultures were studies. Different mitigation measures were used by different economies and cultures according to their needs and financial constraints. It is found out that most people used indigenous knowledge to deal with these

floods. A variety of coping measures were used among them which were frequently used were, borrowing, selling of assets, migration, ground level elevation, sand bags disposal, cleaning of canals and drainages, foundation strengthening.

Studies mentioned numbers of factors of specific mitigation measures and cost of flood. Numbers of factors were mentioned which were involved in mitigation of floods and its cost. Gender, age, location, and other demographic factors were involved in determining why people use certain measures and the relevant cost associated to flood.

As far as statistical methodologies are concerned, most of the studies have used descriptive measures such as, Probit and Tobit models, Poisson, frequency tables, OLS etc. Keeping in view the objective of our study, we shall use both Poisson and OLS measures to get the insight about our study.

Great amount of work has been done globally about floods and its mitigation strategies. Also in Pakistan and specifically Khyber-Pakhtunkhwa a great deal of work has been done. But no work have been done at household level in district Charsadda about the impact of floods. The study will contribute to existing literature by determining mitigation strategies and cost on these mitigation strategies adopted by households. Based on this study policies will be recommended which will be helpful to safeguard against floods in future.

CHAPTER 3

EXISTING POLICIES OVERVIEW

This chapter briefly explains perspective of floods in Pakistan, Pakistan's current flood management system, flood policies and strategies, flood laws, flood institutions, flood planning and flood management measures.

3.1 Perspective of floods in Pakistan

Pakistan has a long history of floods. During 1947-2015 period, Pakistan has experienced 23 highest flood events. During this period, floods of different magnitudes damaged large tracts of lands in Gilgit-Baltistan, FATA (Federally Administered Tribal Areas), AJK (Azad Jammu and Kashmir), KPK (Khyber Pakhtunkhwa), Punjab, Sindh and Balochistan. The 2010 super floods in Pakistan was one of the largest river flood in recent history. For the period 1947-2015, a financial loss of US$ 38.165 billion has been reported as a result of 23 major flood events in Pakistan. Approximately, more than 12,000 human beings were dead and 616,598 km2 land area was affected due to these floods as shown in Table 3.1. On an average, every year floods affect approximately 0.715 population of Pakistan and by 2030 about 2.7 million people in Pakistan may be affected by floods. Table 3.2 shows the amount of financial losses that has been sustained by each province in Pakistan during 2010 mega floods. 24 million Pakistani rupees was the amount of loss by AJK where as KPK, Punjab and Sindh losses were 396, 1838 and 2302 million rupees.

TABLE 3.1. HISTORICAL FLOODS AND DAMAGES DISTRIBUTION

No.	Year	Financial Loss (US$ Million)	Human Deaths (Number)	Damaged Villages (Number)
1	1950	488	2190	10000
2	1955	378	679	6945
3	1956	318	160	11609
4	1957	302	83	4498
5	1959	234	88	3902
6	1973	5134	474	9719
7	1975	685	126	8628
8	1976	3485	425	18390
9	1977	338	848	2185
10	1978	2227	393	9199
11	1981	299	82	2071
12	1983	135	39	643
13	1984	75	42	251
14	1988	858	508	100
15	1992	3010	1008	13208
16	1994	843	431	1622
17	1995	376	591	6852
18	2010	10000	1985	17553
19	2011	3730	516	38700
20	2012	2640	571	14159

21	2013	2000	333	8297
22	2014	440	367	4065
23	2015	170	238	4634
	Total	38165	12177	197230

TABLE 3.2. AGRICULTURE SECTOR LOSS DUE TO 2010 FLOOD IN PAKISTAN

Province/Location	**Loss (USD Million)**
AJK	24
Balochistan	427
FATA	36
Gilgit Baltistan	22
KPK	396
Punjab	1838
Sindh	2302
Total	5045

3.2 Flood Management Current State

Pakistan's current flood management system consists of flood policy and strategy, flood laws, flood institutions, flood planning and flood management measures. These elements of flood management system are described below.

3.3 Flood Policy and Strategy

The development and implementation of flood policy by government reflects a serious commitment of government towards effective and sustainable flood management. In Pakistan, flood management policy has been recognized in the draft national water policy which has not been approved and implemented yet. The main elements of flood policy include "development of new water storages, improvement of operational rules for reservoirs, improved watershed management, promotion of flood retardation structures, improved maintenance of existing flood infrastructure, improved flood forecasting and warning system, enforcement of laws for flood plains protection and flood zoning". In Pakistan, the current flood management strategy consists of three elements, namely; (i) flood planning, (ii) flood preparedness, and (iii) flood fighting and post-flood operations. The flood strategy is implemented through deployment of structural and non-structural measures.

3.4 Flood Laws

Currently, Pakistan lacks in robust flood management laws. However, existing water laws deal with some of the flood-related legal issues. A River Act vetted by the Law Ministry has been drafted to stop encroachment in floodplains.

3.5 Flood Institutions

In Pakistan, flood institutions can be grouped into two categories, namely; (i) flood risk managing institutions which implement structural and non-structural interventions and (ii) flood crisis managing institutions which perform rescue, relief, and rehabilitation tasks. A brief overview of these institutions is depicted below.

3.6 Flood Risk Managing Institutions

Pakistan Commission for Indus Waters: Being a national institute interacts with India regarding the flooding which takes place in the trans-boundary streams.

WADPDA (Water and Power Development Authority): Being a national organization performs planning, development and operation of infrastructure to control flooding. "It also collects hydro-meteorological data including river and rainfall from telemetric system installed in the upper catchments of Indus and Jhelum rivers catchments and inflow and outflow data from the Mangla, Tarbela and Chashma reservoirs".

FFC (Federal Flood Commission): Being a national organization develops and directs implementation of national flood protection plans and supervises flood forecasting and warning activities.

PMD (Pakistan Meteorological Department): Being a national organization performs the tasks of forecasting rainfall and flood and delivering flood warnings.

PIDs (Provincial Irrigation Departments): PIDs are responsible for rivers and riverine surveys, construction, operation, maintenance and management of barrages and flood control infrastructure and implementation of flood management/fighting measures.

3.7 Flood Crisis Managing Institutions

Emergency Relief Cell, Cabinet Division/Federal Relief Commission coordinates' relief operations at national level. NDMA being a national organization supervises and directs rescue and relief activities at country level. PDMAs carry out flood preparedness task, rescue and relief plans. They coordinate with other provincial departments for these activities. Provincial Relief Commissions being provincial organizations perform relief activities after floods. District Administrations

being district organizations conduct relief and rescue tasks after floods. Pakistan Army provides help to other institutions for flood fighting, rescue and relief activities.

3.8 Flood Planning

Since 1978, FFC has developed and implemented three 10-year NFPPs (National Flood Protection Plans) as revealed in Table 3.3. Provincial Irrigation Departments and federal organizations have implemented these plans. The projects implemented under NFPPs mainly included the construction of embankments and spurs, improvement and upgradation of flood forecasting and warning systems and feasibility studies for barrages. The three NFPPs implemented 5240 flood protection schemes at the cost of PKR 25.45 billion as shown in Table 3.3. During 2008-2009 to 2014-2015 period, 170 flood protection schemes were completed at the cost of PKR 3.9 billion. This way, during 1978-2015 period, 5410 flood protection schemes were implemented at the cost of PKR 29.35 billion.

TABLE 3.3. AN OVERVIEW OF NATIONAL FLOOD PROTECTION PLANS (NFPP)

Plan	**Action**	**Total Cost (PKR Billion)**
NFPP-I (1978-1988)	311 flood-protection schemes completed	1.73
NFPP-II (1988-1998)	4444 flood-protection schemes completed	14.92
NFPP-III (1998-2008)	485 flood-protection schemes completed	8.80
Total	5240 protection schemes completed	25.45

3.9 Flood Management Measures

3.9.1 Structural Measures

Flood Protection Embankments and Spurs: In Pakistan, the major flood-protection infrastructure comprises 6,807 km of flood protection embankments and 1,410 spurs. Provincial Irrigation Departments maintain this flood infrastructure.

Water Storage Reservoirs: Reservoirs moderate floods by storing flood water. In Pakistan, Tarbela, Chashma and Mangla reservoirs are used to regulate flood flows during flooding. Flood moderation by reservoirs is not the first priority because the prime function of these reservoirs is to provide water for irrigation and produce electricity. Consequently, their full potential for flood management is not exploited.

3.9.2 Non-Structural Measures

Flood Forecasting and Early Warning System: An efficient and effective flood forecasting and early warnings is vital for effective flood management. The flood forecasting and early warning system needs to be expanded and modernized continuously. PMD performs the task of flood forecasting and delivering flood warnings. FFC is implementing different projects to improve and upgrade the flood forecasting and early warning system thereby to make it more efficient and reliable.

Flood Preparedness: Every year before the commencement of monsoon, federal and provincial flood institutions perform a flood preparedness planning. Flood preparedness includes appraisal of the reservoirs, barrages, and levees conditions and decision-making regarding the measures for flood management well in advance.

Flood Fighting and After Flood Activities: During flood, required measures are taken to regulate the flow at grave sites along the rivers. Provincial irrigation departments, WAPDA and Army play a vital role in flood fighting by regulating flood infrastructure. Rescue and relief tasks are planned and performed at district level.

This study will help both flood risk managing institutions and flood crisis managing institutions. It will institutions in the likes of WAPDA for planning, development and operating control over floods.it will be also helpful to PMD for forecasting of floods predictability, also PIDS (Provisional irrigation departments), flood planning institutions and emergency relief cells.

CHAPTER 4

DATA AND METHODOLOGY

4.1 Theoretical framework

Different household coping measures have been adopted worldwide to deal with floods. According to (Kurosaki et al., 2012), self-coping through borrowing is an important strategy to deal with floods. Borrowing and lending are frequently used to meet urgent financial needs. According to Sultana and (Rayhan, 2012), a significant proportion of households are found to borrow money from informal sources after floods and other natural disasters.

Dasgupta et al., (2007), early flood warning systems are recommended as the best technique for reducing flood damage. In front of their homes, some people utilize Precautionary Savings, Deployed Sand Bags, and Building Dikes. Cleaning the canals that surround the residence Houses with a second floor are being built. On the second floor, preparing a storage area (Shah et al., 2017).

According to FEMA (Federal Emergency Management Agency) flood mitigation is the effort to reduce the loss of life and property by declining the impact of disasters. There are various mitigation measures, taken at households level but for this study author has taken some of the most commonly used strategies in the area which are based on previous researches and journals these are ground floor elevation, foundation strengthening, protection wall, borrowing, assets sale, use of sandbags, Migration and cleaning the canals and drainage system to make the water flow smooth and easy. This study has further tested the hypothesis taken from literature in the context of district Charsadda floods, the household behavior after floods indicates that theoretically the mitigations

measures and other socio economic characteristics validates the existing theories of natural disasters and household response to these natural disasters.

4.2 Data description

Primary data was collected from four villages of district Charsadda, these villages are situated across Jindi River. These villages are highly exposed to flash floods, occurring frequently year after year. The data was collected through household surveys. The survey contained information about flood frequency, losses incurred due to floods, mitigation measures or coping strategies adopted by households and some household level information were also collected to see whether or not household characteristics influence the flood adaptation, cost and losses.

4.3 Data collection process and sampling approach

The study had followed two stage sampling methods. At first stage purposive sampling technique was applied on the selection of villages in district Charsadda, which were affected by the floods. Among the affected villages some of them were highly affected again and again constantly. The following four villages were selected i.e. Sherpao, Umarzai, Tarrangzai and the village of Utmanzai. At the second stage, systematic random sampling was applied on the selection of households. The data was collected from the houses which were situated in the flood prone zones, thus a household survey approach were used to collect the data from respondents. A household after every three households were selected for an interview to collect data regarding flood and its consequences and thus 40 households' units were selected from each of the four villages of Charsadda village. A great numbers of questionnaires were asked from each respondent, some of them were about socioeconomic and demographic, coping measures used, cost of flood determinants and event information. According to Government sources, total households are 11195 households and with this population size optimum sample size is 160 households (confidence level (%): 99

and margin of error (%): 10). First a pilot survey was conducted with 20 household heads which allowed us to refine the research instrument and ensure content and face validity. The household heads of the pilot study were checked and asked to comment the statements for sensible construction, ambiguities, clarity, trivialities and as well as to make sure that the questionnaires meaningfully reflected towards determinants of coping measures and determinants of flood. Following the pilot-testing, the research instrument was shortened with several questions being re-worded for greater clarity. After this step, the questionnaires were reduced which consisted the main data collection instrument measuring the level of agreement over a series of determinants of coping measures and cost of flood. Then he data was collected through questionnaires from the head of the household. The surveys were always started from the right end of the circle and if the household was not available, then the survey team would move forward to the next household in the area. The data was collected and some of the respondents were revisited for some specific information, if they were missing at the time of conducting the interview or demanded some time to find a person to give information to the survey team.

4.4 Important variables of the study

Variable name	Measurement	Use in this study
Age	Age of the person is measured in the number of years. It is a continuous variable	Age is used as an independent variable in both of the models.
Education	Education of the household head is taken in a number of years of schooling.	It is used in both of the models of the study as an independent variable

Value of assets	It is measured in 1000's PKRs and taken as the worth of assets the household has.	Used as an independent variable in both of the models
Employed household members	It is measured in terms of count, where household members with active work status are included.	Used as an independent variable in both of the models
Gender	It is a binary response variable which takes value one if the head of a household is male and zero otherwise	It is used in mitigation measure models as an independent variable
mitigation measures	Mitigation measures are those measures, which are strategies taken by a household to reduce the impact of a flood. It is measured in terms of count, which is the number of coping strategies, adopted by a household. It ranges from zero to 8 i.e. major measures against floods.	It is used as a dependent variable in model one, which is a count variable regression model, known as Poisson regression model. When the dependent variable is a count variable the literature suggests the use of Poisson regression.
Cost of Flood	It is another dependent variable which is used in the second model. It is measured in the monetary value of losses faced by a household against floods. It is measured in 1000s PKRs. Cost of each component is collected	It is the major dependent variable of the second model and the second model is OLS ordinary least squares method. When the dependent variable is a continuous

	and all the cost is summed up to estimate the total cost of floods to a household.	variable, the OLS can be used subject to the given assumptions.
Distance from the river	It is measured in meters. The distance from river banks to the household walls is measured through inch tape also known as scaling tape.	It is used as an independent variable in both the models of the study
Type of house	Type of a house is taken as paved house =1 un-paved house =0	It is used as an independent variable in both of the models
Household size	It is measured as the number of persons in a single household.	It is used as an independent variable in both of the models
Migration dummy	If the household has migrated due to floods in times of flood then we took value one and zero otherwise	Used as descriptive statistics
Protection wall dummy	If the household has built a protection wall against floods to reduce the impact of floods then we took value one and zero otherwise.	Used as descriptive statistics
Sandbags dummy	If the household has used sandbags against floods for protection against flood then we took value one and zero otherwise	Used as descriptive statistics

Drainage system cleaning dummy	If the household has cleaned drainages and canals before floods then we took value one and zero otherwise	Used as descriptive statistics
Floor elevation dummy	If the household has elevated the floor of their house, to reduce the impact of floods as coping measure the we took value one and zero otherwise	Used as descriptive statistics
Borrowing	If the household has taken loans or borrowed money before floods as an adaptation measure to deal with the flood then we took value one and zero otherwise.	Used as descriptive statistics

4.5 Poisson regression for Objective no (1)

This model will address the first objective of the study, which is to **"**Investigate the influencing factors of the mitigation strategies adopted by households**"**. The study has used Poisson regressions to achieve the objective. This regression is used, when the dependent variable of the study is in count form, where the response is counted in digits. Also the possible values of dependent variable are the non-negative integers: 0, 1, 2, 3 and so on. The number of mitigation measures is taken as a dependent variable and Poisson regression is applied on count measures taken before floods. The numeric count dependent variable is analyzed through Poisson because

it follows Poisson distribution and not normal distribution. Poisson also allows to capture differences in follow up time. Here in this case the follow up time is the same, which indicates the occurrence of a number of adaptation measures to be taken in specific time before floods. If the independent variable is in discrete and log linear form, it becomes equal to the Poisson regression model.

$$\mu = \boldsymbol{t\ exp}\ (\boldsymbol{\beta 1 X1 + \beta 2 X2 + \beta 3 X3 + \beta 4 X4 + \beta 5 X5 + \beta 6 X6}, , , , , , , \boldsymbol{\beta k X k}), , , , , , , , \boldsymbol{Eq}(\mathbf{1})$$

Where, Poisson incidence rate μ is determined by a set of k regressor variables (the X's).

X1 is Paved House type and it is a binary dummy variable, which takes value one if the house is paved and zero otherwise

X2 is the gender of household head which takes value one if the person is male and zero otherwise.

X3 is the Distance of household residence from flood flow zone and it's measured in meters.

X4 is Age of the person and it is measured in the number of years. It is a continuous variable

X5 is HH-Size and it is measured as the number of persons in a single household.

X6 is the House Ownership status, which takes value one if the person owns the house and zero otherwise

X7 is Value of assets in monetary terms in Pakistani currency

X8 is the Education of household head in number years of schooling

X9 is Years of stay/residency.

$$\mathbf{Pr(Y=y_i \mid \mu_i t_i)} = \frac{e-\mu i\ ti\ \ (\mu i\ \ ti)\mathbf{yi}}{y!} \ldots\ldots\ldots\ldots eq(2)$$

(y=0, 1, 2, 3…) where μ is the mean incident rate of a rare event per unit of exposure, the unit of exposure can be any independent variable. Here t represents one variable let's say type of house, where the mean incident of mitigation measures is dependent on type of house. The mean incident of mitigation measures depends upon house type, gender, distance, age, household size, house ownership, value of assets, education and years of stay, which are independent variables in the model. Whereas MLE, maximum likelihood estimator is used as estimation process for Poisson regression.

4.6 Ordinary Least Squares Method for Objective no (2)

The second objective of the study is to estimate the relationship between socio-economic variables and cost of flood and for this purpose the study has utilized the OLS regression. The study has used the Ordinary Least Square method, Multivariate regression analysis. It is used because the dependent variable for this model is a continuous variable, which is the cost of flood. OLS is used to predict values of a continuous response variable using one or more explanatory variables.it estimates the relationship by minimizing the sum of the squares in the difference between the observed predicted values of the dependent variable.

The following model is designed

$$Y_i = \beta 0 + \beta 1 Disx_1 + \beta 2 HHSx_2 + \beta 3 Hox_3\ \beta 4 VOAx_4 + \beta 5 EDUx_5 + \beta 6 UPHT_{6+}\ \varepsilon_i \quad (2)$$

Y is a dependent variable of the study, which is cost of flood

Beta0 is an intercept of the regression line,

$\beta 1$ is the slope of the coefficient whereas $Disx_1$ which is independent variable and indicates distance from the flood flow zone to the residential place. .

$HHSx_2$ is HH-Size, which is the numbers of family members

Hox_3 is House Ownership status, whether it's owned or rented

$VOAx_4$ is the total Value of assets in monetary terms

$EDUx_5$ is the Education level of household head

$UPHT_6$ is the Unpaved House type, which if the house is unpaved takes value 1 and zero otherwise

CHAPTER 5

RESULTS AND DISCUSSION

5.1: Descriptive statistics of important variables

This chapter starts from descriptive statistics and frequency distribution, followed by the [1]Poisson regression and OLS regression models. The descriptive statistics are reported in Table 5.1. The mitigation measures have been measured in numbers and varies from one to eight. In our sample on an average 3 mitigation measures have been adopted.

House type is taken as a binary response variable which indicates value 1 if the house is paved and zero otherwise. On average 51 percent of houses are paved with cement coated walls while 49% houses are unpaved. Gender is also a binary response variable which takes value one if the person is male and zero otherwise. The study shows that 65 percent of the respondents are male household heads while the remaining (35 percent) are female household heads.

Distance from the river is taken in meters, which shows that average distance from river is 231 meters and maximum distance was reported 900 meters while surprisingly a household living by the side of the river has built his house close to the river by a distance of only one meter which is the minimum distance from river to house. This much close to the river can cause significant levels of damages to both human lives and house infrastructure. The reason of higher standard deviation with respect to mean of distance indicates that data of distance is spread out. The age of the household head is taken in years, our sample shows a large variation with minimum and maximum age of 20 and 90 years respectively. However, the average age of the respondents in our

[1] It is used on count data, because count data doesn't follow normal distribution function but a Poisson distribution function and dependent variable is a count variable in this study, which is the expected number of measures occurrence or taken in specific time before floods. Further details are given in section 4.5

sample is 49 years. It reflects data is taken from the adult population and responses are assumed conscious and quite responsible. Average household has 7 members but family size varies between 2 to 22. House ownership is taken as value one for ownership of house and zero otherwise. Our descriptive analysis indicates that only 33 percent household are living in their own homes and rest are living in a rented houses i.e. 67%. The value of assets variable is measured in Pakistani currency in 1000's. The data in the table 5.1 shows that the average value of assets of the household is above 50k which is quite a good statistic of economic affairs across the respondents. Standard deviation is lower than mean of value of assets which is an indication of data being more clustered around the mean.

Education of the household head is taken in number of years of schooling because head of the household decisions are important for the family and household members and education can lead to sound decisions making. On average the education is very low across the household heads which on average is four year of schooling but some of the household heads reported education of 18 years of schooling. High variation in education is expected across the respondents. Finally, the years of stay at the current location is taken in years which shows how long the household has been living in this location. The average stay at current location was recorded 6 years with maximum and minimum stay of 46 and 1 year respectively. This shows that people are living for a long time and have faced multiple floods.

Table 5.1: Descriptive statistics of important variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
Mitigation Measures (Numbers)	160	2.94	2.29	0	8

House Type	160	0.51	0.50	0	1
Gender	160	0.65	0.35	0	1
Distance (meters)	160	231.21	287.06	1	900
Age (years)	160	49.77	19.54	20	90
HH-Size (Numbers)	160	7.50	4.71	2	22
House Ownership	160	0.33	0.47	0	1
Value of assets	160	50437.50	29927.31	10000	180000
Education	160	3.91	4.31	0	18
Years Of Stay	160	5.66	4.11	1	46

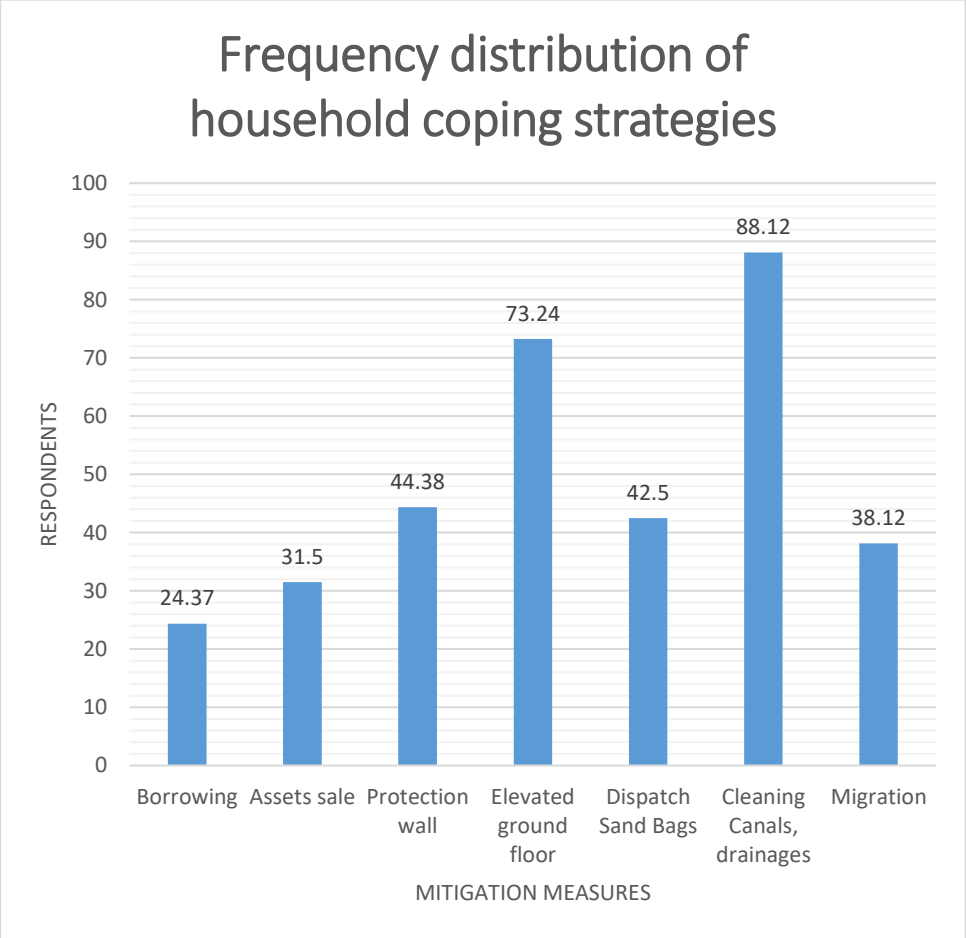
5.2: Frequency distribution of household coping strategies/Floods effects mitigation measures

The frequency distribution of different coping strategies have been reported in figure 1. The frequency distribution indicates that 24.37 percent households are borrowing to cope with flood damages. Similarly, more than 30 percent of households have sold their own assets to regain the economic position and to cope against floods. Our analysis demonstrates that 44.38 percent households constructed a protection wall against flood to reduce the impact of flood hit on infrastructure and other assets. Most of the respondents, 73.24 percent of the total sample, adopted a coping

strategy of elevating the ground floor of their house to reduce the impact of floods. This strategy is comparatively more expensive because it needs reconstruction of the house with technical design that can reduce the hit force of flood and also it can save the valuable resources of a household from the flood flows.

Sandbags can also help in reducing the hit impact of floods, 42.50 percent households used sandbags to safe themselves from flood water flows over their properties. Some households have adopted a strategy of cleaning the water flow ways, drainages and canal systems close to their houses on a very short notice after receiving the red alert about the flood from the concerned authorities. Figure 1 shows that around 88.12 percent of households cleaned up all the block drains and canals to make the water flow smoother alongside their houses and 38.12 percent households migrated to avoid the impact of flood on human livelihood. Most of these migrants were temporarily migrated and majority of these migrated households were living on rent but not in their own houses. Migration was used as a coping strategy against floods. Those migrated, which were close to river banks and prone to floods.

Figure 1: Frequency distribution of household coping strategies/Floods effects mitigation measures



5.3: Descriptive statistics of cost on mitigations measures at household level (PKRs 1000s).

Table 5.2 shows the mean values of cost used to adopt mitigation measures by a household. There is an economic cost associated with each type of flood mitigation measures. Households have spent more than three thousands on dispatching sandbags in front of the weaker side of the house or the most vulnerable side of the house to safeguard against flood. However, the average cost of sandbags as a coping strategy is Rs.3561 for each time a flood hits the region. Sandbags helps to reduce the economic loss incurring as a result of a flood. Dikes are also very effective to reduce the impact of floods, it works because it diverts huge amounts of water flow from the target places through proper planning. Table 5.2 shows that the average cost on dikes is Rs.3534, which is less than sand bags and more effective than sand bags. The most expensive and highly costly coping strategy is to upscale the height of a ground floor. This coping strategy has a cost of Rs.0.259465 million on average but some special work against flood for better protection purposes have spent more than Rs.2 million on reconstruction of the house. It helps to reduce the impact of flood on households which minimizes the damages sustained by a household in future.

Cost of flood mitigation strategies vary across respondents and strategies. Some households have used foundation strengthening as a coping strategy against the floods, which has a cost of Rs.148927 on average but at maximum it has reported that Rs.1.1 million had been spent on foundation strengthening. Average cost of protection of the wall is greater than the foundation strengthening. Protection wall costs around Rs.159846 on average but at maximum it has the same cost as foundation strengthening.

Table 5.2: Descriptive statistics of cost on mitigations measures at household level

Variable	Obs.	Mean	Std. Dev.	Max
Dispatch sand bangs	160	3561.32	4135.68	22000
Dikes to reduce water hit speed	160	3534.68	4408.28	22000
Elevation of ground floor	160	259465	345964	2300000
Foundation strengthening	160	148927.2	257883	1100000
Protecting wall	160	159846.6	268524.1	1100000
Temporary migration	160	5042.43	4139.47	22000

5.4: Influencing factors of mitigation measures against floods

Different households adopted different mitigation strategies to cope with floods and many adopted multiple strategies. The mitigation strategies adopted are measured in numbers and therefore, poisson regression model is employed to estimate the determinants of mitigation strategies. The results reported in Table 5.3 demonstrate that decreasing prediction of the logs of expected count of mitigation measures are negatively associated with households having paved house structure. This implies that strong house building owners are adopting less mitigation strategies because of having less risk. Alternatively, it is found that households with un-paved house building have taken a comparatively high number of mitigation measures against floods. Our results demonstrate a significant relation between house type and mitigation measures. A household with paved structure decreases the logs of expected mitigation measures by -28 percent. A household with paved house are most likely to adopt less mitigation measures by 28%.

Our empirical findings also indicates that male heads of the household have adopted a higher number of mitigation measures compared to female headed households. Our results delineates that if the household head is a male person then it increases the logs of expected outcomes of taking mitigation measures against floods by 10 percent. In other words, households led by a male head of the household are expected to adopt multiple numbers of coping strategies against floods. One possible explanation for these findings is that the study region is mainly male dominant where men have more liberty to implement certain measures then women due to local customs and tradition. Similarly, various measures such as house construction need more physical work and construction knowledge which is limited in women household heads. Therefore, male household heads tend to adopt more measures to safeguard their property and household from such catastrophes. Our results are corroborated by those from Murphy et al. (2005) who also found that men are dominate

in both indoor and outdoor activities and are responsible for any kind of risk-reduction strategies. Increase in distance reduces the logs of taking an expected number of coping strategies by -0.001 percent because the intensity of flood reduces as the distance from the river increases. So with every meter increase in distance of a house from the river, the probability of a household to use more mitigation measures decreases. This is true in the sense that households living near to river need more precautionary measures than others living away from the river. Our results are consistent with other studies (Bantilan et al. 2015; Gioli et al. 2014; Mondal 2014), which found the location as an important factor in determines the choice of mitigation measures in developing countries. Age, income, household size and household ownership status does not indicate any relationship with mitigation measures at household level. Education is positively and statistically significantly associated with mitigation strategies at household level indicating that increase in education level by additional year of schooling will also increase the logs of expected number of measures taken against floods by 2 percent. Education is one of an important determinant of flood coping strategy to enhance one's resilience and quality of life in response to natural disasters (Tong et al. 2012). Education level is also very important in generating awareness of flood forecasting. Higher educational status encourages the adoption of mitigation measures to safeguard floods these findings are supported by those of Ullah et al. (2015b). The significance of the statistical relationship can be determined by looking at the p value. If the p value is less than 0.05 then the association between given variables is significant.

Table 5.3: Influencing factors of mitigation measures against floods

Mitigation measures	Coef.	Std. Err.	P>z	[95% Conf.	Interval]
Paved House type	-0.28***	.10	0.01	-.4787482	-0.08
Gender	0.10**	.04	0.02	.0142437	0.18
Distance	-0.001***	.00	0.00	-.0016077	-0.001
Age	0.001	.00	0.45	-.0031059	0.01
HH-Size	-0.01	.01	0.22	-.0347777	0.008
House Ownership	-0.04	.11	0.69	-.2599521	0.17
Value of assets	2.02	1.69	0.23	-1.30e-06	5.33
Education	0.02***	.01	0.01	.0083751	0.04
Years of stay/residency	.008	.012	0.48	-.0153073	0.03
_cons	1.08	.21	0.01	.673197	1.50
Pseudo R2 = 0.1032	**LR chi2(9) = 76.60**		**Prob > chi2 = 0.0000**		**Log likelihood =** -332.77717
Number of obs. =160					

5.5: Influencing factors of Cost of floods on household (OLS)

The determinants of cost of flood are explored and reported in Table 5.4. Our results demonstrate that here is a negative relationship between distance from rivers and cost of floods. Increases in distance from the river by one meter decreases the cost of damages due to flood by Rs.82.59. This is true in the sense that households living near to river need more precautionary measures than others living away from the river. Our results are consistent with other studies (Bantilan et al. 2015; Gioli et al. 2014; Mondal 2014), which found the location as an important factor in determines the choice of mitigation measures in developing countries. The relationship is statistically significant because p value less than 0.05. The reason behind the negative relationship between distance from river and flood cost is that floods have lower intensity and lower damages for the houses situated away from river. Household size is significant and negatively associated with cost of flood. If a family has large HHsize then its cost of flood will be lesser by Rs.882 with every increase in number of a family member. Our findings are in accordance with Ullah et al. (2015a). Household ownership is negatively associated with the cost of floods because most of the houses owned by the household are paved and already secured by investing in protection walls and other mitigation measures. So if a house is not rented then it's most likely to reduce the cost of flood by 14245.6 rupees because of having strong infrastructure. Housing type owned or rented is considered to be an important factor in determining the household adaptive capacity and choice of certain mitigation strategies. As a household living in their own house will have more freedom in the choice of different adaptation measures. Our results are in accordance with shah et al. (2017). Value of assets has shown positive association with cost of flood. Value of assets is significant and shows that the cost of flood increases by 0.04 million if a house has valuable assets. Households having high valued assets are facing more cost of damages due to flood, as the cost of each of

these assets are high so if it damaged due to flood or completely expired then eventually the cost of flood of such a particular household increases. Education has shown negative association with the cost of flood. Educated households are capable of using their knowledge to reduce the flood cost such as keeping themselves aware of weather forecasts to reduce the cost of flood by taking necessary precautionary measures such as migration or shifting valuable assets during floods to reduce heavy losses. Educated households are likely to reduce cost of flood by Rs.835 each time flood comes. Table 5.4 indicates that HHsize has a negative relationship with cost of flood as the household with high HHsize are capable to take more precautionary measures because of availability of more hand (or family labor) which eventually reduces their flood costs. Unpaved household faces more cost of flood, as unpaved houses are not capable of resisting the flood, so in return the cost of damages due to flood increases by Rs.15482.91 as shown in table 5.4.

Table: 5.4: Influencing factors of Cost of floods on household (OLS)

No of observations= 160	**Prob > F = 0.0000**		**R-squared =0.0584**	
Cost of Flood to household	**Coef.**	**Std. Err.**	**T**	**[P>t]**
Distance (meter)	-82.59***	0.13	-598.36	[0.00]
HHSize (Numbers)	-882.45***	7.59	-116.14	[0.00]
House Ownership Dummy	-14245.6***	79.29	-179.64	[0.00]
Value of assets	0.04***	.001	39.14	[0.00]
Education	-835.29***	9.02	-92.57	[0.00]
Dummy for Unpaved House	15482.91***	77.54	199.67	[0.00]
_cons	163952***	119.89	1367.52	[0.00]

5.6 Major findings

The study found that distance has significant impact on mitigation measures implication. The more closer a house is to rivers proximity the more coping measures are adopted by particular households. This conform to results of Shah et al., (2017). Situating houses on banks of rivers will cost significant cost to the household as when flood approaches more losses are sustained by a house which is near river. Where maintaining the distance from flood lines is economically beneficial as well as socially stable to avoid the disturbance caused by the floods every year.

The study found that education of the household head increases the level of care for household members and increases the number of mitigation measures, which conform to study of Daniel at al., (2014). Which keeps them secure from such disasters. Also more educated household heads tends to reduce their cost of flood by keeping themselves aware of the flood early warnings and taking early precautionary measures.

The study found that paved house structured households have faced less damages and lower cost against floods hits. This is related to the study of Mehebub., (2021). The study shows that ownership of a house has great impact on cost of flood this conform to work of Shah et al., (2017). Paved households uses less mitigation measures as well as the cost of flood sustained by such houses are very low.

CHAPTER 6

CONCLUSION AND POLICY RECOMMENDATIONS

6.1 Conclusion

This study was based on primary data which were collected from four villages of district Charsadda, which were situated across Jindi River. These villages were highly exposed to flash floods, occurring frequently. The data was collected through household surveys. The survey contained information about flood frequency, losses incurred due to floods, mitigation measures or coping strategies adopted by households and some household level information were also collected to see whether or not household characteristics influence the flood adaptation, cost and losses. The study had followed two stage sampling methods. At first stage purposive sampling technique was applied on the selection of villages, which were affected by the floods. At the second stage, systematic random sampling was applied on the selection of households. The data was collected from the houses which were situated in the flood prone zones, thus a household survey approach were used to collect the data from respondents. A household after every three households were selected for an interview to collect data regarding flood and its consequences and thus 40 households' units were selected from each of the four villages of Charsadda village. A sample of a total 160 was collected for this research. The data was collected through questionnaires from the head of the household. The descriptive statistics showed that on average every household adopted three mitigation measures. 65% of the respondents were male whereas the average age was 49 years. Most of the households used Elevated ground floor, dispatch sand bags and protection wall as coping

measures against flood. Among respondents 141 used cleaning canals as mitigation measure whereas 118 used elevated ground floor and 71 used protection wall as coping measures. There is an economic cost associated with each type of flood mitigation measures. The average cost of sandbags as a coping strategy is Rs.3561 for each time a flood hits the region. Whereas elevated ground floor, protection wall and foundation strengthening costed Rs.0.259465 million, Rs.159846 and Rs.148927 respectively. The study concluded that distance, education and value of assets are important influencing factors of flood cost and coping measures. The study concluded that households having paved residential areas are facing less cost of floods as they are more resilient to flood impacts and as a result their flood damages were minimal. The study shows that gender also played a vital role in the coping of mitigation measures. If the household head is a male person then it increases the probability of taking mitigation measures against floods by 10 percent. In other words, households led by a male head of the household are expected to adopt multiple numbers of coping strategies against floods. Increase in distance reduces the logs of taking an expected number of coping strategies by 0.001 percent. Education is positively and statistically significantly associated with mitigation strategies at household level indicating that increase in education will also increase the logs of expected number of measures taken against floods by 2 percent. Our results demonstrate that an unpaved household faces more cost of flood by Rs.15482.91. Increases in distance from the river by one meter decreases the cost of damages due to flood by Rs.82.59. Household ownership is negatively associated with the cost of floods, So if a house is not rented then it's most likely to reduce the cost of flood by 14245.6 rupees because of having strong infrastructure. Value of assets has positive relation with cost of flood whereas education has negative relationship with cost of flood. The results shows a negative relationship with household size, so if the household size is larger than the household is most likely to face less flood cost by

Rs.882.45.The study found that situating houses on banks of rivers will cost significant losses to the household economy, where maintaining the distance from flood lines is economically beneficial as well as socially stable to avoid the disturbance caused by the floods. It is also found that mitigation measures also reduces the cost of floods to households caused by the disasters and education of the household head increases the level of care for household members and increases the number of mitigation measures, which keeps them secure from such disasters. The study found that paved house structured households have faced less damages and lower cost against floods hits. Education reduces the flood losses and increases the understanding against flood and helps to access the early warning system and news, which also reduces the adaptation cost of flood mitigating strategies.

6.2 Policy recommendation

- Certain level of distance maintenance should be imposed on construction of new houses. The more distinct a house is constructed from river the less economic cost will be sustained by a household.
- Awareness about Education should be increased because literacy rate among the people is very low. Also flood awareness programmers should be introduced to aware people about flood consequences.
- Our empirical results demonstrated that sand bags and dikes should be dispatched before floods to reduce the impact of floods on agriculture and household residency in order to mitigate the effect of floods at lower cost.
- Financial assistance from Government is required to facilitate locals to pave their houses. Which will help them to fight against flood and will reduce their losses. As shown in results paved houses have faced less cost in comparison to unpaved houses.

- Rental houses should be upgraded according to modern standards by owners. Most of the houses are rented to tenants and their condition is highly vulnerable. So upgradation of houses is very vital to minimize further losses.

6.3 Future vision

This thesis will be helpful for government sector institutions to take initiative to provide guidelines, knowledge and platform for peoples to understand the consequences and aftermath of these floods both in economic and social terms. Seminars and workshops should be conducted to aware people in the area. Guidelines will led local's to take exact necessary amount of measures to safeguard themselves against these floods. Changing the attitude of peoples in one region will lead to have positive impact on many peoples in other localities which as a whole will help the nation to safeguard themselves against floods.

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Appendix

Questionnaire

Questionnaire No. _____ Village: _____

Date: _____

1. Name of the Household _____
2. Age of the HH _____ Years
3. Gender

   Male ☐ Female ☐
4. Residence

   Urban ☐ Rural ☐
5. Marital Status

   Single ☐ Married ☐ Widow ☐
6. Highest level of education

   No Education ☐ Grade 1 to 5 ☐ Grade 6 to 8 ☐

   Matric ☐ F.SC. / F.A ☐ Master (16 years of Edu) ☐

   Vocational School ☐ Other ☐
7. Occupation

   Minor Unemployed ☐ Subsistence Farming ☐ Farm worker ☐

   Trained Employee ☐ Small trader ☐ Gov't Employee ☐

   Military ☐ Student ☐ Housewife Pension ☐

   Other ☐
8. Number of family members_____?
9. How many persons of your household members are in earning position _____?
10. Total Income of the HH Rs _____
11. Does any of household member has any disability?
12. Home type

    Pucca ☐ Kutcha ☐
13. Size of your house (in Marla's) _____

14. No. of rooms in your home _____

15. Current value of the house you are living Rs _____

16. What is your present occupancy status?

Owned ☐ Rented ☐

17. If rented then how much you pay for the rent Rs _____

Event information

18. When heaviest rain did came in most recent years _____

19. During the month of heaviest rain, was there flood in your areas

Yes ☐ No ☐

20. How frequent do you experience floods

More than once a year ☐ once a year ☐ every alternative year ☐

Once in a five year ☐ Once in a ten year ☐ Never ☐

21. Mostly in which month does it gets flooded _____

22. How many times have you faced Flooding during last decade _____

23. When was the last time you have experienced flood. Year_____

24. What were the mitigation measures after last flood_____

25. How much cost incurred on those MM. Rs_____

26. Damages during last flood. Rs_____

27. Damages incurred during last two floods. Rs_____

28. Mitigation cost incurred during last two floods. Rs_____

29. Have you been informed about flood (Y / N)

30. What was the source of information please mention_____

31. How much was the source of information reliable.

Satisfactory ☐ very satisfactory ☐

Unsatisfactory ☐ very unsatisfactory ☐

32. What was your response as a result of such information

Migration ☐ Shifting of valuables to safe place ☐

33. What was the cost of migration or shifting of valuables Rs_____

34. Distance from home to river _____ Km.

35. For how long water remained standing in the area after flood occurrence _____ days.
36. Is there any injury occurred in your family due to flood

    Yes ☐ No ☐
37. If Yes then how much cost you bear due to injury Rs _____
38. How many days you did not work during flood _____ days
39. Is any death in your family

    Yes ☐ No ☐
40. If Yes then was his/ her monthly earning Rs _____
41. What kind of impact do you experience as a result of flood

    Loss of lives ☐ Loss to agriculture crops ☐ Loss to livestock ☐

    Loss to utilities ☐ Loss of infrastructure ☐ other ☐
42. Due to floods, did you incurred any damages?

    Yes ☐ No ☐
43. If yes, please mention the nature of damages?

    Falling of rooms ☐ Falling of walls ☐ Floor damages ☐ others please mention ☐

    Bolter (boundary support of house to prevent from floods) damages ☐
44. Have you incurred any repairing cost due to floods?

    Yes ☐ No ☐
45. If yes please mention the cost of repairing.

    Falling of Rooms Rs _____ Floor Damages Rs _____

    Others please mention Rs _____ falling walls _____

    Bolter (boundary support of house to prevent from floods) damages Rs _____
46. Did Gov't help you in emergency situations like floods?

    Yes ☐ No ☐
47. If yes, then how much government facilitated you?

    With monetary support _____ Shelter value in Rs_____

    Food then value in Rs _____

    Any other then value Rs. _____
48. In case of monetary support how much did you got Rs _____

Borrowings

49. Did you borrow during or after the most recent flood?

    ☐ ☐

Yes No

50. If Yes please mention the source

Source	**Y for yes (Rs.)**	**N for no**	**Total Borrowings (Rs)**
Friends/Relatives			
Neighbors			
Pvt. Banks			
Govt. banks			
Other source			

51. Assets loss and Disposal

Description of asset	**Quantity Owned Before Flood**	**Quantity Owned After Flood**	**Lost in KG's/ Tons**	**Loss in Rs.**	**Sold Quantity**	**How much re-ceived (Rs.)**	**Purpose of Selling**
Wheat							
Rice							
Maize							
Sugarcane							
Barley							
Others Cereals							
Poultry							
Cows							

Buffalos							
Sheep's and Goats							
Fodder							
Dairy Products							
Vegetables							
Others like jewelry, Savings etc.							

Coping Strategies

S.no.	**Question**	**Responses**
2	Have you used Deployed sand bags to cope with floods?	□ Yes □ No
3	If yes please mention the number of sand bags used and the total cost incurred.	Quantity._____ Rs._____
4	Have you ever constructed Dikes to protect against Floods?	□ Yes □ No
5	If yes, what were the total cost of construction?	Rs._____
6	Is there EGF in your house?	□ Yes □ No
7	What's the cost of EGF construction?	Rs._____
8	Is your house being built with reinforced material?	□ Yes

		□ No
9	If yes, what were the total cost of it?	Rs._____
10	Is your Dwelling foundation been constructed durably?	□ Yes □ No
11	Total cost incurred to strengthen Foundation?	Rs._____
12	Do u use precautionary savings as a coping source during floods?	□ Yes □ No
13	What is the Amount of precautionary savings used during floods?	Rs._____
14	Do you clean canals to reduce flood damages?	□ Yes □ No
15	What's the cost of canals cleaning?	Rs._____
16	Did you migrated from this area after floods?	□ Yes □ No
17	If Yes, what was the type of migration from this area after floods? Also mention the cost borne for such migration due to flood.	□ Temporary (reoccupied own houses) RS._____ □ Temporary (reconstructed own house) RS._____ □ Permanent within the same area/village RS._____ □ Permanent to other area RS._____

Damages incurred during last two floods (question 27)

Sn	Year	Health cost (Rs)	Assets damages (Rs)	Building in-frastructure damages (Rs)	Livestock damages (Rs)	Utilities damages (Rs)	Other damages (Rs)
1							
2							
Total (Rs)							

Mitigation costs during last two floods (question 28)

Sn	year	Deployed sand bags (Rs)	Dikes (Rs)	EGF (Rs)	FS (Rs)	RM (Rs)	Canals cleaning (Rs)	Migration (Rs)	Others (Rs)
1									
2									
total									