

**International Master's Program in Infrastructure Planning  
UNIVERSITY OF STUTTGART, GERMANY**

**Master's Thesis**

**ASSESSING VULNERABILITY AND CAPACITY OF FLOOD  
AFFECTED COMMUNITIES IN PUNJAB, PAKISTAN  
CASE STUDY: DISTRICT JHANG AND MUZAFFARGARH**



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## ABSTRACT

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In Punjab, the continuous floods in the last six years especially in 2010 and 2014, due to climatic and non-climatic reasons, have exposed physical, socio-economic, and environmental vulnerabilities. The flood disaster management in Punjab is primarily focused on rescue, relief, and dependence of structural measures. The assessment of vulnerability is limited to district level (in form of mapping) which is incapable of identifying essential socio-economic drivers of vulnerability and local ability to cope and adapt. The mega flood of 2010 inflicted several changes in government structure and within communities. This research study assessed the vulnerability and capacity of flood affected communities as well as fluctuation in their vulnerability and capacity by analyzing planned and unplanned post flood responses. The study also determined the role of spatial planning in reducing flood vulnerabilities.

To conduct the study, a vulnerability assessment framework was modified from sustainable livelihood and BBC framework. Qualitative and quantitative analysis and their triangulation were conducted to apprehend the pertaining issues. Interviews with officials of disaster management and spatial planning institutes were conducted to analyze changes after 2010 flood and government interventions. Participatory Rapid Appraisal (PRA) for two flood events (2010 and 2014) and household survey provided the vulnerability and capacity assessment of four flood affected communities in two severely affected districts (Jhang and Muzaffargarh) of Punjab. The concept of vulnerability syndrome provided the relationship between different community elements and factors that fluctuated vulnerability.

The results indicated that government interventions were limited to financial aid and early warning. These measures remained victim to political biasness, mismanagement, and lack of coordination and communication between departments. Other formal changes (legislation, policies, plans etc.) seemed to be less effective due to top-down approach, lack of technical man power; disaster management knowledge and financial constraints. Spatial planning appeared ineffective in mitigating flood risk as it was limited to urban areas and deficient incorporation of DRR measures in development plans. The results of PRA and household survey indicated that vulnerability of immovable assets increased or remained the same after 2014 flood disaster, but reduced significantly for moveable assets. Complex relationships existed within and between various dimensions of vulnerability that fluctuated vulnerability of related elements and factors. These relationships demonstrated that lack of physical infrastructure and awareness were the key drivers of vulnerability in Punjab.

Triangulation of analyses indicated similarities and differences in PRA and household survey. In spite of similarities and differences, the results indicated that capacities have been developed in communities autonomously. NGOs and media played a vital role in increasing community's capacities especially in district Muzaffargarh. However, negative consequences of some coping and adaptation measures were observed and several social, physical, financial and institutional limitations were highlighted which increased community vulnerability in long term. Overall, the results revealed that Muzaffargarh has developed more capacities to cope and adapt to floods due to massive media and NGOs attention which is demonstrated diagrammatically in the form of recovery process.

Due to several limitations, this research study could not significantly address the fluctuation in vulnerability and urgencies for capacity measures. Nevertheless, it gives an idea of what is important for community to increase its capacity and what loopholes exist in government systems that escalate community vulnerability. The research suggests implementation of second order adaptation measures to eliminate negative consequences of some capacity measures. The study underlines the importance for horizontal coordination and communication between government line departments, private organizations and communities to link formal and informal responses in order to reduce future flood vulnerabilities.

## **DECLARATION**

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I hereby declare that:

- the thesis is the outcome of my own efforts and has not been published anywhere else before and not used in any other examination,
- the material and methods used and quoted in the text has been properly referenced and acknowledged,
- the electronic copy is consistent with the hard copy.

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Signature: \_\_\_\_\_



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## LIST OF ACRONYMS

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AV	Actual Value
BCOP	Building Codes of Pakistan
CB	Cantonment Board
CBDRM	Community Based Disaster Risk Management
CDG	City District Government
CICERO	Center for International Climate and Environmental Research
CKDN	Climate Knowledge Development Network
CPI	Critical Physical Infrastructure
DA	Development Authority
DDMP	District Disaster Management Plan
DFID	Department for International Development
EHV	Extremely High Vulnerable
EHV	Extremely High Vulnerable
FCC	Federal Flood Commission
FIG	Federation of Surveyors Denmark
GCRI	Global Climate Risk Index
GHGs	Greenhouse Gases
GoP	Government of Punjab
HV	High Vulnerable
IPCC	Intergovernmental Panel on Climate Change
IRSA	Indus River System Authority
JICA	Japan International Cooperation Agency
Km	Kilometers
KPK	Khyber Pakhtunkhwa
LV	Low Vulnerable
MCII	Munich Climate Insurance Initiative
MCs	Municipal Corporations
MV	Medium Vulnerable
NDMA	National Disaster Management Authority
NDMP	National Disaster Management Plan
NFIs	Non-Food Items
NGO	Non-Governmental Organization
NRM	National Reference Manual
PDMA	Provincial Disaster Management Authority
PHATA	Punjab Housing and Town Planning Agency
PKR	Pakistani Rupees (\$1 = 101 PKR as on 22-08-2015)
PLG&CD	Local Government and Community Development
PMD	Pakistan Metrology Department
PRA	Participatory Rapid Appraisal
PUV	Partial Utility Value
SREX	Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation
TMA	Town/Tehsil Municipal Authorities
TOI&S	Tehsil/Town Officer Infrastructure and Services
TOP&C	Tehsil/Town Officer Planning and Coordination
TOR	Tehsil/Town Officer Regulations
UCs	Union Councils
UN-ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNFCCC	United Nations Framework Convention on Climate Change
UN-OCHA	United Nations Office for the Coordination of Humanitarian Affairs
UV	Utility Value
VLV	Very Low Vulnerable

# 1 INTRODUCTION

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## 1.1 Background

Disasters pose serious threats to the environment and development. The frequency of natural disasters has amplified throughout the world with the number of disasters and affected people having doubled during 1990 to 2000 (UN-ESCAP, 2006). A major contributing factor is climate change which has made human and natural systems more vulnerable to disasters due to its impacts on these systems (IPCC, 2012a, 2014a). One of the primary climate extremes is increased precipitation and glacier melting influenced by greenhouse gases (GHGs) which results in urban and rural flooding (Seneviratne et al., 2012; Cisneros et al., 2014). The impacts of these extreme events are not equally distributed globally (Cardona et al., 2012). Developing countries particularly those in Asia are at risk of climate change, and therefore most vulnerable to flood disasters (Cruz, et al., 2007; Hijioka et al., 2014), mainly due to lack of resources to adapt (socially, technologically and financially) to such disasters (Mirza, 2003; UNFCCC, 2007).

Floods are the most occurring disaster in the world. Pakistan is one of the countries where it is a perpetual phenomenon. Nevertheless, floods have become frequent and intense during the last ten years due to climatic and non-climatic reasons. In 2009, Pakistan ranked 12<sup>th</sup> among countries most vulnerable to impacts of climate change (IUCN, 2009), but assumed 3<sup>rd</sup> rank within next four (4) years owing to continuous floods in the later years (Kreft & Eckstein, 2013), which affected large section of poor population living in low lying flood plains. These floods took thousands of lives, destroyed millions of houses, damaged millions of hectares of standing crops, and caused huge population displacement (UN-OCHA, 2014). The province of Punjab has been massively affected in these years due to lack of preparedness, ineffective early warning system, and want of institutional capacity to assess vulnerability.

## 1.2 Problem statement

Climate change is an important aspect of disaster management owing to its significant contribution in incessant floods in Pakistan. Last five years of flooding has greatly impacted the Punjab province by enormously damaging property and infrastructure, substantial loss of lives and livelihood of people. Although disaster management plans at national, provincial and local level are available and are updated every year, the public authorities still failed to manage the floods and reduce damages and community vulnerabilities (North, 2014). The review of Disaster Management Plans (DMPs) suggests that management is primarily focused on rescue and relief (NDMA, 2014a,b; PDMA, 2014) instead of assessing local level vulnerabilities (which is a “*key determinant of disaster risk*” (IPCC, 2012)), and taking adaptation and Disaster Risk Reduction (DRR) measures because of low level of understanding of these concepts in public sector disaster management and development circles (Shahid, 2012; MCII, 2015).

Several literatures suggest the need of vulnerability assessment and taking consequent measures which is vital in reducing the flood impacts on communities in Pakistan (CICERO, 2000; Shahid, & Piracha, 2010). Top down approaches using mapping for vulnerability and risk assessment, for

example: Rafiq & Blaschke, (2012); Uddin et al., (2013); and other government studies could not contribute well in reducing the flood impacts and losses. These approaches are incapable of identifying essential social drivers of vulnerability and local ability to adapt (Adger et al., 2007) as compared to the community-based approaches which are effective to this end. (O'Brien et al., 2004; Tompkins & Adger, 2005).

Assessment of community vulnerable assets and measures / factors that contribute to or reduce vulnerability, based on peoples' urgencies, is absent in research circles at grass root level in Pakistan. Furthermore, vulnerability assessment during and after flood is necessary to record the formal and informal changes (Birkmann, 2008; Birkmann et al., 2008). The past flood disasters have caused many changes in the structures and working of public authorities as well as altered the behavior and life styles of people to reduce vulnerability, the aspects which have not been explored. Moreover, spatial planning is an effective DRR tool (Sutanta, 2012; Burkett et al., 2014), but little attention has been paid on this tool and its role has not been assessed in Punjab. Therefore, considering the situation of floods in Punjab, a research on assessment of vulnerability, capacity, formal and informal changes, and role of spatial planning is needed. The problem statement is depicted in Figure 1.

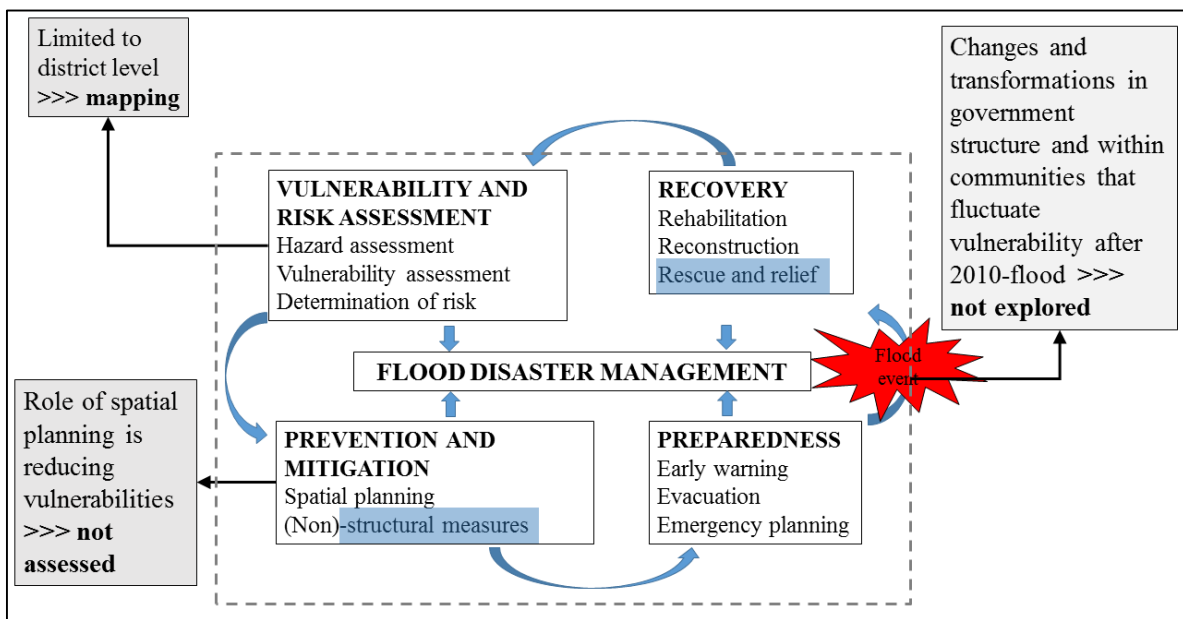


Figure 1: Problem statement  
Source: Author's own, 2015 based on FIG, 2006.

### 1.3 Research objectives

- To determine the role of spatial planning in reducing vulnerability at local level, especially in rural areas.
- To assess the vulnerability and capacity of communities by active involvement of flood victims.
- To explore the changes in structure of government and community that fluctuated vulnerability after the mega flood event of 2010.

## 1.4 Research questions

- What planned and unplanned changes took place following the flood disaster of 2010?
- How, and to what extent spatial planning tools are utilized in reducing flood vulnerability at rural level in Punjab?
- Which community assets are susceptible and what are the factor shapes vulnerability and how do the communities cope and adapt during and after flood disasters?
- How the vulnerability of assets as well as urgencies for coping and adaptation measures altered with flood events considering planned and unplanned changes?

## 1.5 Research methodology

*“Research methodology is the systematic way of solving a research problem”* (Kothari, 2004). Research methodology involves several steps which need to be followed for accomplishing research objectives. A general but specific and systematic approach is used for carrying out the research. Steps and tasks undertaken for the research are explained below and scheme designed for conducting the research is presented in Figure 2.

### 1.5.1 Literature review

Literature was reviewed for theories and concepts of vulnerability as well as its assessment at grass root level in international and local context to comprehend pertinent issues and selecting an appropriate framework for vulnerability assessment (see Chapter 2, Section 2.5.4). Several documents related to past flood disasters were analyzed in order to assess flood causes, exposure, loss and damages, as well as interventions and changes induced in post flood situation by public authorities to reduce future vulnerability. Moreover, the role of spatial planning was searched for rural and urban flooding by analyzing different government documents. Literature review and document analysis provided a guideline for selecting appropriate elements, indicators and questions for different assessments and helped identify research gaps in Pakistan. It also aided in refining the objectives and research questions.

### 1.5.2 Selection of study areas

Several study areas related to the research topic were available. However, it was imperative to select those areas which provide sufficient material for authentic findings. The selection of specific settlements within a district was not possible due to unavailability of data at the very local level. Therefore, selection of districts were made by chalking out two criteria to assist in the selection of final and logical study area.

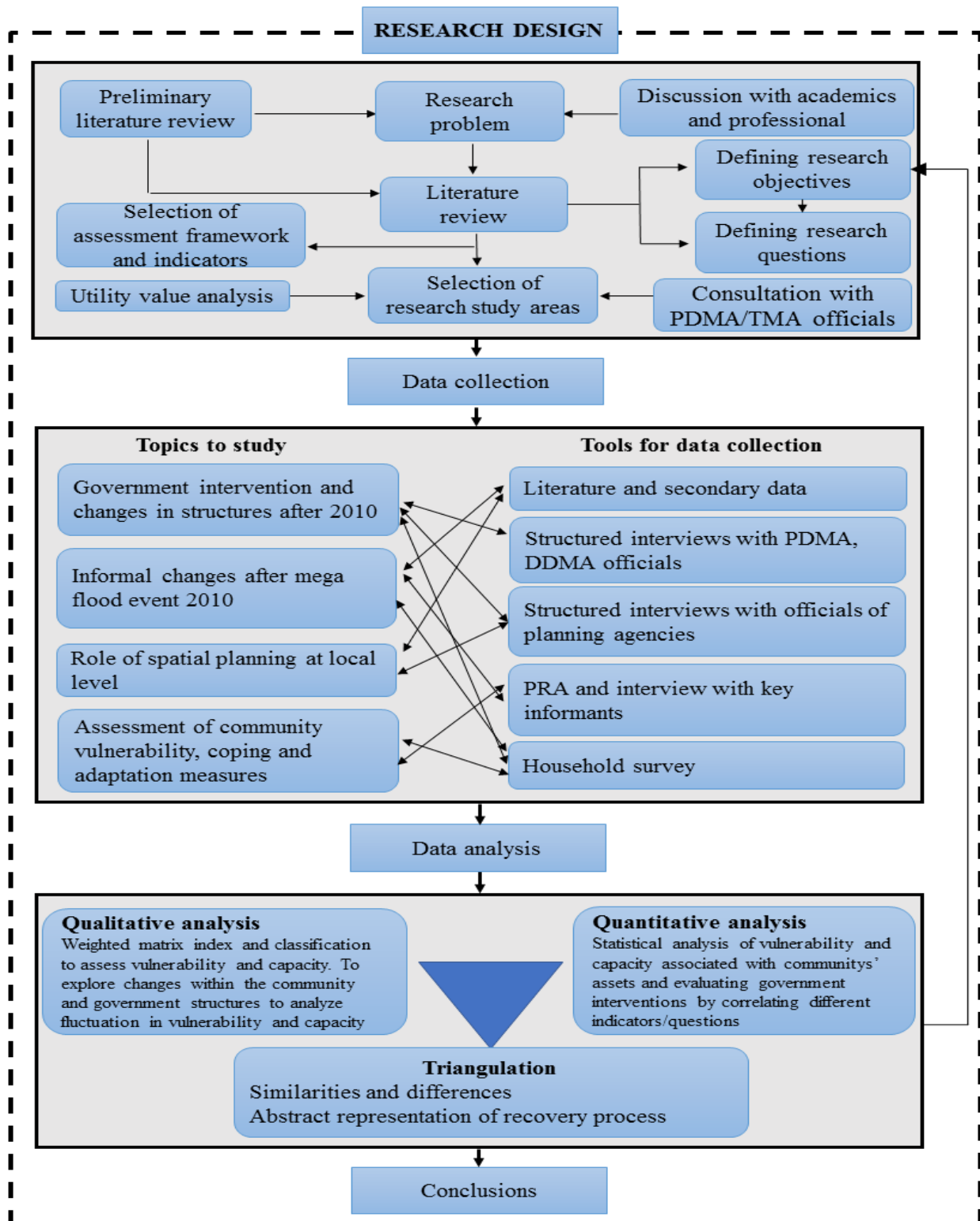


Figure 2: Research methodology  
Source: Author's own based on Van Taun, 2014.

First criterion was to select those districts which were massively affected in the flood of 2010 and 2014. The districts were selected based on the flood risk category of districts (PDMA, 2014, p.16). Since more than 10 districts are at high flood risk, four districts which were severely affected in 2010 and 2014 were chosen to narrow down the research (see Table 1).

Table 1: Utility value analysis for possible alternatives. Blue colour indicates the selected study districts.

Indicators	Share	Possible Alternatives											
		Muzaffargarh			Rajanpur			Jhang			Multan		
		AV <sup>1</sup>	PUV <sup>2</sup>	UV <sup>3</sup>	AV	PUV	UV	AV	PUV	UV	AV	PUV	UV
Percentage of rural population (%)	20%	87	87	17.4	86	86	17.2	76	76	15.2	58	58	11.6
Literacy rate (%)	20%	28	57.7	11.5	21	67.0	13.4	37	45.7	9.1	43	37.7	7.5
Vulnerable population (million)	20%	1.46	92.7	18.5	1.09	68.1	13.6	0.31	15.5	3.1	0.14	21.0	4.2
Affected settlements (number)	20%	909	93.2	18.6	642	77.1	15.4	777	83.9	16.8	464	61.4	12.3
Crops destroyed (million hectare)	20%	0.51	53.0	10.6	0.45	49.4	9.9	0.91	93.7	18.7	0.16	23.8	4.8
<b>Total score</b>	100%			77			70			63			40

Source: Memon, 2013; Bureau of Statistics, 2014; NDMA, 2014a,b.

Second criterion was to use utility value analysis for final selection of districts out of the four shortlisted districts. Five indicators (related to vulnerability and capacity) for utility value analysis were chosen and equal weights were given to each indicator considering equal importance to remove bias (see Table 1). The result showed Muzaffargarh as the most suitable study area. In order to compare the vulnerability of areas, two districts need to be selected. Jhang was therefore selected as second research study area instead of Rajanpur due to accessibility issues, unavailability of contact person, language barrier, and crime problems.

### 1.5.2.1 District Jhang

District Jhang is located in the center of Punjab province. It is situated in the south-west of Islamabad, the capital of Pakistan. The district has two major rivers: Chenab flows from north-east to south-west, and Jhelum river flows from east to south-west, both of which meet at a point called Trimmu where Trimmu barrage is constructed to regulate flow of water. The district is at high risk of riverine flood and suffered heavy damages and exposed various settlements in the floods of 2010 and 2014. Two flood affected settlements: Bela Jhabana and Goniya (see Figure 3) were selected from district Jhang by consulting local contact persons<sup>4</sup> (see Annexure-A, Table 25 for description of settlements).

### 1.5.2.2 District Muzaffargarh

District Muzaffargarh is located in the south of Punjab province. River Indus flows in the north of the district and Chenab River runs in the south. These two rivers instigated massive floods in the 2010 and 2014 which resulted in destruction of thousands of houses and huge population displacements. Muzaffargarh sits at the top of the high flood risk districts. Doaba and Thatta Qureshi are two settlements selected for the study (Figure 3). Brief description of settlements is

<sup>1</sup> AV is the Actual Value of each indicator.

<sup>2</sup> PUV (Partial Utility Value) obtained from the graph of level of accordance (see Annexure A, Figure 38)

<sup>3</sup> UV (Utility Value) calculated by multiplying share of each indicator with PUV.

<sup>4</sup> Local contact persons were the friends and hired personnel living in the districts having sufficient knowledge of the area, and officials of local government.



provided in Annexure-A, Table 26. It was made sure that all the selected settlements in both districts should have exposed and affected in 2010 and 2014.

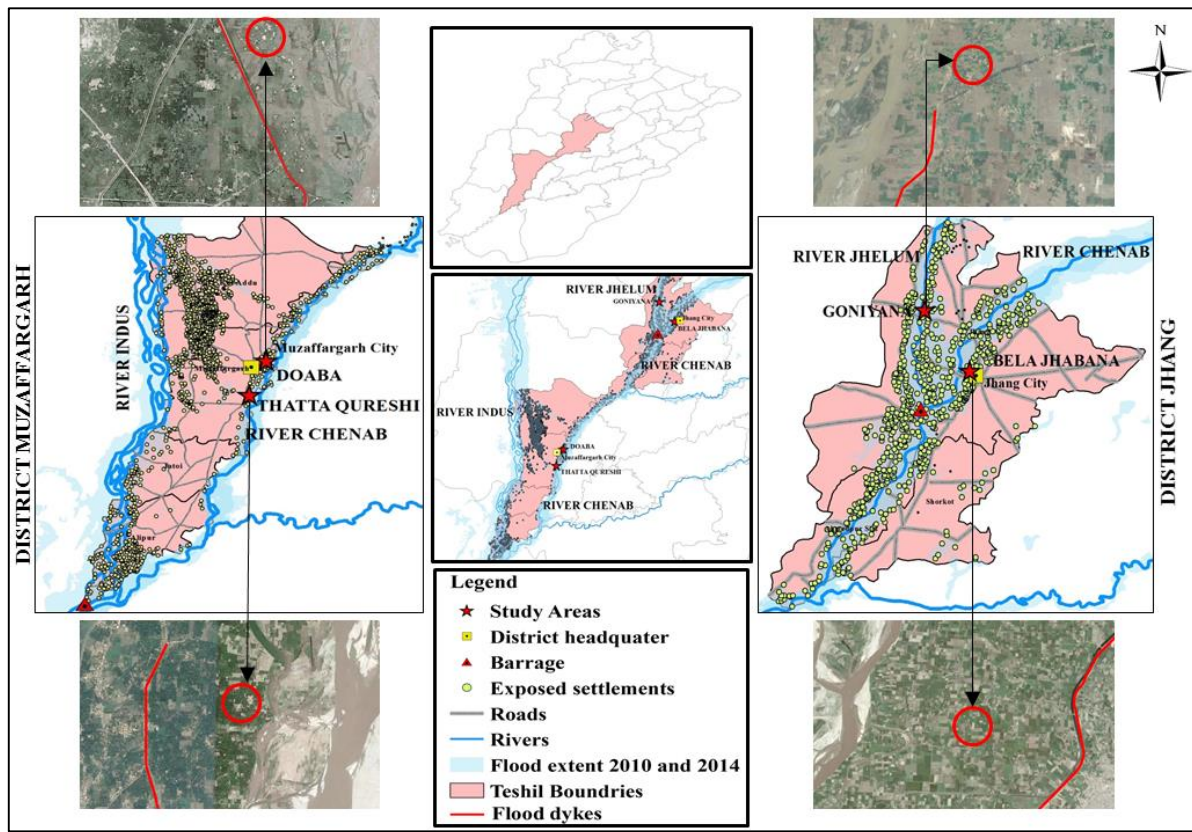


Figure 3: Location of case study areas together with flood extent and exposed settlements  
Source: Author's own, 2015, based on data from Humanitarian Response, 2015.

## 1.6 Preparation for data collection

### 1.6.1 Sampling

The population and number of houses in the selected settlements were almost similar. With the confidence level of 95% and error margin of 0.05, almost 28-30 houses need to be selected from each settlement. Therefore, 30 houses were surveyed from each settlement. From district Jhang, 15% in Bela Jhabana and 14% of houses from Goniya, whereas 16% houses from Doaba and 15% from Thatta Qureshi were surveyed from district Muzaffargarh. Random sampling was utilized for the household survey in order to involve households with different income and caste. It also helped save time by recording responses of those who willingly participated in the survey (Zink, 2012).

### 1.6.2 Preparation of questionnaire

Three different types of questionnaires were designed. Firstly, a structured questionnaire was designed for public disaster management authorities (see Annexure-B). Secondly, a structured questionnaire was developed for the development and planning authorities to investigate their role in managing flood hazards (see Annexure-C). Thirdly, a PRA was designed for assessment of vulnerability and coping/adaptive capacity based on five livelihood assets specified in assessment

framework (see Annexure-F). Additionally, another questionnaire was drafted for household survey and obtaining relevant information (see Annexure-D). A specific sheet was designed for making village profile (see Annexure-E).

## **1.7 Data collection**

Data collection is a vital part of research which makes the research valuable and authentic. The data was collected from primary and secondary sources. Qualitative and quantitative data was collected in order to provide strong statistical and theoretical basis for the results. Secondary data collection involved collecting maps, plans, area profiles, and other information related to the case study areas, which was gathered from the PDMA Punjab, local municipality offices, and other related offices. Primary data collection involved conducting interview of key informants of the PDMA, DDMA and local planning officer through structured questionnaires which were designed to get information regarding government interventions for assessing vulnerabilities and increasing the coping/adaptive capacities of rural flood affected communities, and to explore the role of spatial planning in reducing flood vulnerabilities from districts at high flood risk.

Assessment of vulnerability and adaptive capacity was carried out using Participatory Rapid Appraisal (PRA) for each study area which was made effective through weighted index matrix (Younus & Harvey, 2013). For this purpose, a group of 25 people comprising of affected local villagers, head of mosque, local government official and public representatives were gathered at one point. The weights were given by the members of the local community to each pre-specified/suggested vulnerability element and capacity measure with respect to the two flood events of 2010 and 2014. The weight depended on the number of people who raised their hand to the concerned issue. A questionnaire was prepared to get socio-economic and disaster relevant data as well as public opinion of government involvement in reducing vulnerabilities.

## **1.8 Data analysis and findings**

The collected data was analyzed qualitatively and quantitatively. The weights in PRA of two settlements were aggregated and averaged separately for each flood event and for each study district to get a final weight which was classified / prioritized based on severity of vulnerability (extremely high, high, medium, low and very low) and urgency of capacity measure (see Figure 4). The comparison of PRA for two flood disasters showed fluctuation in vulnerability, coping and adaptation of community. The household survey was analyzed using MS Excel and SPSS to produce cross tables and charts for comparing different factors in both districts. Triangulation of qualitative and quantitative analysis was carried out to examine similarities and differences; to provide linkages of formal and informal changes; and accordingly define a recovery process for both districts.

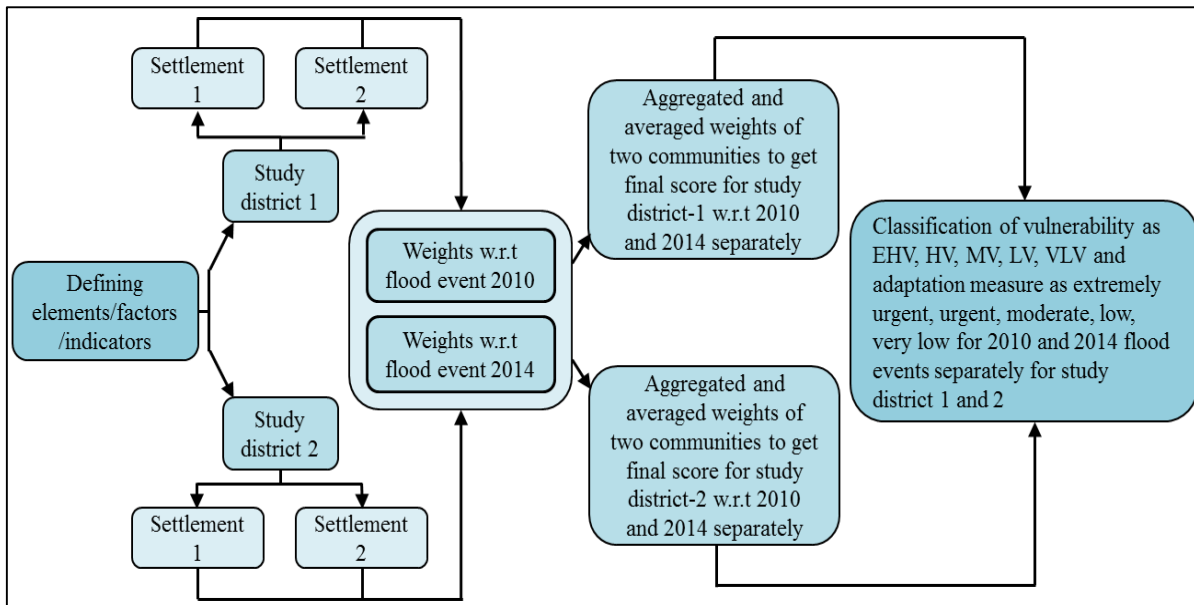


Figure 4: Flowchart for methodology and analysis of Participatory Rapid Appraisal (PRA)  
 Source: Authors own, 2015 based on Younus & Harvey, 2013.

## 1.9 Organization of report

Chapter 1 delivers the background information, problem statement, research objectives and research questions, and brief methodology of research.

Chapter 2 explains basic concepts and theoretical perspective of vulnerability, its assessment framework, and related concepts like resilience and adaptation, and presents a modified framework.

Chapter 3 gives an overview of flood hazard and risk profile of Punjab and its management.

Chapter 4 examines the formal and informal changes that took place after the mega flood event of 2010.

Chapter 5 explores the role of spatial planning at local level in reducing flood vulnerability and risk by analyzing different spatial planning tools utilized in urban and rural flood affected areas.

Chapter 6 assesses the vulnerability and capacity of different community assets using participatory approach. It also assess the how vulnerability and capacity fluctuated considering planned and unplanned changes

Chapter 7 provides the results of household survey for vulnerability and capacity measures using cross tabulation, graphs and diagrams.

Chapter 8 triangulates all the results and gives similarities, differences, and defines the recovery process accordingly.

Chapter 9 concludes the results of all the analysis and provides future directions for further research.

## 2 THEORETICAL PERSPECTIVE OF VULNERABILITY AND RELATED CONCEPTS

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Increased frequency of natural disasters particularly floods, intensified by climate change and its impacts, is perilous to the affluence of mankind. Understanding and clarification of concepts of vulnerability (susceptibility), resilience (ability to deal with changes), and adaptation (adjustment) are important for assessment of capacity of communities to deal with flood hazards. These terms are widely used in multi-disciplinary (Brooks, 2003) and multi-dimensional context (Cardona et al., 2012). This chapter will provide comprehensive theoretical basis of vulnerability and its related concepts. Frameworks for vulnerability assessment are studied to select an appropriate framework. The framework selection helps in assessments that are effective and efficient in disaster planning (Buckle et al., 2000) and provides opportunities to cope with flood disasters (Tompkins et al., 2010).

### 2.1 Vulnerability: Definitions

Vulnerability is not a novel term and has been in use in literature since decades. It is widely used in geography, social science and natural sciences. Nevertheless, Schoon, (2005) argued that 50% of the term ‘vulnerability’ is used in natural hazard research and the rest is used in the context of poverty and by climate change researchers. In this thesis, vulnerability in the context of natural hazards is discussed. Vulnerability is defined as:

*“...the characteristic of person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard” (Blaikie et al., 1994, p.11).*

*“... the degree to which a system, subsystem, or system component is likely to experience harm due to exposure to a hazard, either a perturbation or stress stressor” (Turner et al., 2003) .*

*“The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt” ( IPCC, 2012b, 2014c)*

In hazard research, vulnerability is defined in different ways and perspectives. It is evident that most of the definitions developed in 20<sup>th</sup> century deal with the loss (property and life in particular) and refer to the social-economic conditions of the people (income, age, sex, caste and other) that shape vulnerability. The new era deals with the sensitivity or susceptibility of a system. Although the context of previous definitions also lies in the system but is particularly associated with humans, whereas new concept is particularly associated with coupled socio-economic system (Turner et al., 2003). IPCC definition describes three features: exposure of place, objects, population or system; *sensitivity or susceptibility* based on characteristic of place, objects, population or system exposed; *coping and adaptive capacity* of a place, population or system to adjust. Birkmann et al., (2013a) mentioned that sensitivity is used in climate change literature, and susceptibility in disaster risk literature. It is analyzed that exposure and sensitivity tend to escalate vulnerability, while capacity reduces it.

## 2.2 Drivers and dimensions of vulnerability

The understanding of causes of vulnerability is important for reducing the risk. Several causes have been summarized by Cardona et al., (2012): inappropriate urban/rural development; population growth; social segregation and economic inequalities; failure in governance due to corruption and mismanagement; environmental degradation. Vulnerability also results from poverty, lack of knowledge, technology and skilled man power. Critical infrastructure for example: water supply, sanitation, roads, shelter, communication media are necessary for building capacity, whereas inappropriate planning escalates vulnerabilities of societies.

Vulnerability has several dimensions viz., physical, social, economic, environmental, and institutional aspects. Physical dimension covers the tendency of damage of infrastructure, settlements, places, services or structures due the occurrence of hazardous event. According to Birkmann, (2013), social dimension deals with the social differentiation, poverty, justice, education, social network, demography, livelihood and many others. Economic dimension is related to the economic strength of a region, area, or community which is threatened by the loss of income/means of income, production, and other assets due to occurrence of hazard.

Environmental dimension of vulnerability deals with the ability of different interrelated ecosystems to cope with and recover from impacts of a disturbance. Human interference with environment not only increases the environmental vulnerability but also the social vulnerability. Institutional dimension includes the actions of establishment (rules and regulation, governance system) which increase/decrease the capacity of system to deal with hazard. These actions could be livelihood diversification, risk management and adaptation strategies (Ciurean et al., 2013).

It is learned that vulnerability is multi-dimensional, scale dependent and dynamic. It differs from one theme to another and acts differently at local, national and global level. This complex and dynamic nature of vulnerability makes it difficult to understand and assess vulnerability. Several frameworks in this context have been developed to comprehend the multifaceted nature of vulnerability at different scales. These frameworks are explained in the Section 2.5.

## 2.3 Coping and adaptation capacity

The concept of capacity is imperative in vulnerability and risk assessment and helps in modifying the resilience. It is not necessary that a system which is exposed and susceptible is also vulnerable because the system's vulnerability is influenced by capacity to cope and adapt. Vulnerability is characterized by two closely related terms: coping and adaptive capacity. Literature has identified similarities and differences in these terms. In IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX), the coping capacity is indicated ex-post and adaptive capacity is indicated as ex-ante. In this view, "*...coping maintain the system and its functions in the face of adverse conditions and adaptation involves changes and requires reorganization processes*" (Cardona et al., 2012). Coping is characterized by the availability of community resources and ability to utilize these resources. It focuses on protection of existing structure and institutions.

Adaptation is planned action to anticipate the future hazards and organize the community or system accordingly. Smit & Wandel, (2006) argued that “...adaptations are manifestations of adaptive capacity, and they represent ways of reducing vulnerability”. Birkmann, (2011) differentiated two concept of coping and adaptation. Figure 5 illustrates that coping is immediate response to the impact of a disaster whereas adaptation is related to changes based on the learning from that event. Thus, adaptation is a long term process which takes advantage of the changing environmental and socio economic conditions and makes adjustments in the social, economic and institutional structures of community and government. Nevertheless, coping and adaptation are interrelated and complement each other (Van Tuan, 2014).

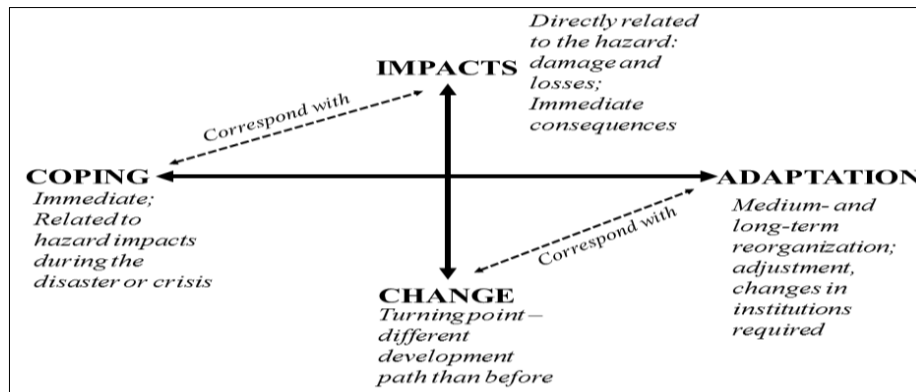


Figure 5: Coping and adaptation correspond to impact and changes  
 Source: Birkmann & von Teichman, (2009) in Birkmann, (2011).

### 2.3.1 Types of adaptation

Adaptation is categorized in to different types indicating how people respond to natural disaster or impact of climate change. IPCC, (2001) has differentiated types of adaptation as anticipatory, autonomous, planned, private, public and reactive. More forms of adaptation have been identified by Smit et al., (1999) (for example reactive, tactical and routine) which are categorized according to purpose, timing, scope, form and performance. Some adaptation types are given in Table 2.

Table 2: Type of adaptation as per different categories

Category	Definitions
<b>According to the purposefulness</b>	<i>Autonomous adaptation</i> is an unconscious response to changing environment and climate initiated due to the alteration in ecological, natural or human system. It is also referred to as spontaneous adaptation. <i>Planned adaptation</i> is based on the information, knowledge or awareness about the changes in the condition of environment to plan the actions for maintaining the system according to the meticulous policy decision by the public agency.
<b>According to the timing</b>	<i>Reactive adaptation</i> is the deliberate response to the impact of climate change in order to prevent the future impacts. It is an ex-post form of adaptation <i>Anticipatory adaptation</i> is the plotted action that takes place before the impacts of climate change are observed to prepare for and abate the possible impacts. It is also referred to as proactive and ex-ante adaptation.
<b>According to temporal scope</b>	<i>Routine adaptation</i> is foreseeable and characterized by the conscious reaction to the changing climate which becomes the regular part of the operation of the system <i>Tactical adaptation</i> is the response to the variation in the climate which requires the change in the behavior of the individual, community or system.

Source: Summarized from Smit et al., (1999) IPCC, (2001), Huq, (2003) and Younus, (2014).

### **2.3.2 Limitation to cope and adapt**

There are several limitations to cope and adapt depending on different factors. Birkmann, (2011) stated that limits to adapt depend on the magnitude of natural disaster and on social, physical, financial, institutional and political aspects. In social aspects, individual beliefs, behaviors and values might limit the households to undertake adaptation measures. Physical limitations are due to massive impacts of disaster which unable communities and eco-systems to adjust to disturbances. Additionally, financial condition of households, communities and governments may keep them from taking any adaptation measure. Lastly, lack of capacity of institutions to adapt is further hampered by political will or other political priorities. Thus, several limitations exist which can hinder the coping and adaptation process. Adaptation under such circumstances might have negative consequences and increase vulnerability.

### **2.3.3 Resilience in relation to adaptation and change**

The concept of resilience deals with the ability of community or household to deal with the changes. Living with changing environmental and socio-ecological conditions, building resilience is seen as a vital approach that transforms societies, communities or socio-ecological system (Folke, 2006). It is directly connected with the adaptive capacity, where an increase in capacity will increase the resilience of the system and resultantly reduce the vulnerability of individuals, communities, or social and ecological system. In the context of resilience, adaptation does not only denote the adaptive capacity to respond but also the changes in the capacity of ecosystem (Berkes et al., 2003). Thus, resilience provides the opportunity for change and innovation which is different from the concept of vulnerability (Birkmann, 2013).

Birkmann et al., (2008) studied the formal and informal changes in the socio-ecological system after the impact of natural hazard. They developed a framework for analysis of change and its relation with the impacts of disaster (see Appendix-G, Figure 40). Utilizing this framework, several formal and informal responses were observed in social, economic, environmental, political and organizational context which aimed at increasing resilience. It was also found that these changes had dual effect which could be progressive and regressive especially in the social context. In this perspective, second order adaptation measures are needed in correspond to the changes for building proper resilience (Birkmann, 2011 and see Annexure-G, Figure 41).

## **2.4 Sustainable livelihood approach and vulnerability context**

The livelihood is defined as “*capabilities, assets (stores, resources, claims and access) and activities required for a means of living*” and sustainability is coping and recovering from disaster as well as maintaining and enhancing capacity (Chambers & Conway, 1991). The approach was first presented by Chambers (1989) and further developed by several researchers and organizations to be utilized at local level for rural development. The approach is centered on rural livelihood assets of individuals, households and communities to identify their capacities to cope and recover from a shock. In this context, access to social, natural, physical, financial and human assets can recognize vulnerability. It also depends on changes and transformations in social and political processes that shape the ability of household/community to entitle a resource. Furthermore,

entitlement is vital in prioritizing the livelihood strategy to be adopted to reduce vulnerability and sustain their livelihood resources. In flood affected districts of Punjab, large landholders easily cope with flood by selling a part of their land.

## 2.5 Vulnerability assessment frameworks

Frameworks are a group or system of concepts, ideas, beliefs used to provide the foundation for planning and deciding something (Cambridge Dictionary, 2015). Several frameworks for vulnerability assessment are available presenting different views and concepts. These frameworks are crucial in evolving different methods for measuring and assessing vulnerability, and help in developing appropriate indicators, focusing on most relevant factors affecting vulnerability. Some frameworks are discussed in detail and others are summarized in Table 3.

Table 3: Summary of different conceptual frameworks for vulnerability assessment

Framework name	Description
<b>The double structure of vulnerability</b>	Bohle, (2001) presented this framework for assessing vulnerability and classified external (political economy approach, entitlement theory, and ecological perspective) and internal (conflict theory, action theory and assess to assets) sides of vulnerability. The external perception attributes to the structural dimensions of vulnerability (exposure) whereas internal side deals with the capacity to anticipate, cope with, and recover from hazard. The framework suggests that coping and adaptive capacities need to deal together to adequately characterizing the vulnerability (Birkmann, 2006)
<b>Vulnerability in the global environmental change community</b>	Turner et al., (2003) defined vulnerability in perspective of exposure (ecosystem, infrastructure, households, etc.), sensitivity (human and natural systems) and resilience (ability to withstand against environmental change). The framework presents a comprehensive view of different scales which is easily understandable. Nevertheless, linking of sensitivity, adjustment and coping at local level to the larger scale is not clear.
<b>The pressure and release (PAR) model</b>	The framework is presented by Wisner et al., (2004), specifies disaster risk as a product of hazard and vulnerability. The development of vulnerability is defined by three progressive levels, root causes, dynamic pressures and unsafe conditions. The framework emphasizes for changing the political and economic system to reduce vulnerability and disaster risk It works at different spatial scales.
<b>Actor oriented approach</b>	Bohle, (2007) developed framework for assessing social vulnerability by presenting four central elements: vulnerable actors, their activities, vulnerability agenda, and its arenas. The approach emphasizes on actor living with vulnerability, the actors who make them vulnerable and their activities for reducing vulnerability by securing their livelihoods. It takes into account the arenas for struggling for livelihood and human securities exists and look into the agenda where entitlements of the vulnerable are at stake (Bohle, 2007).
<b>IPCC vulnerability and risk framework</b>	Risk is seen as interaction of vulnerability, exposure of human and natural system and climate related hazard. It underscores that hazards influenced by climate and natural variability are not only the core reason of impacts as socioeconomic process have also a major role in it and are crucial in framing the exposure and vulnerability of socio-ecological systems. The framework summarized that climatic systems and socio economic process are the causes of vulnerability, exposure and risk (IPCC, 2014a)

Source: (Turner et al., 2003; Birkmann, 2006; Bohle, 2007; Birkmann, et al., 2013b; IPCC, 2014a)

### 2.5.1 Sustainable livelihood framework

This framework is developed by the Department for International Development (DFID) based on the early work of Chambers in 1989. It focuses on two concepts: ‘sustainability’ and ‘livelihood’. Main elements of the framework are: livelihood assets (human, social, natural, financial and physical); transformation of structures/processes and vulnerability context. Sustainability is viewed as ability to cope and recover from stresses and maintain natural resource



bases (DFID, 1999). The framework stresses that vulnerability (which is characterized by shocks, trends and seasonality) can be influenced by the transforming public and private structures and institution, and determine the access to livelihood assets. The access (to assets) and influence of transformation affect the livelihood outcomes (see Figure 6). The approach also highlights the need for empowering local communities for reducing vulnerability. The notion of ‘security’ is neglected (Bohle, 2007) and the role of livelihood outcomes in context of hazard is disregarded in this framework. However, it is beneficial for other approaches to identify the susceptibility and coping capacity for natural hazard by providing important sources and checklists (Birkmann, 2013).

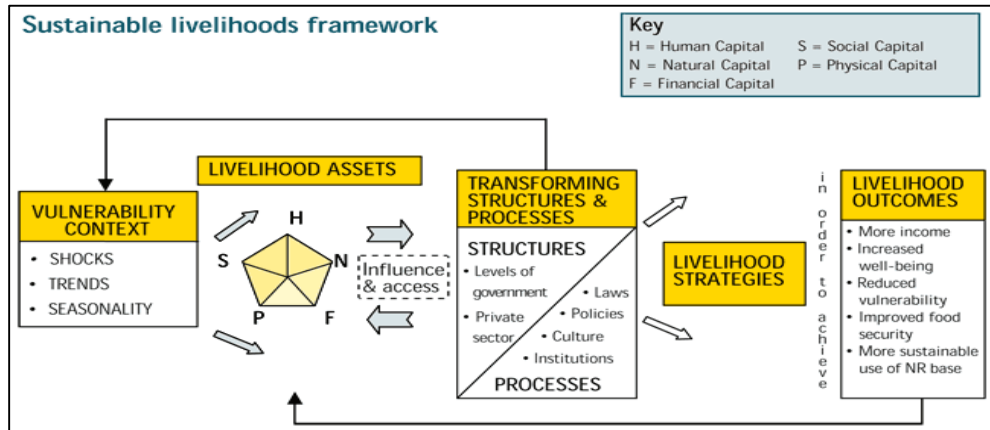


Figure 6: Sustainable livelihood framework  
Source: DFID, (1999).

### 2.5.2 The BBC framework

The BBC conceptual framework was proposed by Bogardi & Birkmann, (2004) and developed by merging different components of the onion framework and holistic approach. The framework emphasized on linking vulnerability with the concept of sustainable development by considering three major aspects (social, economic and environmental) of sustainability (see Figure 7).

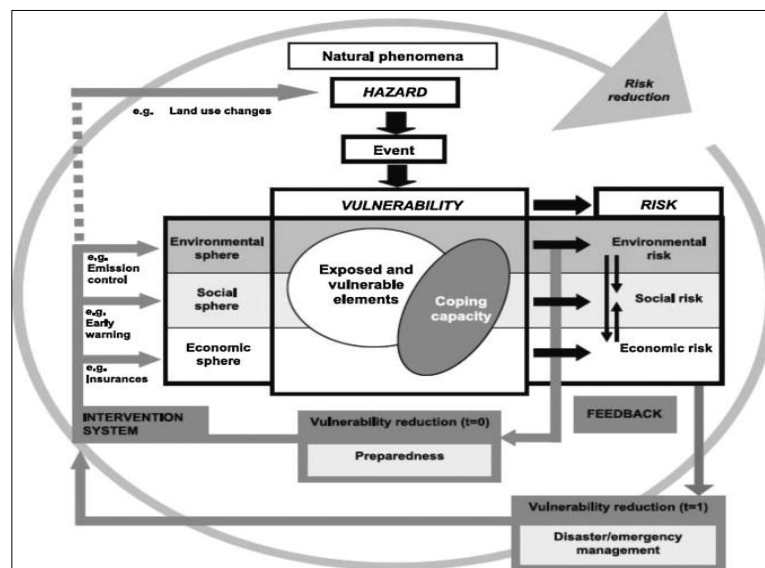


Figure 7: BBC conceptual framework for assessing vulnerability  
Source: Birkmann, (2013).

It underscores that dynamic nature of vulnerability should be taken into account, and calls for assessing exposure, sensitivity and coping capacities at the same instant providing a problem-solving perspective. The framework emphasizes on consideration and examination of the organizational and institutional aspects within the said spheres of sustainability. Moreover, it provides two arenas for reducing vulnerability, before the demonstration of the risk which is characterized by preparedness ( $t = 0$ ), and when the risk is revealed which is defined by disaster management and response ( $t = 1$ ). The major strength of this framework is the integration of other frameworks within three sphere of sustainability.

### 2.5.3 MOVE framework for vulnerability assessment

MOVE framework is a multidimensional and holistic framework for assessing vulnerability developed by Birkmann, et al., (2013b). The MOVE conceptual framework highlights hazards as of natural or socio-natural origin, and considers vulnerability as versatile in nature connected with social processes. Versatility of vulnerability is defined in different dimensions consisting of physical, social, ecological, economic, cultural and institutional dimensions. MOVE framework incorporates the concept of adaptation into disaster risk management and consequently distinguishes coping from adaptation (Birkmann, et al., 2013b). Additionally, the framework integrates the concept of risk governance which is a vital part of response process for formulating adaptation strategies (see Figure 8). This framework provides the basis for developing indicators rather than providing specific indicators. Moreover, it considers characteristics that are valid and typical at certain scale and reflects the scale specific needs of institutions and stakeholders. The framework also combines approaches from different fields for example: natural and social sciences and disaster risk management, and helps to demonstrate the linkage between DRM and CCA.

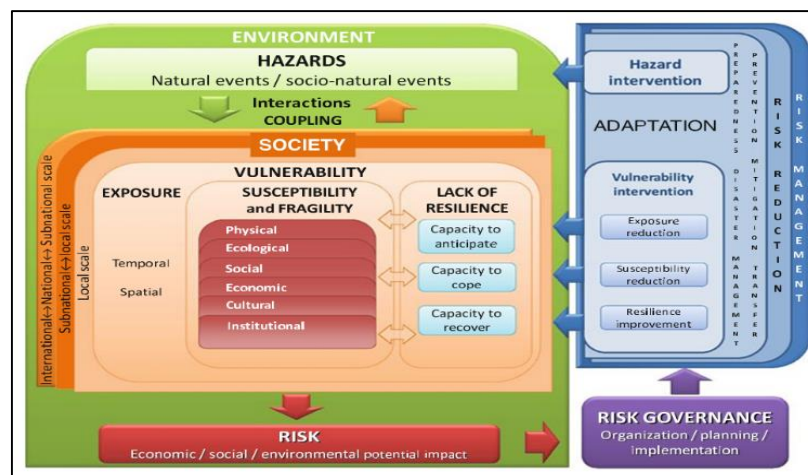


Figure 8: MOVE framework  
Source: Birkmann, et al., (2013b).

Vulnerability frameworks are vital for systemizing different concepts of exposure, coping, adaptation and sensitivity. It is evident from the frameworks detailed above that vulnerability is conceived differently in different schools of thought (Birkmann, 2013). These frameworks provide basis for developing methods and indicators for the assessment. Some of the methods for

vulnerability assessment are described in the Section 2.6. The framework adopted for this research work is combination of different frameworks and briefly explained in following section.

### 2.5.4 Modified framework utilized for vulnerability assessment

Several available frameworks can be utilized to assess vulnerability. A combination of various frameworks is however needed in order to analyze susceptible elements and factors that alter vulnerability associated with livelihood assets, and impact of formal and informal changes on coping and adaptive capacity of households and communities. Considering some drawbacks in mentioned frameworks (broader scope, inability to deal with livelihood assets in rural context, considering only positive livelihood aspects and others), a modified framework is adopted which is further revised in order to integrate framework for recording planned and unplanned changes.

The framework is modified from the research work of Van Tuan, (2014) which is based on sustainable livelihood framework, BBC framework, and framework to record post disaster formal and informal changes (see Figure 9). The framework incorporates two different but interrelated themes: impact based approach and post-impact changes. The impact based approach deals with assessing the vulnerability of elements and factors surrounded by different community livelihood assets, considering impacts of mega flood events. It analyzes how flood impacts have altered the susceptibility of households and community as well as influences the capacity to cope and adapt by disrupting or strengthening their livelihood base. On the other hand, post-impact changes deal with planned (government structures and processes) and unplanned changes (within community, households, private organizations) brought about by mega flood events, which can further influence the vulnerability by altering the capacity of coping and adaptation. Overall, changes in the level of vulnerability of different elements and factors based on measures undertaken for coping and adaptation are defined by the feedback loop.

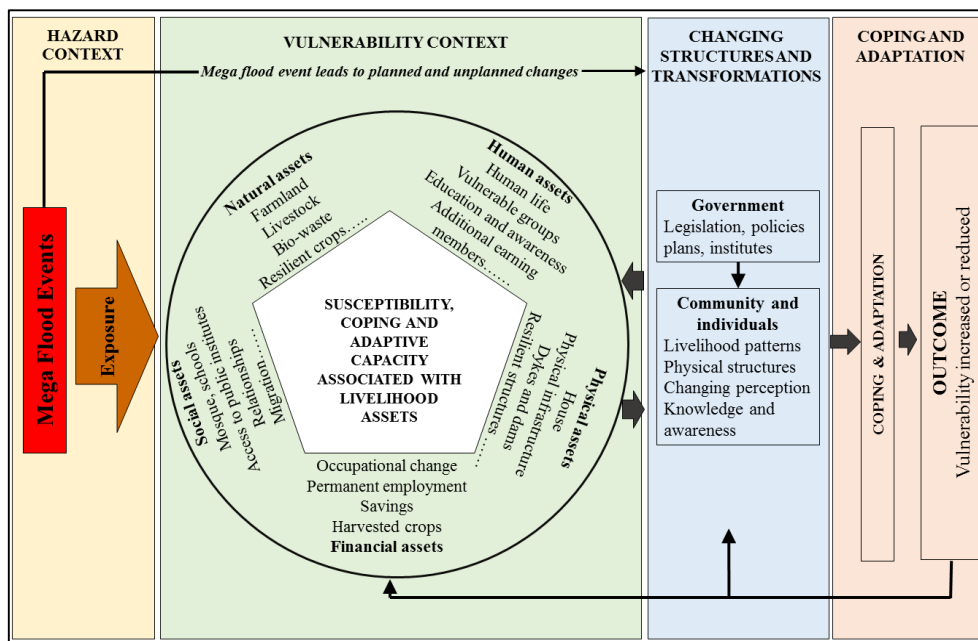


Figure 9: Modified framework for assessing vulnerability, adaptive capacity and changes  
 Source: Modified from Van Tuan, 2014 based on DFID, 1999; Birkmann, 2006; Birkmann et al., 2008.

## 2.6 Vulnerability assessment methods

Vulnerability assessment is considered as the first step for reducing disaster risk. Assessment of community vulnerabilities informs about the profiles, different forms and changes in risk and vulnerability (Birkmann, 2006). Several top-down and bottom-up approaches for assessments are being used both separately and together. Top-down assessments contribute in highlighting those most vulnerable to climate risks. Nevertheless, unavailability of data and incapability of identifying essential social drivers of vulnerability and local ability to adapt limit their use (Adger et al., 2007; UNFCCC, 2007). The bottom-up approaches provide the root causes and factors in social, economic, physical, political and environmental contexts that make communities and households more prone to natural hazards. It is evident that most of the bottom-up approaches are participatory and demand active involvement of the community. Some methods are ex-post and some are ex-ante. PRA is a common approach. Community based risk index gives one final value for a district regarding its vulnerability, exposure and hazard (Bollin & Hidajat, 2013). The method adopted by Younus & Harvey, (2013) indicated vulnerable elements in one community and related adaptive measure by ranking matrix and making categories. Participatory scenario method presented by Birkmann et al., (2013a) is different than participatory vulnerability and risk assessment as it intends to analyze and discuss future trends. It provides methodological toolkit for examining future vulnerabilities and an opportunity to enhance the thematic focus. The method of vulnerability assessment to be employed depends on the context of vulnerability research.

### **3 FLOOD DISASTERS AND ITS MANAGEMENT IN PUNJAB, PAKISTAN**

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Climate change has increased the “...*frequency, intensity, spatial extent, duration and timing*” of natural hazards (Seneviratne et al., 2012) especially the floods, and has increased risk of damages (NASA, 2015) and added to the vulnerabilities of communities especially for the poor of global south (Mertz et al., 2009; Ayers et al., 2014). Floods caused by changing monsoon precipitation and glacier melting have increased vulnerability of developing countries in Asia where many people live along flood plains. Pakistan is one of the countries that have been hit by flood disasters in the last few years especially the province of Punjab and Sindh. This chapter will briefly explain the flood disasters in Pakistan. A brief overview of flood causes, impacts, and existing vulnerabilities in province Punjab is provided. Additionally, role of flood management institutions at different levels and measures adopted to manage floods in Punjab are discussed.

#### **3.1 Pakistan: A general overview**

Pakistan is a developing country in the South Asia. It is situated between 24° to 37° north latitude and from 62° to 75° east longitudes where temperature and precipitation varies widely. Pakistan has the total geographic area of 796,096 square kilometers and shares its borders with China in the north, Afghanistan in the north-west, Iran in the west and India in the east whereas Arabian Sea is situated in the south. The country is divided into five provinces: Punjab, Sindh, Baluchistan, Khyber Pakhtunkhwa (KPK), and Gilgit Baltistan, as well as a federal territory of Azad Jammu and Kashmir (see Figure 10). The glaciers in the Karakorum and Himalayas ranges feed six main and more than 50 small rivers, and are lifelines for Pakistan’s agro based economy (Rahman, 2015). The population of Pakistan is growing rapidly, having increased by 350% since 1947. It is estimated at 196 million in 2014 (CIA, 2014) which was 132 million in 1998, more than half of which subsists in the province of Punjab (Bureau of Statistics, 2015). One third of population lives under the poverty line and most of it lives in hazardous locations. According to an estimate, 63% of total population lives in rural areas and more than 70% lives in flood plains (PDMA, 2011).

#### **3.2 Floods hazards in Pakistan**

Pakistan is one of the counties facing flood hazards since its independence in 1947. It has the highest average annual number of people physically exposed to flood among South Asian countries. These floods are caused by storms instigated in Bay of Bengal during the monsoon season, which pass from central India and penetrate northern parts of Pakistan (Sayed & González, 2014). Floods hit Pakistan regularly with yearly frequency of 1.8 from 1973 to 2014 (EM\_DAT, 2015). These floods are characterized as riverine floods, flash floods, glacial lake outburst floods, and tropical cyclones. Riverine floods are the most occurring events. Indus, Jhelum, Chenab and Kabul are the major river which cause flooding in Pakistan. Dams, barrages, and link canals are major water management and flood fighting measures. Moreover, flooding due to Ravi and Sutlej rivers depends on the water discharged by India. Pakistan is at the extreme risk of climate change and its impacts. Climate change has become a major concern for disaster management with respect to flood

hazards (NDMA, 2012). Pakistan ranked 3rd among the most affected countries due to climate related extreme events (Kreft & Eckstein, 2013). Climate change has increased the frequency of hydro meteorological events and increased irregularity of monsoon in South Asia (Cisneros et al., 2014) which poses a major threat to those who are living in flood plains (Shahid, & Piracha, 2010).

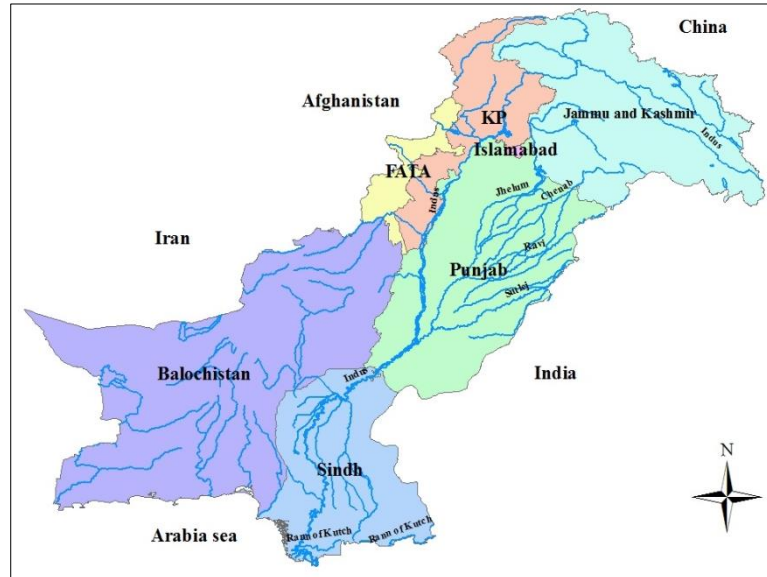


Figure 10: Map of Pakistan with all the provinces, federal territories and major water ways  
Source: Authors own, 2015 and data from Humanitarian Response, 2015.

### 3.2.1 Causes of floods

Most of the disasters in Punjab and whole country are instigated by meteorological processes (NDMA, 2012) which account for more than 76% of total disasters recorded between 1970 and 2014. Floods make up more than 50% of this percentage (MCII, 2015) wherein most of the floods are brought about by River Indus and Chenab. Weather related events are not only the cause of floods as several human influences on environment and infrastructure failure are also becoming the core reasons. Some of the reasons are discussed briefly.

#### 3.2.1.1 Heavy precipitation, changing monsoon pattern and snow melting

Intense rainfall during the monsoon from July to September is causing riverine floods in Punjab. Monsoon pattern is shifting 80 km from eastern to northern side which is producing flash floods (Gronewold, 2010). Salma et al., (2012) have indicated an upward trend of 55mm in average annual rainfall until 2030 (see Annexure A, Figure 39). Additionally, high temperatures in the north results in snow and glacier melting in Karakorum and Himalaya ranges which also increases the flows in rivers and later results in massive floods (Gronewold, 2010).

#### 3.2.1.2 Infrastructure and administrative failure

Lack of regular maintenance of flood management infrastructure has triggered floods in the past. The funds allocated for the maintenance and repair of dikes, dams, canals and rivers barrages have not been used properly and repair work could not hold the flood of low intensity (Memon, 2011).

### 3.2.1.3 Human influence on environment

In Pakistan, repercussion of humans on environment is a growing reason of floods. Deforestation by the local communities for making the land viable for agriculture and settlement has removed the natural set-back of river and converted the high water flows into floods. According to an estimate “...approximately 5,683 acres of riverine forest is lost every year” (Memon, 2011) instigating future floods. Furthermore, local people have constructed illegal small dikes to shield agricultural land on the flood plains which has disrupted the natural river flow.

### 3.2.1.4 Influence of political personalities and land lords

The majority of land in rural areas are owned and controlled by rural elites and political personalities. During the past years, it has been experienced that local political personalities and land lords divert the flood by breaking the dykes to save their farmlands which cause flooding in areas previously protected from flood. It has further exacerbated the flood damages.

## 3.2.2 Exposure loss and damages in Pakistan

Floods are more or less a continuous phenomenon in Pakistan. Since 1947 until 2011, Pakistan have faced 90 flood events out of which 21 were considered as major floods (Memon, 2013). Later, flood of 2012, 2013 and 2014 inflicted massive loss to the economy. Floods have claimed more than 13 thousand lives, affected 77 million people and caused economic loss of US\$ 20 billion in form damages to infrastructure, houses, crops and others (EM\_DAT, 2015). Most of these floods are caused by Indus River where the flood plain is occupied by more than 120 million people. It is estimated that floods affected 85% of the overall population affected by disasters from 1980 to 2013, out of which 75% was affected by riverine floods. Similarly, 69% of economic damages were caused by riverine floods during the same period (MCII, 2015). The economic and life losses in major riverine floods from 1970 to 2014 are presented in Figure 11.

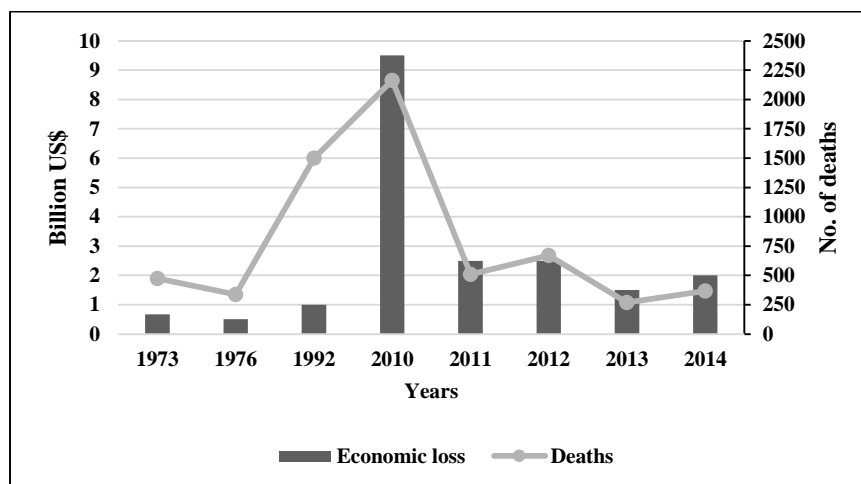


Figure 11: Economic and life losses due to flood disasters  
Source: Authors own, 2015 based on EM\_DAT, 2015b.

### **3.3 Flood hazard and vulnerability in Punjab**

Punjab is the most densely populated province of Pakistan with the population of 99 million (Bureau of Statistics, 2014). Literary meaning of Punjab is “*land of five rivers*”. Major rivers include Indus, Chenab, Jhelum, Sutlej and Ravi. Punjab features a very old and extensive irrigation system which makes most of its area arable and supports the livelihoods of people living in flood plains. Regardless of that, River Indus, Chenab and Jhelum are continuously playing havoc with the lives of people from many decades. Punjab faced high floods in the past in 1973, 1976, 1992, 1997 and every year since 2010. The province consists of 36 administrative district out of which 12 are on high flood risk and 14 are on medium flood risk (PDMA, 2014). The following section will provide the information on existing flood vulnerabilities, exposure and damages of 2010 and 2014

#### **3.3.1 Existing flood vulnerabilities in Punjab**

##### **3.3.1.1 Physical vulnerability**

Physical vulnerability deals with the structures, building and infrastructure aspects. Buildings and houses in rural areas are constructed from mud or adobe bricks which are extremely vulnerable to flood. Adobe houses account for 41% of total houses in rural areas (Bureau of Statistics, 2014). Most of such houses are on flood plains which are either encroached or leased on very low rates (NDMA, 2012). Private dykes have been constructed which disturb the river flow. Moreover, water ponds of the flood management infrastructure have been encroached upon which puts an additional pressure on barrages, making them vulnerable to floods. Insufficient and poor water regulatory infrastructure, lack of communication equipment, and inadequate and ineffective forecasting system have increased flood susceptibilities of population living in high vulnerable zones.

##### **3.3.1.2 Socio-economic vulnerability**

Population pressure and expensive living in the cities have contributed to increase in the population density in flood plains where the poor can find land for livelihood activities (Khan & Jan, 2015). The districts at high flood risk have high poverty rate with an average of 32% households living below poverty line (Sumra, 2014). Destitute section of the society cannot afford to incorporate DRR measures. Lack of education and awareness make people more vulnerable, as happened in the flood event of 2010, when people ignored the flood warning. Furthermore, inadequacy of knowledge, and access to flood resilient building construction technology and material as well as gender imbalance are other factors enhancing people’s vulnerability (Khan & Jan, 2015). The main source of income (agriculture and livestock farming), was severely affected in previous floods. Hence, socio-economic conditions have further increased the vulnerability and reduced their capacities.

##### **3.3.1.3 Environmental vulnerability**

Massive deforestation in the Northern Province has exposed the population of Punjab to flood hazard. The monsoon rains along with snowmelt, intensify the water flow in rivers causing massive destruction of riverine, irrigation and public infrastructure in the downstream (NDMA, 2012). In



rural flood plains of Punjab, massive livestock farming caused over grazing and resulted in loss of flood plain vegetation and has increased the flood vulnerability.

### 3.3.2 Characteristics of 2010 and 2014 floods

The flood of 2010 and 2014 flood events were slightly different in terms of their causes, occurrence, and losses. Table 4 and Figure 12 provide the characteristics of both flood events.

Table 4: Characteristics of flood event 2010 and 2014.

Indicator	Flood event 2010	Flood event 2014
<b>Time of occurrence</b>	Last week of July	First week of September
<b>Causes</b>	Monsoon, snow melt, political influence	Monsoon, snow melt, transboundary water discharge
<b>River bodies</b>	Indus and Chenab	Chenab, Jhelum and Ravi
<b>Exposure</b>	Affected districts 12 3000 settlements 7 million people (approx.) 3.5 million acre land area (figure)	Affected districts 15 3500 settlements 3 million people (approx.) 3 million acre land area
<b>Loss and damages</b>	Deaths 112 Houses damaged 0.4 million Standing crop losses 7.5 million acre	Deaths 284 Houses damaged 0.1 million Standing crop losses 2.4 million acre

Source: NDMA, 2010, 2014a; BBC News, 2014.

In addition, 2010 flood disaster had a devastating impact on the physical infrastructure such as health centers, education buildings, water supply systems, roads, and telecommunication facilities. The flood brutally impacted the livelihood of people by damaging standing crops on 7.5 million, acres and destroying more than 40,000 small shops (NDMA, 2010). In 2014, the flood caused the livelihood loss of 73% farmers and 50% daily wage laborers. Almost 750 schools were damaged and hampered the schooling of children. It has also been reported that more than 50% of access roads were completely damaged (NDMA, 2014a). It is analyzed that both flood events have their own characteristics. The timing of occurrence of flood events were quite different. The flood event of 2010 occurred in the normal monsoon and flooding season, but the flood event of 2014 occurred in September which was not normal for the local communities. The sudden shift in monsoon seems to be a consequence of changing climate.

The flood event of 2010 was caused by Indus and Chenab rivers, and was quite big in magnitude and due to “...slow response, absence of comprehensive DRR, and preparedness mechanisms in the country was a major factor that caused the large-scale destruction” (Sayed & González, 2014) where only 10% of villages received flood warning. The flood of 2014 was only caused by the eastern rivers. Two of these eastern rivers are controlled by India who released its excess water without any warning. Therefore, dense population and settlement structures near these rivers caused more losses to life and affected settlements as compared to the 2010 flood.

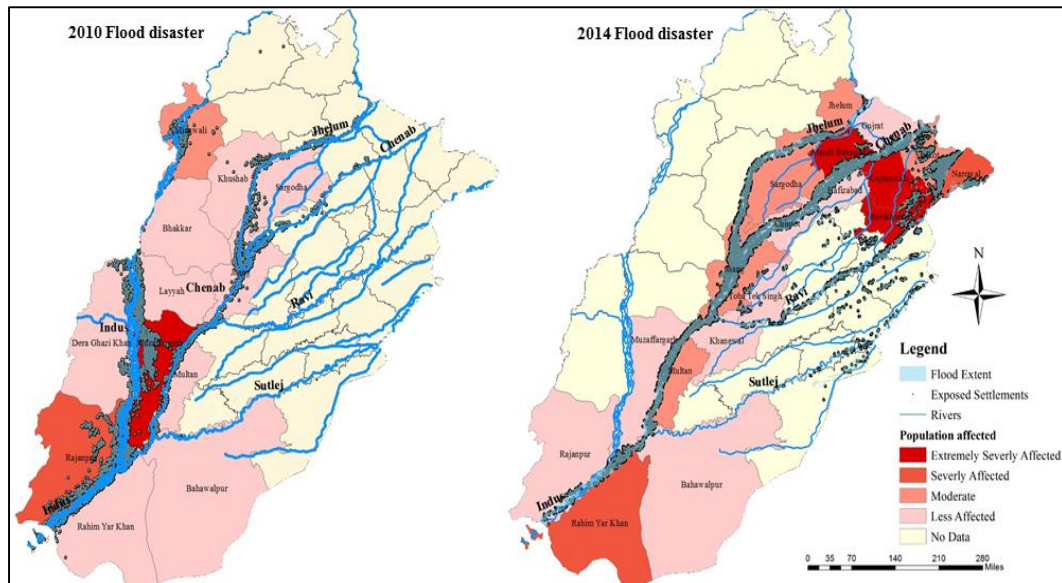


Figure 12: Flood extent, settlement exposed, and population affected in flood event of 2010 and 2014. Source: Authors own, 2015 using Arc GIS and data from Humanitarian Response, 2015.

### 3.4 Flood management in Pakistan

#### 3.4.1 Legal and political framework for flood management

Legislation promotes the allocation of resources, effective communication, and coordination of actions between different government levels. It ensures the sustainable engagement of key actors on one hand, and framework for establishing authorities, drafting policies and strategies, on the other hand (Murray et al., 2012). The legislative frameworks for dealing with natural hazards are limited in Pakistan. The brief descriptions of legislations are provided in the Table 5.

Table 5: Brief history of disaster management legislations in Pakistan.

Legislation title	Description	Validity
<b>National Calamity Act-1958</b>	The act focused on the relief, rehabilitation and reconstruction of areas affected by flood disasters. Under this act relief commission in every province was responsible for the relief and rehabilitation efforts.	1958 to 2006
<b>Local Government Ordinance-2001 (LGO, 2001)</b>	The ordinance deals with assigning responsibilities of local government in organizing relief activities and providing aid to flood affected people.	2001 to date
<b>Emergency Services Ordinance-2002</b>	The ordinance defines the responsibility for establishing emergency services at different government level for providing quick response to flood disasters.	2002 to date
<b>National Disaster Management Ordinance-2006 (NDMO, 2006)</b>	The ordinance was the result of 2005 earthquake in Pakistan which demands for establishment of disaster management institutions at different administrative levels and to prepare guidelines, policies and plans to deal with flood hazards.	2006 to 2010
<b>National Disaster Management Act-2010</b>	The NDMO 2006 was approved by the parliament after the massive flood of 2010. This act has defined powers and roles and responsibilities of disaster management departments and focuses on the preparedness, response, recovery and reconstruction. It also provides the legal basis to establish a disaster response force, National and Provincial Disaster Management Funds and National Institute for Disaster Management (NIDM). It also demands to incorporate DRR in all development plan	2010 to date

Source: Government of Pakistan, 2010; Khan, 2010; Rahman & Shaw, 2015a.

The legislation before the 2010 primarily focused on rescue and relief rather than preparedness and long term planning. Previous legislation ignored the establishment of specific authorities for managing flood disasters. The legislation of 2010 is comprehensive and covers different areas to reduce flood vulnerabilities. However, several elements, for example, establishment of disaster response force and training of concerned officers are not in practice.

### 3.4.2 Flood management institutions in Pakistan

The success of management of flood hazard and reducing flood vulnerabilities lies in the availability of disaster management institutions with clearly defined roles and responsibilities as well as equipped with sufficient resources to deal with hazards of different nature. Several institutions are formed under the legislation of disaster management. Some institutions only have the coordinating function but play a vital role in the management of flood hazards. Brief description of flood management institution at different levels is provided in the Table 6.

*Table 6: Description of role and responsibilities of flood management institution*

<b>Institutions</b>	<b>Roles and responsibilities</b>
<b>National Disaster Management Authority (NDMA)</b>	The NDMA was established in 2007. The main roles are: <ul style="list-style-type: none"> <li>• to develop disaster management guidelines, policies and plans</li> <li>• to give guidelines to other ministries to mainstream disaster management in their plans</li> <li>• to monitor the implementation of plans</li> <li>• provide technical assistance to PDMAAs</li> <li>• promote education and awareness</li> </ul>
<b>Provincial Disaster Management Authorities (PDMAs)</b>	PDMAAs were established in 2010. The main responsibilities include: <ul style="list-style-type: none"> <li>• to formulate provincial disaster management policy and prepare plan</li> <li>• approves disaster management plans prepared by other departments</li> <li>• examine the flood vulnerability of different parts of province</li> <li>• coordinate the response in case of flood</li> <li>• carry out disaster management drills regularly</li> </ul>
<b>District Disaster Management Authorities (DDMAAs)</b>	DDMAAs are the lowest tier institution of disaster management in province and hold most important responsibilities in managing flood hazards. <ul style="list-style-type: none"> <li>• prepare district level Disaster Management Plans (DMPs)</li> <li>• identification of vulnerable areas in districts</li> <li>• taking measures for prevention and mitigation of flood disaster</li> <li>• monitor and implementation of disaster management plan</li> <li>• organize training programs for officers of different departments</li> <li>• arrange community training and awareness programs for flood prevention and mitigation</li> <li>• maintain and review early warning system</li> <li>• prepare district disaster response plan</li> <li>• arrange for location and buildings to be used for relief camps and arrange relief items</li> <li>• involve NGOs in disaster management at community level</li> </ul>
<b>Tehsil/Town Municipal Authority (TMA)</b>	TMA has the following responsibilities <ul style="list-style-type: none"> <li>• prepare flood contingency plans for towns/tehsils</li> <li>• identification of dangerous buildings</li> <li>• assistance to DDMA in relief activities and dewatering of low lying flooded areas</li> <li>• provision of drinking water and hygienic environment in relief camps</li> <li>• removal and disposal of debris and waste resulted from flood disasters</li> </ul>
<b>Federal Flood Commission (FFC)</b>	FFC came into being in 1977. The roles and responsibilities are: <ul style="list-style-type: none"> <li>• preparation of flood protection plan</li> <li>• giving approval to flood control schemes/measures by government</li> <li>• calibration of designs for flood protection work</li> <li>• assessment flood damages to infrastructure</li> <li>• taking appropriate actions to improve flood forecasting and early warning</li> <li>• arranging research programs for controlling and managing floods</li> </ul>

<b>Pakistan Metrology Department (PMD)</b>	<p>PMD is responsible for forecasting floods and disseminating early warning. Its main roles are:</p> <ul style="list-style-type: none"> <li>• forecasting rainfall pattern and situation of floods</li> <li>• spreading weather data and rainfall records to Disaster Management Agencies (DMAs)</li> <li>• disseminating early warning in case of flood situation to relevant department</li> <li>• simulating river flows to identify vulnerable elements in the different areas</li> </ul>
<b>Irrigation department</b>	<p>Irrigation department is one of the most important institutions for managing and controlling flood disaster. The major responsibilities of this department are:</p> <ul style="list-style-type: none"> <li>• monitor and regulate water discharge rate in different water channels</li> <li>• issue early warning in case of flood or breach in the water channels and repair these damages</li> <li>• protection of rivers, barrages, canals, and dykes</li> <li>• prepare a yearly flood fighting plan</li> <li>• identification and removal of encroachments on/in flood control infrastructure</li> <li>• repair of vulnerable points on flood protection/control infrastructure before flood season</li> </ul>
<b>Pakistan Army</b>	<p>The core responsibilities of army are to:</p> <ul style="list-style-type: none"> <li>• carry out search, rescue and relief efforts</li> <li>• opening of breaching section of dykes/embankments in case river flow diversion is required</li> <li>• installation of wireless communication system if existing system is disrupted due to flood</li> </ul>

*Source: Government of Pakistan, 2010; PDMA, 2014; Rahman & Shaw, 2015a*

The role and responsibilities of different institutions involved in flood management are defined in legislation or in DMPs. The interviews with PDMA officials, and field visits unveiled several important factors that directly and indirectly increased the vulnerability of communities. The disaster management drills have not been carried out due to the insufficient resources and trained staff. DDMA which is one of the core flood management institution at local level, does not exist in any district of Punjab province. Therefore, majority of District Disaster Management Plans (DDMPs) could not be prepared and implemented. Absence of DDMA results in transferring of many of its flood management responsibilities to TMA, in addition to the latter's original responsibilities during flood seasons. Additionally, TMAs, lacking in capacity (machinery and other resources), could not perform majority of DDMA's duties, even the early warning is not communicated effectively.

Irrigation Department controls the water flows and is informed about the condition of flood protection infrastructure. Consultative workshop on 2014-flood attended by the author revealed that absence of Irrigation Department from field during flood events caused colossal damages in settlements. There is a lack of coordination in information dissemination about water discharge from flood management infrastructure of irrigation department and flood warning from PMD. On the other hand, Pakistan Army is one of the core institutions which do its work as per their role identified. Pakistan Army has good communication infrastructure, skilled and trained man power.

In short, institutions are not well aware of all of their responsibilities on one hand, and there are overlapping of roles and responsibilities, on the other hand. The lack of horizontal coordination among DMAs and other line departments is observed (Rahman, 2010) which needs to be strengthened. The disaster management institutions lacks the capacity to handle flood emergency situation due to insufficient staff possessing technical knowledge. The lack of institutional capacity has indirectly increased the community vulnerability by not giving them timely flood warning; arranging rescue and relief activities; properly maintaining physical infrastructure; and mainstreaming DRR measures in infrastructure.

### 3.5 Flood management measures

#### 3.5.1 Structural measures

In Pakistan and Punjab, flood management is done mainly by structural measures which include barrages, embankments, dykes, spurs, and dams. The structural measures are mainly controlled by the Irrigation Department of Punjab. In the province, structural measures consist of 14 barrages and head works, 2 dams, and more than 3000 thousand kilometers of dykes and 640 spurs (PDMA, 2014). The locations of head works and barrages are shown in Figure 13. One of the most common and extensively used structural approaches is flood dykes, spurs and embankments along the five major rivers in Punjab. The details of spurs and dykes are provided in Annexure G, Figure 42. The spurs and dykes have reduced significant damages in the past (Rahman & Shaw, 2015a). Nevertheless, most of the structural measures are very old and in vulnerable conditions. On the other hand, dams are not specifically made solely for managing the flood hazards.

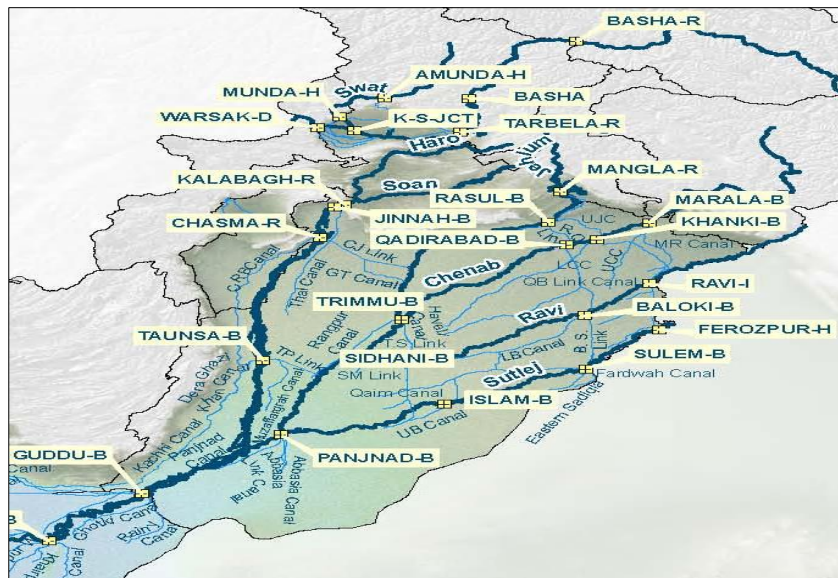


Figure 13: Location of different structural measures for managing floods in Punjab. B stands for Barrages, R for Reservoir, H for Headwork  
Source: IRSA, 2013.

#### 3.5.2 Nonstructural measures

Nonstructural measures are low cost as compared to the structural measures and require active involvement of public. Early warning system is one of the core and active measure for reducing flood hazard in Punjab. Flood forecasting division of meteorology department in Punjab is responsible for forecasting floods and disseminating early warning to the concerned departments. The division is equipped with network of weather stations and radar facilities in whole province. Flood response, preparedness, and vulnerability and risk assessment are other measures to manage and mitigate the flood hazards (Rahman & Shaw, 2015a). These measures did not receive due importance in the past but are now getting due emphasis because of impacts of recent flood events.

## 4 PLANNED AND UNPLANNED CHANGES AND TRANSFORMATION

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Mega disaster events lead to planned and unplanned changes that have positive and negative consequences on affected communities (Birkmann et al., 2008). Flood disaster-2010 induced changes in the legislation framework, organizational and institutional structure, and within the communities, which can prompt resilience (Folke, 2006). This chapter briefly analyzes the changes in government structures and within socio-economic domains of community to recover their assets in mentioned aspects following the flood events of 2010.

### 4.1 Changes and transformations after the mega flood event of 2010

Large disasters influence social, economic, political and environmental conditions of an area, community or individuals. Change is a response to an impact and can develop vulnerability or resilience. The changes can be slow or rapid, planned or unplanned, and formal or informal. Formal changes/responses are from the government organization and informal responses are from the individuals, communities, private organizations and social groups (Birkmann et al., 2008). Mega flood event of 2010 in Punjab lead to the several formal and informal changes within social, institutional, economic and environmental spheres indicated by different colors (see Figure 14). Unplanned changes within communities are discussed in detail in Chapter 6 and 7.

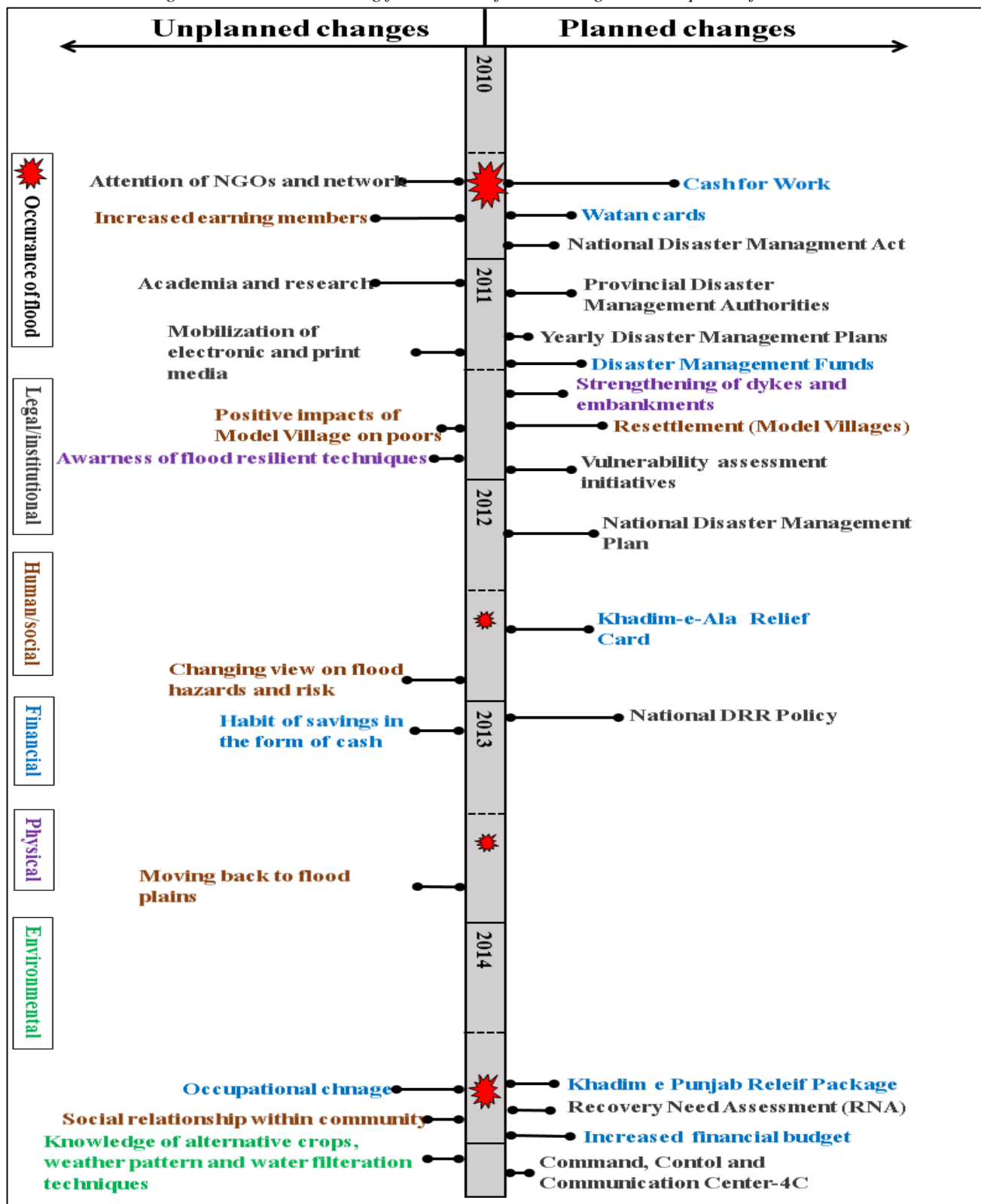
#### 4.1.1 Planned changes

The mega flood event of 2010 initiated a process of formal changes in Pakistan particularly in the province of Punjab, which was relatively slow paced. The government and its department devised strategies and plans to alter the old and traditional methods of reducing flood vulnerabilities and increasing the resilience of infrastructure, settlements and its inhabitants.

##### 4.1.1.1 Resettlement in the form of Model Villages

In response to 2010 floods, Government of Punjab (GoP) for the first time devised a strategy to construct '*Model Villages*' (planned resilient rural settlements with different amenities. see Annexure G, Figure 43) in severely affected districts of the province. The idea was to provide the most affected population with modern facilities in safe rural areas to raise their living standard and reduce their vulnerability. It is observed that model village experience was novel and had no roots in any policy document or legal framework. Local planning agency was not involved in the planning and development of model villages, and locational decision was highly political. Thus, many villages have since been constructed within the flood extent and away from existing settlements (Jamshed, 2011). Community training, awareness and education; livelihood constraints; land acquisition and political influence in selection of flood victims hampered the success of the project (Nadeem et al., 2014). During the revisit of model village, it was found that many allottees had sold the houses and moved to their original places due to lack of livelihood opportunities. Due to these complications, in addition to financial constraints, this strategy was not implemented in the following flood events. Nevertheless, model villages had positive impacts on landless flood affected people by providing them with proper house with ownership of land.

Figure 14: Timeline showing formal and informal changes with respective flood events



Source: Author's own, 2015 based on literature and field survey.

#### 4.1.1.2 Legislation and institutions

National Disaster Management Act-2010 is a stepping stone towards the efficient and effective management of the disasters after the mega flood event of 2010. The legislation has changed the

traditional paradigm of relief and recuse towards long term and comprehensive (proactive) approach to deal with flood disasters. Several institutions with multiple functions have been established under the legislation. DMAs at national and provincial levels were established right after the promulgation of legislation with a role in preparing DMPs, vulnerability assessment, and coordination with line departments. 4C is another breakthrough (considering coordination problems in the past five flood events) in improving coordination between concerned public authorities and dissemination of early warning. Nevertheless, local level authorities have not been established resulting in significant consequences as described in Chapter 3, Section 3.4.2. NIDM established under this act has failed to arrange and conduct research programs. Although, NIDM do arrange sponsors for training of officials from international institutions but training calendars of these institutes coincide with the monsoon season when every official is busy in managing the flood hazard. Nonexistence of these elements has reduced the capacities of disaster management and related departments as well as hampered awareness for managing flood hazards. Resultantly, it has added to the institutional and human vulnerability.

#### **4.1.1.3 Plans, policies and other documents**

Numerous plans and documents were prepared after the flood event of 2010. It is observed that that none of them is implemented in reality. NDMP-2012 is the only document which specifies long term planning (for 10 years 2012-2021) in line with the legislation and was prepared by investing huge amount of money. It is explored that 99% of scheduled activities have not been carried out. Hazard and vulnerability assessment at local level, multi hazard early warning system, CBDRM, mainstreaming DRR into development planning are among the main activities which should have been implemented until now. It is noted that due to top-down coordination between departments, PDMA have not been consulted in the preparation of this plan or any other plan drafted at national level. The provincial plans for flood contingency, response and its management are prepared regularly but their implementation is still absent. Moreover, plans at provincial level focus only on disaster response with top-down approach and neglect the disaster prevention and adaptation, as also indicated by Birkmann et al., (2008) in Sri Lanka and Indonesia.

In the aftermath of mega flood event of 2014, a document titled RNA is prepared by the NDMA with the collaboration of PDMA and UN agencies. Housing, agriculture, livelihoods and community infrastructure, with DRR and build back better are identified as the principal themes (NDMA, 2014c). Actions identified in Table 7 are planned to be implemented by 2016 to increase community coping and adaptive capacity. Field survey and interviews with officials revealed that none of the activities mentioned in Table 7 has been implemented as yet which indicates the incapability and incapacity of the government institutions to carry out the coping and adaptation tasks for increasing community capacities. The discussions further revealed that PDMA Punjab lacks the capacity in the form of trained and qualified officials to prepare comprehensive plans and implement them in true spirit. The PDMA has total staff of 90 out of which none has the technical knowledge of disaster management or is qualified in this field. Same is the case at national level which has obstructed the implementation of plans and projects at various levels.



Table 7: Activities/actions planned for recovery of affected communities after the flood of 2014.

<b>Housing</b> <ul style="list-style-type: none"> <li>• Housing reconstruction centers</li> <li>• Resilience aspects in reconstruction</li> <li>• Technical training and awareness on safe construction</li> <li>• Formation of village committees</li> <li>• Women participation in training and construction</li> <li>• Consideration of environmental impact</li> </ul>	<b>Agriculture</b> <ul style="list-style-type: none"> <li>• Flood resilient crops</li> <li>• Perennial/Alternative crops</li> <li>• Climate smart agriculture</li> <li>• Kitchen gardening</li> <li>• Reforestation of rangelands</li> <li>• Raised bed for food godowns (increased food storage)</li> <li>• Micro insurance</li> </ul>
<b>Critical Physical Infrastructure (CPI)</b> <ul style="list-style-type: none"> <li>• Community based infrastructure development</li> <li>• Resilient elements in infrastructure (raised roads, water drainage schemes, dikes and storage ponds)</li> <li>• Community based early warning system</li> <li>• Community based disaster risk management</li> </ul>	<b>Livelihood</b> <ul style="list-style-type: none"> <li>• Creation of Employment Information Center</li> <li>• Employment Intensive Infrastructure Program</li> <li>• Cash for work/Food for work</li> <li>• Vocational training/skill development</li> <li>• Non-farm livelihood</li> <li>• Gender based livelihood opportunities</li> </ul>

Source: Modified from NDMA, 2014c.

#### 4.1.1.4 Mechanism for financial aid

In the aftermath of 2010-flood, Government of Punjab initiated a cash compensation program called “*Watan Cards*” (ATM cards). Each card was loaded with PKR 20,000 to help the food victims (PDMA, 2011). This was followed by a new card system called “*Khadim-e-Ala Relief Card*” in 2012, and in later years flood victims were provided “*pay orders*” under the program named “*Khadim-e-Punjab Relief Package*”. In this program, the amount of compensation differed according to extent of damage to house and number of acres of cropped area damaged (maximum of 12.5 acres). The financial aid became a regular phenomenon after the mega flood event of 2010. Nevertheless, the system lacks the consistency in the financing mechanism by developing new instrument every year. Although, risk financing mechanism is still in experimental stage but 2010-flood has revolutionized the system of compensation.

#### 4.1.1.5 Flood vulnerability assessment in Punjab

Flood vulnerability assessment system in Punjab province did not exist in the past, and flood disaster of 2010 heightened its importance in government circles. However, vulnerability assessment by the government is focused on district level and very little attention is paid to the local level. Limited indicators were used to assess vulnerability using top down approach which has made the assessment imperfect and inefficient. PDMA Punjab’s framework for assessing vulnerability of physical infrastructure was not utilized and remained in the document. A framework “*Vulnerability and Capacity Assessment (VCA)*” from Anderson & Woodrow, (1998) is adopted in NDMP-2012 but has never been used by the public agencies for assessing vulnerability in different domains. The “Android Based Application” system for vulnerability assessment at local level (for 6000 settlements which come under the 10 kilometer buffer along the major rivers in Punjab) is initiated in 2012. The project is hampered by flood events of 2013 and 2014 and is still in progress. Furthermore, pace of data collection is reduced due to short tenures of PDMA heads, as every new official implements his own plans and priorities. The project does assess the vulnerability at local level but does not prioritize the elements and factors making people

vulnerable. In short, vulnerability assessment system does exist in Punjab but there is an immediate need to update and implement it.

#### **4.1.2 Unplanned changes**

It is apparent from the literature that communities and individuals react in response to a disaster. Several informal changes were observed in lives of people, social groups, and organization after the mega flood disaster of 2010 and are explained in following sections.

##### **4.1.2.1 Community response on resettlement**

Positive and negative responses from the community were observed from resettled community. The MVs had positive impacts on the landless and marginal people by providing the safe and healthy environment on one hand, and ownership of land on other hand. However, it also generated new vulnerability for people by unavailability of livelihood forcing people to move back to flood plains or other places where security of livelihood is ensured. Field survey exposed that many people had sold their houses after getting the ownership and moved back to their previous places or shifted near the city. Lack of monitoring by the government, transparency in the process of allocation, unavailability of onsite livelihood opportunities caused shifting of communities to flood plains.

##### **4.1.2.2 Network of private organization with changing priorities**

The mega flood disaster-2010 created a vast network of international and national organizations in the country working in different sectors. It stimulated the reconstruction and rehabilitation of affected village and unburdened the government to some extent. Multiple organizations changed their working priorities to disaster management and risk reduction by skill development to diversify livelihood; adult literacy program; women empowerment; and many others. It is analyzed that rehabilitation activities of some organization were limited to flood event of 2010, and were conducted without proper strategy or methodology. However, focus of majority of NGOs remained in district Muzaffargarh due to massive damages. Such activities had positive impacts on flood victims, as discussed in Chapter 5 and 6.

##### **4.1.2.3 Awareness through media mobilization**

Print and electronic media has played an essential role in creating awareness in general public regarding flood disasters. Before the start of monsoon, print and electronic media mobilized their reporting teams in areas of high flood risk in order get information on situation of water discharge, rainfall, and preparedness of concerned departments. Flood disaster-2010 altered the old reporting procedure of print and electronic media with more organized and structured one. Media, to some extent, changed the traditional reasoning of floods as "*Wrath of God*" to more logical ones as "*lack of dams, more intense rains, snow melt and other*". Nevertheless, the government agencies argues that media is creating a destructive image of public authorities by portraying everything negatively. Each TV channel gives different figures for rescue and relief needs, and, damages which causes confusions and hinders the departmental working due to political pressures caused by inappropriate media news.

## **5 ROLE OF SPATIAL PLANNING IN REDUCING FLOOD VULNERABILITY IN PUNJAB**

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Floods are one of the most occurring natural disasters in Pakistan. The frequency of floods in Pakistan as well as around the world has increased causing widespread human and economic losses. Spatial planning is now regarded as one of the tools to reduce the vulnerability and disaster risk of flood prone communities. In this respect, low regret measures, also regarded as soft accommodation measures (Wong et al., 2014), for example: hazard zoning, effective land use planning, building regulations (Burkett et al., 2014), and good quality of sufficient infrastructure services in urban and rural areas (Revi et al., 2014), are considered as vital in reducing community vulnerability to flood hazards. This chapter explores the spatial planning system in Punjab province with the specific focus on flood prone rural areas. The role of spatial planning at local level in Punjab in reducing vulnerabilities of flood affected communities is analyzed by reviewing literature, and conducting interviews from local planning officers and communities. Moreover, reasons are explored for deficient spatial planning system in reducing flood vulnerabilities.

### **5.1 Spatial planning in Punjab**

#### **5.1.1 Spatial planning legislation**

There are multiple acts and ordinances under which several institutions perform planning tasks at different tiers in Punjab (Yuen & Choi, 2012). The planning tasks, at various levels, are undertaken considering laws and regulations which include: Development of Cities Act 1976, Punjab Local Government Ordinance (PLGO) 2001, Punjab Housing and Town Planning Agency (PHATA) Ordinance 2002, and Cantonment Act 2002 (Ahmad & Anjum, 2012). The legislations provide the legal basis to develop planning institutions at provincial, district and local level, and assigns different roles and responsibilities for managing the urban and rural areas (Figure 15).

#### **5.1.2 Spatial planning institutions**

Spatial planning in urban and rural areas of Pakistan is governed by various departments at different levels. At provincial level, spatial planning institutional structure is more complex. It is overseen by provincial ministries and departments: Ministry of Housing, Urban Development and Public Health; Department of Planning and Development; Department of Local Government and Community Development (LG&CD); and, PHATA. At the local/district level, spatial planning is directed through Development Authorities (DAs), Cantonment Boards (CBs), City District Governments (CDGs) Town/Tehsil Municipal Administrations (TMAs) and Union Councils (UCs)/Village Councils (VCs) (CKDN, 2013). Cantonment Boards have their jurisdiction only in the areas administered by Pakistan Army (Figure 15).

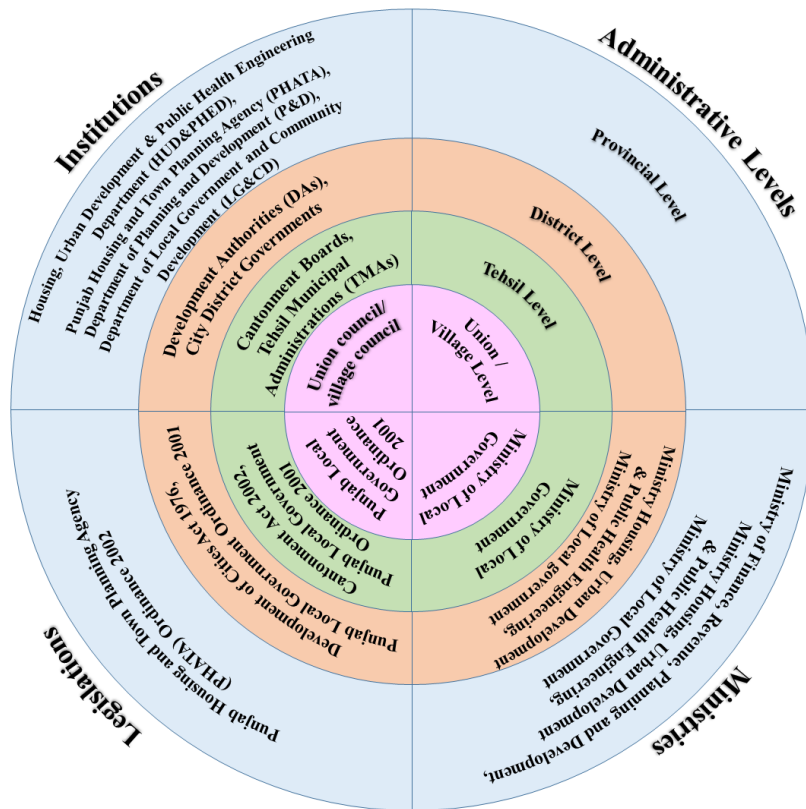


Figure 15: Spatial planning institutions and legislations at different administrative levels in Punjab  
 Source: Author's own, 2015 based on Hameed & Nadeem, 2011; Ahmad & Anjum, 2012.

Planning system in the province is without a comprehensive planning law and “...body of planning law has not kept pace with the reality of spatial development” (Yuen & Choi, 2012). All mentioned legislations at provincial and local level do not deal with rural planning except PLGO 2001. The roles and responsibilities of all the departments are more or less similar. These roles include: preparation and implementation of master plans, land use plans as well as land use and building control. PLGO 2001 advocates the preparation of zoning, land use and other development plans for rural areas as well. Ahmad & Anjum, (2012) contended that multiplicity of institutions with numerous legal frameworks and unclear roles and responsibilities of the planning task hindered the spatial planning process and its implementation at local level.

### 5.1.3 Rural planning strategies

Rural planning in the province is a top-down process. Rural development policies and plans were the part of “National Five Year Development Plan” until 2008 when this responsibility was delegated to local government. Rural development planning is not covered in the mentioned legislation and institutions only but also in several policy documents. Policy document on “Poverty Reduction Strategy” intends to improve the quality of life of rural communities, creating better and clean living environment, and improving the economic condition of rural people. Under the “National Drinking Water Policy-2009,” several projects were planned. The projects included improving rural infrastructure (clean water, sanitation, village roads, electricity and others) and provision of basic social amenities (education and health) (CKDN, 2013). The field survey revealed

that these projects have not started yet. However, successful implementation of these projects could reduce the future flood vulnerability of communities.

#### **5.1.4 Local government system as a strategy for rural development planning**

In Punjab, the three tier local government system consists of CDGs, TMAs and UCs. The district governments are responsible for: approval of master plans; zoning plans; land use plans; housing and development schemes; schemes for beautification of areas along rivers and review of implementation of building regulations and land use bye-laws. TMAs have vital role in spatial planning and development of rural areas under this system. TMA is responsible for providing infrastructure services, preparing spatial plans (land use plans and plans for their classification and reclassification, zoning plans) and exercising control over land use, land subdivision, and housing schemes for the area under its jurisdiction. The rural Union Councils (UCs) are called as Village Councils (VCs). UCs/VCs are the lowest tier in this system where each tehsil is divided into number of UCs. Union Councils are responsible for collecting and maintaining socio-economic data, coordination with TMA in preparing spatial plans, drafting regulations and guidelines, and coordinating with planning officers for enforcing these regulations. VCs are also responsible for informing TMAs about any activity against the land use plan (GoP, 2001).

The system has eliminated the difference of rural and urban areas and deals all the jurisdiction of district with the same laws and regulations which muddles the process of development and planning (Ahmad & Anjum, 2012). Accordingly, it is necessary for the TMAs to exercise the building and land use control as well as provision of infrastructure and basic services in rural areas. Unfortunately, infrastructure development has not been extended in different rural areas, and delivery of services and applicability of regulations are limited to urban areas of the tehsils.

## **5.2 Assessing role of spatial planning in reducing flood vulnerabilities in Punjab**

Reducing community vulnerabilities against flood hazards requires a comprehensive approach from the public sector. It is increasingly accepted that integration of spatial planning into disaster management can build resilience of communities. Hazard and risk mapping, land use planning, building codes and regulations are key tools for reducing vulnerability of areas prone to flood risk. Local governments play a vital role in formulating regulations for effective land use planning and its execution to reinforce the resilience (Cutter et al., 2012). The following section analyzes applicability of different spatial planning tools in reducing flood vulnerabilities.

### **5.2.1 Land use planning and zoning**

Land use planning provides the decision for the advantageous use of flood prone areas, results in minimizing the flood damages, and reduces the financial spending on flood protection (Rahman, 2010). It mitigates the flood hazard and reduces community vulnerability by regulating use of land, relocation of people and settlements away from the hazard prone areas as well as by providing appropriate escape routes (Cutter et al., 2012). PLGO 2001 provides legal backing for formulating guidelines and regulations for rural development of each tehsil under sections 191 and 192. In

Punjab, several land use planning and zoning rules and regulations exist for preparation of land use and zoning plans which are summarized in following Table 8.

Table 8: Rules, regulations and guidelines for spatial planning at local level

Regulation/Rule/ Guidelines	Role	Implementation institutes	Jurisdiction of applicability	Consideration of flood prone areas
<b>National Reference Manual (NRM) on Planning and Infrastructures Standards-1986</b>	Provision of homogenous standard and guidelines for development of areas in the whole country.	Municipal Corporations (MCs), Development Authorities (DAs).	Urban areas within the jurisdiction of MCs and DAs	No
<b>Model Building and Zoning Regulations-2007</b>	Provide standards and guidelines for preparing zoning plans for different uses (residential, industrial, commercial and special zones).	DAs, TMA and its offices (Tehsil Officer Planning and Coordination (TOP&C), Tehsil Officer Infrastructure and Services (TOI&S) and Tehsil Officer Regulation (TOR).	Jurisdiction of urban and rural areas of each tehsil	Yes
<b>Land Use Classification, Reclassification and Redevelopment Rules-2009</b>	Provide rules for preparation of maps and plans for land use classification, reclassification and redevelopment of areas.	DAs, CDGs, TMAs and its officers, UCs.	Jurisdiction of urban and rural areas of each tehsil	Yes
<b>Punjab Housing and Town Planning Agency (PHATA) Building and Zoning Regulations</b>	Prepare plans for low cost housing schemes and other development projects in urban hinterland.	PHATA and its offices.	Hinterlands including the areas of rural character	No

Source: GoP, 2008; Hameed & Nadeem, 2011; CKDN, 2013

The rules and regulations for land use planning must cover both urban and rural areas. Informal discussion with spatial planning experts and interviews with planning officers revealed that the scope of these rules and regulation are limited to urban areas. NRM is outdated and PHATA regulations do not fit into rural areas and development of villages. Zoning Regulations-2007 provide the basis for dealing with flood prone areas by identifying them within “special zones”. It states that “*flood plains as defined in the approved master plan or notified by the relevant department shall be dealt with strictly in accordance with the recommendations of the master plan. However, if Government provides protective bunds and safeguards in flood plain area then Authority may prepare special building regulations in accordance with local conditions*” (GoP, 2008). Interview of the planning officers revealed that neither the master plans are prepared for the tehsils/districts at flood risk nor the flood zones have been identified. Literature suggests that preparation of flood zoning maps was initiated in 1988 but the project soon came to halt (Rahman & Shaw, 2015a). Until recently, master plans prepared for the big cities (especially Multan which is at high risk of flood), had not integrated DRR guidelines.

Land Use Classification, Reclassification and Redevelopment Rules-2009 incorporate a land use category with “*environmental sensitive areas*” (GoP, 2009). In this category, the concerned authority may add ‘flood plains’ as environmental sensitive area but definition of the term is not clear. The rules provide the procedure for preparation of land use maps and plans, and for

reclassification of the land uses according to the trends and changing conditions. Until now, only 17 out of 128 tehsils in Punjab have prepared the land use plans considering these guidelines. Figure 16 indicates the tehsils where land use and zoning plans are prepared. It is analyzed that most of the tehsils at flood risk do not have any land use plans, and tehsils where land use plans were prepared, none incorporated rural and flood prone areas.

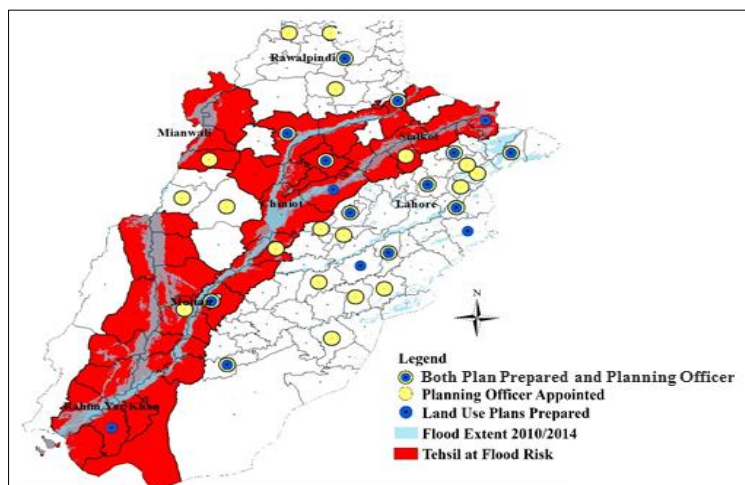


Figure 16: Tehsils where land use and zoning plans were prepared and planning officer are available  
 Source: Authors own and data from field survey, 2015.

### 5.2.2 Building codes and regulations

The vulnerability of communities living in flood prone areas can be reduced by implementing flood resilient construction or by restricting certain types of construction. Building codes and regulations play an important role in this regard. The codes guide the procedures for designing and constructing safe structures in different conditions, and direct the selection of appropriate material (Rahman & Shaw, 2015b). These codes work effectively when coupled with land use and zoning plans. In Punjab, several building codes and regulations exist (see Table 9). PLGO-2001 gives powers to TMAs to formulate building bye-laws for their jurisdiction.

Table 9: Building codes and regulation for local level

Regulation/Rule/Guidelines	Role	Implementation institutes	Jurisdiction of applicability	Consideration of flood prone areas
<b>Building Code of Pakistan (BCOP)-1986 and seismic provision-2007</b>	Minimum standard requirements for designing buildings, test of soil and material used in construction in order to create awareness and ensure safe constructions against disasters	Municipal Corporations (MCs), Development Authorities (DAs), Institutions dealing with disaster management	All the urban areas, rural areas fall in the seismic zone of Punjab and other provinces	No
<b>Modal Building and Zoning Bye-laws-2007</b>	Provide standards and guidelines for construction of different types of buildings	TMA and its offices (Tehsil Officer Planning and Coordination (TOP&C), Tehsil Officer Infrastructure and Services (TOI&S) and Tehsil Officer Regulation (TOR)	Jurisdiction of urban and rural areas of each tehsil	No

Source: GoP, 2008; CKDN, 2013

BCOP 1986 and 2007 completely ignores the building construction guidelines which are specific to the rural areas of Punjab, while seismic provision in 2007 incorporates only earthquake hazards. BCOP 1986 and 2007 are not utilized by the TMAs and DAs in Punjab as they follow their own building regulations. Model Building Bye-laws-2007 are applicable in every part of the tehsil but are only enforced in the urban settlements. More than 10 planning officers of TMA were interviewed and none of them has enforced the building bye-laws in rural areas and some did not even impose it in urban areas. On the other hand, building codes or guidelines specific to the flood prone areas lack in these codes. It is further noted that none of the TMAs has formulated the building codes and regulations for flood affected areas as communicated by PLGO 2001.

Guidelines for climate compatible construction and DRR have been prepared for the flood affected rural areas of Punjab by Climate Knowledge Development Network (CKDN) after the mega flood event of 2010. The document is prepared with the active involvement of PDMA and consultation of flood affected TMAs, UCs, and communities. It provides the procedures for construction of buildings in flood prone areas and recommends appropriate materials. It also provides comprehensive guidelines on village level physical and emergency planning. Field survey indicated that neither the TMA officials have knowledge about this document nor the PDMA is aware of it.

### **5.2.3 Flood hazard and risk mapping**

Flood hazard and risk mapping is another spatial planning tool that guides the land use planning and zoning. Flood hazard maps illustrate the different characteristics of flood with the potential hazardous locations including buildings, infrastructure services, and public facilities. In Punjab and in whole of Pakistan, flood hazard and risk mapping is done at district level which classifies the districts as very high, high, medium, low and very low. It does not provide any information regarding different elements of risk. These hazard and risk maps are prepared considering limited indicators and do not represent the elements that shapes vulnerability and hence the overall risk.

### **5.3 Reason for neglecting spatial planning at local level**

It is apparent that spatial planning is totally neglected in Punjab for reducing flood vulnerabilities. Multiple reasons are concluded in Table 10 from analysis of literature and surveys.



Table 10: Reasons for neglecting spatial planning at local level for reducing flood vulnerability

Reasons	Explanation
<b>Lack of interest and influence of public representatives</b>	The spatial planning system in the country is highly political. The final approval of every plan or regulation is given by head of tehsil council elected by the people. The public representatives do not take interest in making of land use and zoning plans and neglect the enforcement of building regulations. On the other hand, political influence is the main hurdle in implementation of plans and enforcement of regulations where such plans exist.
<b>Insufficient technical manpower</b>	There are 128 TMAs in whole Punjab and only 31 TMAs have a planning officer. Most of the tehsils which have been highly affected by the flood disasters in the past do not have a planning officer Figure 16. On the contrary, those TMAs where planning officers have been appointed, possess only 1 to 2 persons in the supporting staff (Hameed & Nadeem, 2011). It is difficult for the TMAs to prepare land use and zoning plans in stipulated time frame and enforce building regulations in the whole jurisdiction with the limited technical human resource.
<b>Lack of coordination of TMAs with PDMA/DDMA</b>	NDMA Act-2010 clearly states incorporation of the DRR measures in development plans. The lack of coordination of PDMA with TMAs and absence of DDMA in districts has resulted in the neglect of flood disaster risk reduction measures in development planning of tehsils. During flood, all the man power and resources of TMA is diverted to manage it which results in illegal and unlawful constructions during this period by land mafia.
<b>Financial constraints of TMAs and community</b>	Revi et al., (2014) indicated limited investment trends in land use planning in middle and lower income countries like Pakistan. The budget of TMAs is limited which hampers the plan making and implementation process. Limited financial budget results in development and provision of services in urban areas. Besides, approval of building plans as per building codes requires submission of fee from the applicant. The economic condition of rural communities does not allow them to get the building plan approved and use specified construction material.
<b>Appropriateness of building regulation with rural character</b>	All the building regulations which are formulated for rural areas are irrelevant and invalid considering the rural character. Floor space ratio provided in the regulation does not apply in rural areas. The regulations have completely neglected the rural culture whereas none of the building regulations is pertinent to flood prone areas.
<b>Absence of monitoring and evaluation mechanism</b>	The monitoring and evaluation mechanism for checking the progress of plan preparation and its implementation is deficient in the whole province. Therefore, TMAs, where planning officers exists, overlook the plan making exercise, and do not imposing building regulations effectively in urban and rural areas. On the contrary, spatial plans which are prepared do not incorporate all the elements as communicated by the PLGO 2001 especially identification of flood zones and preparation of regulations for these areas.

Source: Author's own from field survey, interviews and literature 2015.

## 6 PARTICIPATORY APPROACH TO ASSESS VULNERABILITY AND CAPACITY

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Participatory approaches are vital in assessing and prioritizing vulnerable elements and adaptation needs of community under the distress of a hazard. Such approaches are now being increasingly used around the globe due to their cost effectiveness and time saving potential. Participatory approach for assessing vulnerability and capacity is absent in Punjab in the context of flood hazards. Additionally, plans and policies are prepared to reduce community vulnerability without prioritizing vulnerable elements and factors as well as needs to increase the adaptive and coping capacity. Therefore, vulnerability and adaptive capacity is assessed in this study using the weighted matrix index and ranking method (Younus & Harvey, 2013) in two severely flood affected districts: Jhang and Muzaffargarh. The chapter discusses qualitative analysis of elements at vulnerability, factors that contribute towards vulnerability; measures embraced by community to cope and adapt to flood.

### 6.1 Participatory Rapid Appraisal (PRA)

Participatory Rapid Appraisal (PRA) is a method for quick assessment of social, economic, physical, and, environmental conditions. The PRA is defined as “*a family of approaches and methods to enable rural people to enhance, share and analyze their knowledge of life and condition, to plan and to act*” (Chambers, 1994). Participatory methods use the bottom-up approaches by the active involvement of target communities to prioritize their needs and emphasize on their perspectives (Younus, 2010). It has become imperative in the discourse of planning and development, and is used by NGOs to make implementable and effective plans (Michener, 1998). In order to understand the complexities of a topic, most of the PRA analysis is performed in front of and by the target communities. Therefore, it gives accurate information regarding peoples’ values, attitudes, opinions, and capacities to perform certain tasks (Mukherjee, 2004) and saves time and money as well as creates awareness. In the field of disaster risk research, multiple participatory methods are widely used for assessment of community vulnerability and adaptive capacity. Some of these methods include: seasonal calendars, mapping and modeling, transect walks, matrix scoring, weighted indexing and ranking, focus group discussions, well-being and wealth ranking and grouping, and analytical diagramming (Chambers, 1994; Younus & Harvey, 2013).

### 6.2 PRA in study areas

Two flood affected communities from each study districts were selected (Bela Jhabana and Goniwana from district Jhang, and Doaba and Thatta Qureshi from district Muzaffargarh). PRA was conducted by organizing 25 people from each commune including local public representatives, teachers, and government officials (Annexure G, Figure 44 and 45). It helped in identification and prioritization of local flood vulnerabilities and needs to the government representatives so that the same could be incorporated in future plans and programs accordingly. Several elements/factors/measures were weighted against two massive flood events of 2010 and 2014. For

each flood year and for each district, two sets of weighted values corresponding to settlements (from 1-25 depending on number of votes) were obtained and averaged to get a final score. The weights for each district were ranked according to level of vulnerability and urgency or priority for a measure to increase adaptive capacity. The assessment of vulnerability and capacity is carried out by comparing overall weighted score of each flood event for both study districts using spiral diagram.

### 6.3 Vulnerability assessment

22 elements and 9 factors were identified which were weighted by the attendees of PRA in both the districts (Annexure F, Table 28 and 29). In case of Jhang district, Extremely High Vulnerable (EHV) elements were less in 2010, and increased to 19 in the 2014 flood event. It is due to the characteristic of flood in 2014. On the contrary, in district Muzaffargarh, the overall vulnerability in flood event of 2010 was significantly high as evidenced from 23 EHV elements which decreased to 15 in the flood event of 2014 (see Table 11). It indicates that some capacity measures were adopted by the communities which reduced their vulnerability. A comprehensive assessment of selected elements and factors having significant impact on peoples' vulnerability was carried out.

*Table 11: Elements and factors classified according to severity of vulnerability*

District	Flood events/ Category of Vulnerability	Extremely High Vulnerable (EHV) 21-25	High Vulnerable (HV) 16-20	Medium Vulnerable (MV) 11-15	Low Vulnerable (LV) 6-10	Very Low Vulnerable (VLV) 1-5
<b>Jhang</b>	2010	09	11	05	02	04
	2014	16	07	05	02	02
<b>Muzaffargarh</b>	2010	23	04	01	03	--
	2014	15	06	05	03	02

*Source: Field survey, 2015.*

Moreover, vulnerability syndrome based on the syndrome concept for global change (Schellnhuber et al., 1997) is demonstrated in Figure 17. Vulnerability syndrome indicates the relationships and dependencies between selected elements and factor showing how vulnerability of one element increases vulnerability of other element/factor and vice versa. The community assets under various classification of vulnerability is connected with each other. It indicates how different aspects of vulnerability are interrelate in complex way. Further, it helps to identify how elements/factors at extremely high vulnerability pushes the elements/factors at low vulnerability. Important linkages associated with community assets or factors that enhances vulnerability are provided separately with the relevant sections for better understanding.

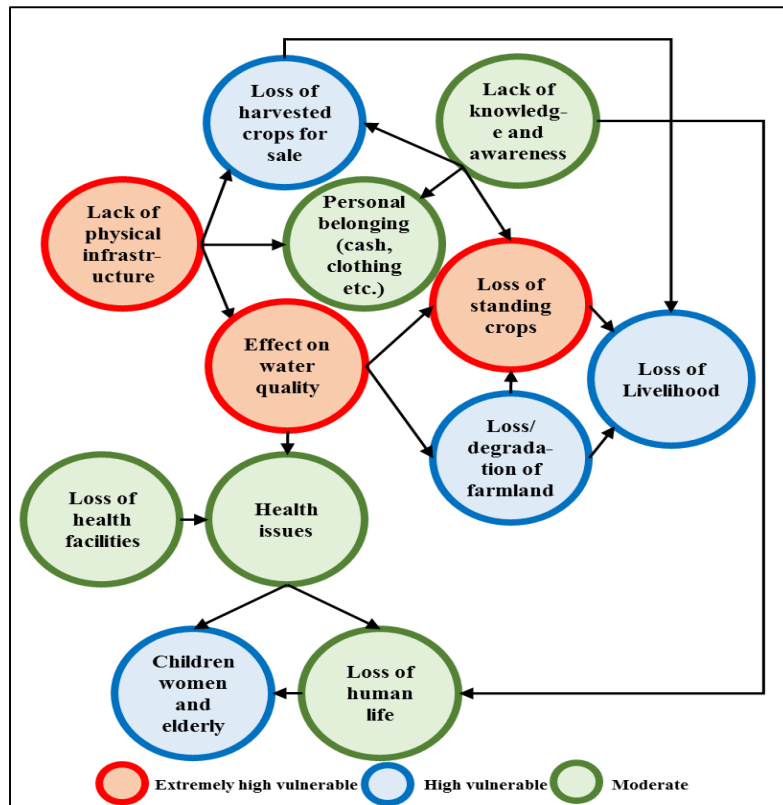


Figure 17: Vulnerability syndrome for flood disasters  
Source: Author's own, 2015 based on Schellnhuber et al., 1997.

### 6.3.1 Elements at vulnerability

A comparison of vulnerability of various community elements were assessed based on the losses and damages in flood events of 2010 and 2014 (Figure 18).

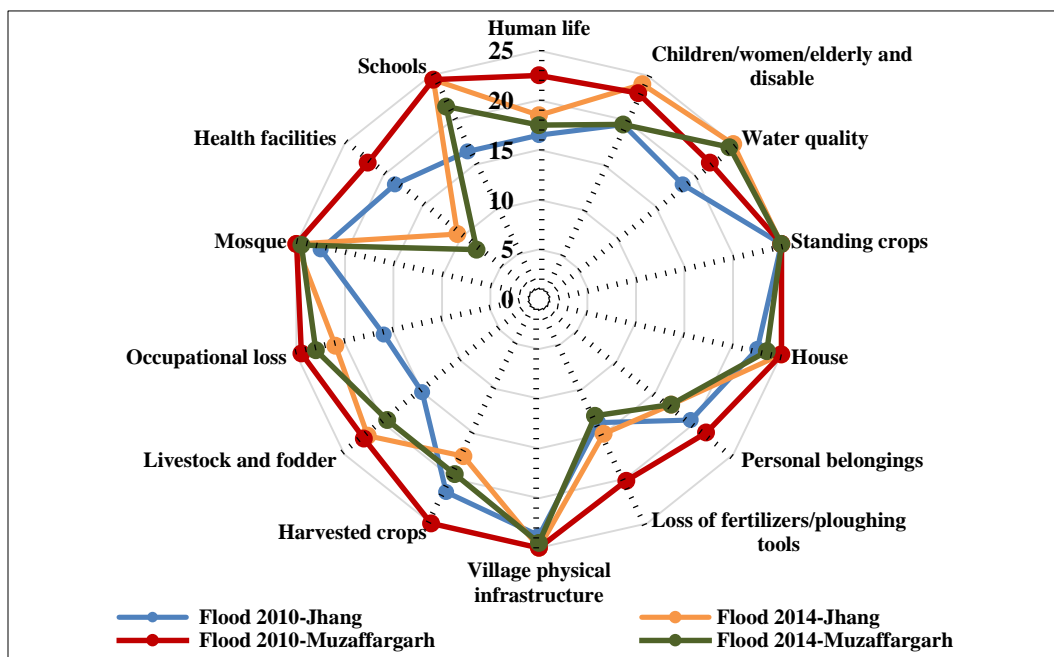


Figure 18: Comparison of vulnerable elements with respect to 2010 and 2014 flood in study districts  
Source: Author's own, 2015.

### 6.3.1.1 Human assets

The loss of life in 2010 in district Jhang was slightly less as compared to the second flood event, while, in Muzaffargarh, the issue was prioritized as EHV in 2010 and ranked as HV in 2014 indicating lesser life loss in the latter event. In case of vulnerable groups, community in Jhang district considered it as HV in 2010 but ranked it EHV in 2014 indicating that 90% children, women and elderly were affected by flood. It was vice versa in the viewpoint of communities in Muzaffargarh. Increase in loss of life and vulnerability of women, children and elderly in Jhang was due to the perception that flood event like 2010 would not occur again. Therefore, sudden flood occurrence created chaos and people focused on shifting their belongings, and vulnerable groups could not be attended well. Whereas in Muzaffargarh, in the aftermath of the 2010 flood, due to excessive focus of NGOs, villagers had become aware that vulnerable groups should be protected first and taken to safe places before flood. Despite this, life losses and injuries did not reduce significantly.

### 6.3.1.2 Natural assets

Natural assets such as water quality and standing crops were impacted badly by the flood events. Both flood events in the study districts deteriorated the quality of ground water. As the community relies on ground water for drinking and farming, they ranked it as EHV with score of 25 for 2014 which previously was between 19 and 22 for the flood event of 2010. Similarly, loss and damage of standing crops was also considered as EHV in both floods where 100% of attendees lost their crop in the respective flood years. Impact of each flood event additionally declined the quality of water. The predominant reason is the open drains carrying city's sewage which passes nearby these communities (Annexure G, Figure 46). With the occurrence of flood, sewage mixed with river water and worsened the water quality. It also spoiled the fertile land and crops and destroyed major income source of local villagers. With each flood impact, decline in water quality and crop losses increased further adding to community vulnerability by destroying their health, damaging their land, and depriving them from their livelihood (see Figure 19). It was observed that financial constraints in renting machinery to plough farms resulted in the use of traditional methods which required more time and hence increased maturity time of crops pushing it beyond monsoon season. Moreover, variable timing of flood occurrence aggravated the issue.

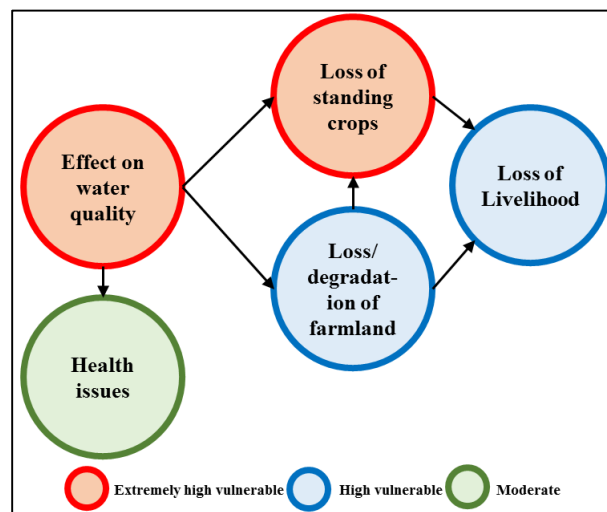


Figure 19: Flood impact on water quality increased vulnerability of other elements and factors.  
 Source: Author's own, 2015.

### 6.3.1.3 Physical assets

Several physical elements were considered as EHV by the attendees of PRA. House and village infrastructure (roads, electricity, open drains, water pumps and culverts) were totally damaged by both flood events. Household items and personal belongings (beds, cutlery, clothing, cash and others) were ranked as HV in case of Jhang and EHV in case of Muzaffargarh. In 2014, decrease in losses indicated some community actions in reducing vulnerability. Loss of fertilizers and ploughing tools for the crop were ranked as MV and EHV for Jhang and Muzaffargarh respectively in 2010 which increased slightly for Jhang and significantly reduced for Muzaffargarh in 2014.

Loss of personal belongings (cash and jewelry) in 2010 which they had saved for marriages and education of children, had a negative social impact on some attendees. House was a key vulnerable element which people constructed by investing years of saving. Its loss had a long term psychological effect on households. People usually built their houses with mud or adobe bricks which could not withstand high floods (see Annexure G, Figure 47). Loss of water pumps, ploughing tools and fertilizers were an additional burden on the pocket of farming dependent society. It is analyzed that fixed assets like house and infrastructure were extremely vulnerable whereas moveable assets like fertilizers, ploughing tools and personal belongings seemed vulnerable in 2010 flood disaster but their vulnerability tremendously reduced in 2014 flood disaster.

### 6.3.1.4 Financial assets

The floods severely impacted the financial assets of community. The flood of 2010 resulted in almost 100% loss of harvested crops which was stored for sale in both districts as compared to loss to livestock. The harvested crop losses reduced in 2014 and community prioritized it as HV. The occupational and livestock losses increased significantly in Jhang for the flood event of 2014 to EHV, and slightly reduced by 2 points in Muzaffargarh as compared to 2010. The impacts on financial assets in different flood events indicated that excess loss of one financial asset in one flood event psychologically diverted the attention on that asset in the next event. In 2014, community saved their crops by shifting to safe place or sold it earlier, as was done in Muzaffargarh for livestock. Moreover, loss of livestock in Jhang was found associated with ignorance of flood warning and unavailability of fodder during flood that made them vulnerable. Loss of occupation had a direct link with loss of standing and harvested crops and farmland, as most of flood victims were farmers (see Figure. 19).

### 6.3.1.5 Social assets

As regards to social assets, there were significant losses and damages to social institutions in the flood events of 2010 and 2014. Mosques, an important community element, were the most vulnerable ones, and were ranked as EHV in both districts in both flood events. Secondly, schools were prioritized as most vulnerable and scored by community as 21 and above. Health facilities were considered as HV and EHV in case of 2010 flood event in Jhang and Muzaffargarh

respectively, and were prioritized as LV in 2014. Mosques were more vulnerable than schools and health facilities due to fragile construction. Schools and health facilities were constructed from baked bricks and concrete which made them less vulnerable than mosques. It is noted that communities constructed mosques on higher ground but deficient awareness of resilient techniques and financial constraints increased losses. In response to flood disaster of 2010, health department shifted many health facilities

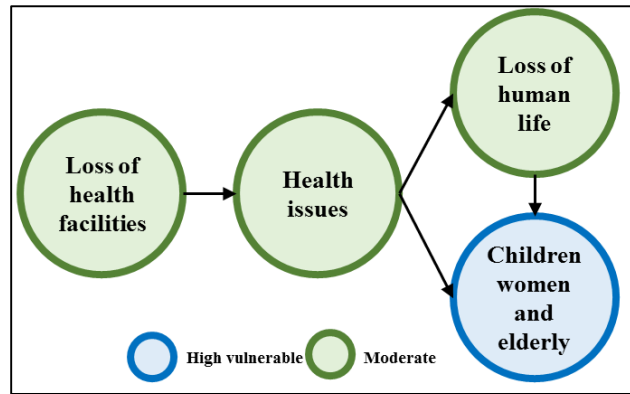


Figure 20: Relation of loss of health facilities with other elements and factor

Source: Author's own, 2015.

from flood affected areas to safe places due to massive loss of expensive medicine and machines, which resulted in comparatively less damage to health facilities in 2014. However, damage and inaccessibility of health facilities due to relocation exacerbated health issues associated with flood impacts and therefore increased the susceptibility of vulnerable groups and resulted in loss of human life (see Figure 20). Most of the schools inside or near settlements provided easy access to children and were at high flood risk. The authorities neglected the resilient measures during reconstruction after the flood event of 2010.

### 6.3.2 Factors contributing to vulnerability

The factors which contribute to vulnerability of communities are identified in Figure 21. Some of these factors have direct relationship with elements which increase their vulnerability. Lack of knowledge and awareness about local conditions (flow of water, escape route, safe locations, weather conditions, understanding of warning and others) has an impact on vulnerability. In Jhang, people considered this factor as highly increasing the vulnerability in both 2010 and 2014. Similarly, in Muzaffargarh, the factor was considered as contributing to extreme vulnerability in 2010, but reduced to 20 in 2014. The continuous flood events created awareness and local knowledge that helped understand early warning signs, escape routes, weather conditions, understanding of the water flows and depth from irrigation scales. Additionally, awareness also reduced the losses of personal belongings and harvested crops (see Figure 17).

Loss of farmland (mostly partially) was both, a vulnerable element, and, a factor that contributed to susceptibility. The loss and degradation of farmland in Jhang for 2010 was slightly less as compared to 2014 where almost 95% of people lost their farmlands either due to erosion, sand deposit, or stagnant dirty water. In Muzaffargarh, the flood disaster of 2010 increased people's vulnerability by damaging almost 100% of farmlands, which was slightly reduced in 2014. Each flood event after 2010 deprived flood victims from a part of their land in Jhang district. The reasons for slight reduction in farmland loss in Muzaffargarh were observed to be: private dykes for land protection (which is not effective). The loss and degradation of farmland had direct impact on livelihood source which made farmers susceptible to flood hazard.

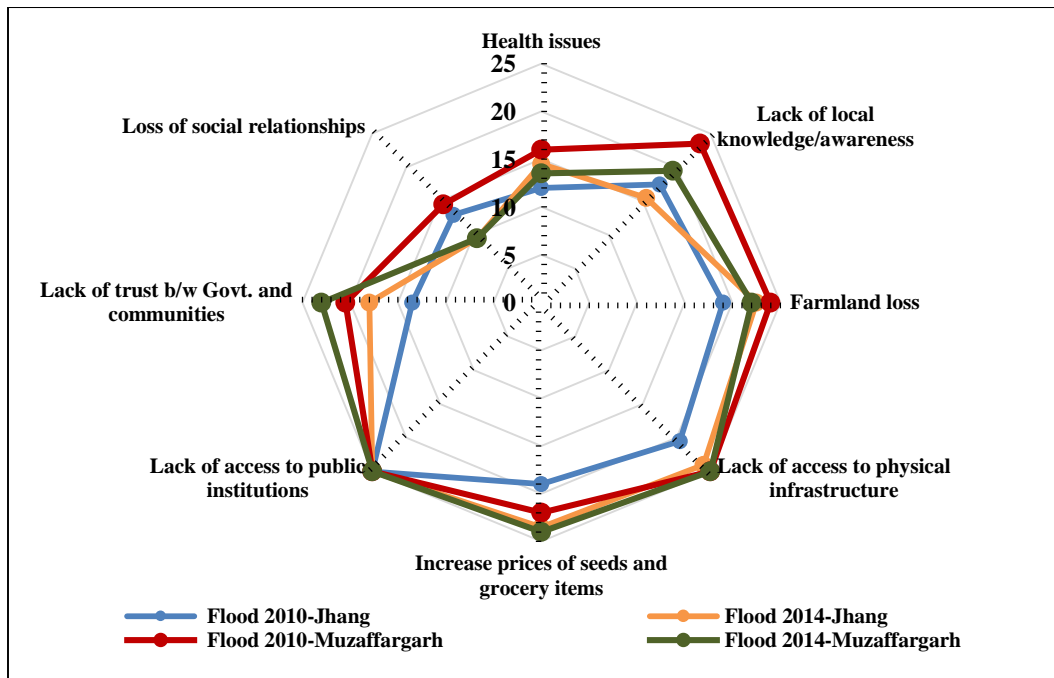


Figure 21: Comparison of factors that contributed to vulnerability before/during/after 2010 and 2014 flood in district Jhang and Muzaffargarh. Source: Authors own, 2015.

Lack of physical infrastructure such as access roads, drainage, water supply, electricity, telecommunication and others in settlements of both districts added to extremely high vulnerability. In Jhang, the score was 21 for 2010 flood event, which increased to 24 in the flood event of 2014. The inaccessibility of infrastructure facilities in the study areas reduced capacity of people to cope and adapt to flood hazard. Village roads had not been reconstructed by the government after the flood of 2010, and created problems in evacuation and shifting of livestock, harvested crops and personal belongings in 2014. Besides, this restricted the access to health centers and of emergency services, further exacerbating health issues. Improper drainage caused water logging and worsened the water quality (see Figure 22 and 48). Nonexistence of telecommunication systems and interruption of electricity before monsoon season created hurdles in receiving warnings and communicating immediate needs in case of flood event.

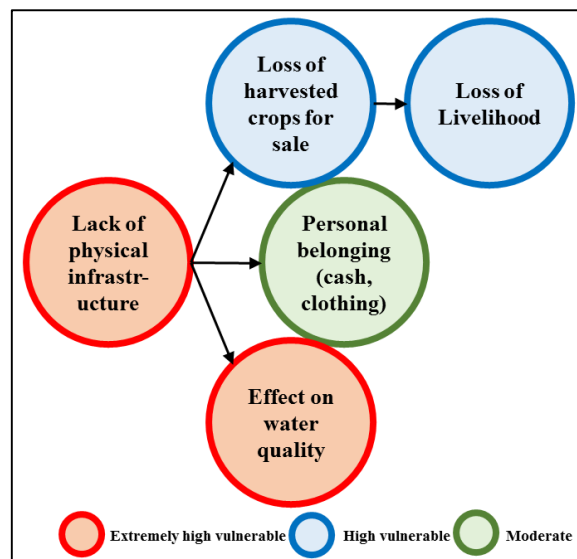


Figure 22: Relationship of physical infrastructure with other community assets Source: Author's own, 2015.

Social factors such as lack of access to public institutions and trust between local government and communities worsened the vulnerability situation. All the participants of four settlements thought that lack of access to public institutions (government offices, banks, and education) due to



absence of social relationships; and deficient income and cast issues increased their vulnerability. Furthermore, inefficient performance of government in supporting communities through relief and recovery activities and transparency issues abridged the community trust. Furthermore, vulnerability was found induced by loss of social relationships due to migration or deaths, as community members used to help each other in case of flood.

Level of vulnerability for elements and contributing factors changed overtime. Still, some elements and factors which ranked as EHV in both events and study districts include: water quality, standing crops, house, loss and limited access to physical infrastructure, mosque and lack of access to public institutions. It was recognized that majority of vulnerable elements and factors attributed to community vulnerability were fixed assets which indicates that capacities were developed in the communities to reduce vulnerability of immovable assets. Nevertheless, several limitations in different domains seems limitation in reducing vulnerability of immovable assets. It is evident that flood impacted social, physical, financial and natural assets but most vulnerabilities were associated with income and livelihood aspects (standing and harvested crops, farmland, occupational loss and others). Changes in local natural conditions caused by flood significantly disturbed the income source of flood victims.

Moreover, complex relationships between elements/factors were identified showing that increase in vulnerability of one element increased vulnerability of one or more elements. Furthermore, it was noticed that factors and elements at extreme vulnerability contributed to the vulnerability of elements at moderate level and vice versa. The relationship indicated that lack of physical infrastructure and local knowledge was the key in increasing vulnerability of various community assets as most of the connections are found with these two factors. Here, spatial planning departments can play a vital role in reducing vulnerability by providing critical physical infrastructure as discussed in Chapter 4 and 5.

#### **6.4 Assessment of capacity measures**

As for assessing vulnerability, several measures were identified for judging capacity of flood affected communities. 41 measures in total were identified as per livelihood assets, out of which 19 measures were implemented by the community to cope and adapt, and 22 measures were suggested by the attendees and author (Annexure F, Table 30 and 31). Final scores were classified and ranked as *extremely urgent*, *urgent*, *moderate*, *low* and *very low* indicating community urgencies. Table 12 shows that only 02 measures were ranked as extremely urgent in Jhang for flood event of 2010 which drastically increased to 13 in 2014. It means that the communities had either embraced some measures to increase their coping and adaptive capacity or at least had some knowledge of coping with floods. The detailed analysis of selected measures helped identify not only community needs for adaptation but also the changing urgencies with the passage of time.

Table 12: Capacity measures classified as per urgency of community in study districts for 2010 and 2014 flood

District	Flood events/ Category of urgencies	Extremely urgent 21-25	Urgent 16-20	Moderate 11-15	Low 6-10	Very Low 1-5
Jhang	2010	02	15	08	08	08
	2014	13	12	07	04	05
Muzaffargarh	2010	20	04	07	09	01
	2014	19	08	08	02	04

Source: Field survey, 2015.

## 6.4.1 Assessment of implemented measures

### 6.4.1.1 Human assets

Regarding human assets, partial starvation is seen as coping measure against flood hazard where people took one meal a day instead of three. In district Jhang, its adoption was moderate in 2010 but was employed tremendously in Muzaffargarh, and vice versa in 2014 (see Figure 23). The partial starvation was seen among the poor and neglected section of community due to limited food stock, loss of physical and financial assets, as well as saving money for livelihood recovery. It increased in district Jhang due to extreme surge in prices of grocery items after the flood of 2014. Furthermore, limited coverage of distribution of relief items also forced people to adopt this measure. The increase in number of earning members in household was another strategy to adapt to flood but was not commonly utilized by the people in Jhang and Muzaffargarh. People started to send their children to work in order to reconstruct houses and revive farmlands. The trend in Muzaffargarh remained constant as people found it difficult to find informal jobs after 2014 floods.

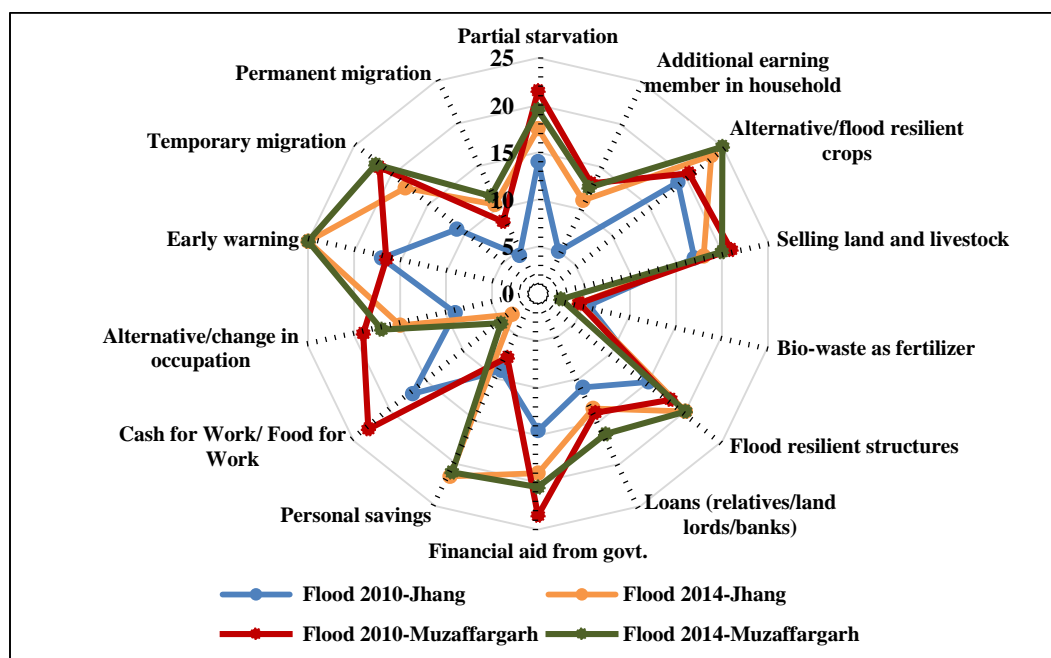


Figure 23: Comparison of measures to cope and adapt to flood embraced by the communities during and after 2010 and 2014 flood disaster

Source: Author's own, 2015.

### 6.4.1.2 Natural assets

The utilization of some natural assets for coping and adapting to flood was witnessed. In response to flood event of 2010, both study districts started sowing alternative crops which can either have less maturity period (for example vegetables) or resilient to floods (sugarcane). The urgency of this measure reached to extreme in the aftermath of 2014 floods. The flooding created an autonomous adaptation in the community, but variation in flood timings reduced people's capacity by damaging these crops. The phenomenon was reported during PRA when many people grew vegetables instead of other crops but flood hit the area in May-2015 rather than in August.

Selling a part of farmland and livestock as coping measure was reported in both districts which was slightly increased after the 2014-flood (see Figure 23). The selling of land and livestock deprived farmers from their livelihood sources in order to meet their immediate housing and hunger needs. In addition, flood victims found selling livestock a better option due to unavailability of fodder in the vicinity which was impacting animal health. Due to easy retail of livestock, it was ranked more urgent than additional earning members since not all the households sent their children to work, besides there being lack of job opportunities.

### 6.4.1.3 Physical assets

In response to floods, local community started to construct flood resilient houses to withstand future hazards. This was done by raising the platform/plot of the house or by constructing pecca<sup>5</sup> houses (see Annexure G, Figure 49 and 50). The trend for such houses increased after the flood of 2014 in both study districts. These measures were supposed to save the house from flood damage. Nevertheless, inappropriate techniques (depth of foundation, raising platform), negligence of building regulations due to their inappropriateness with rural character, poor quality of material due to financial constraints severely damaged these houses in the aftermath of the 2014-flood.

### 6.4.1.4 Financial assets

The floods significantly diverted the local communities to increase their capacity using financial means. Financial aid from the government seemed to be helpful for flood victims in enhancing their capacities. In case of 2010 flood, not many attendees received financial aid in Jhang but in Muzaffargarh more than 90% people received it due to massive media and NGOs' attention. In 2014, the figure rose for Jhang to 19 and lowered to 21 for Muzaffargarh. The financial aid scheme in 2010 was proclaimed to be highly politically partisan and without any specific compensation delivering criteria. On the contrary, in 2014 new scheme for compensation had certain criteria for compensation disbursement which reduced the number of people aided with compensation (see Chapter 4, Section 4.1.1.4). Transparency issues were still reported in distribution of aid.

Loans from relatives, landlords and banks also influenced coping strategy. The loans were mainly taken for buying food and seeds and house reconstruction. There was slight increase in taking loans for the flood event of 2014 in both study districts. It is observed that high interest on loan from banks and landlords restrained villagers from using this measure. Therefore, the measure

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<sup>5</sup> Pecca house is a local word used for houses constructed from burnt bricks and mortar.

was considered less important than financial aid from government. Although, some marginal groups who lost most of the resources in the flood event had no other option than to take loans on high interest rate. Savings in the form of cash was employed by the villagers to recover from flood after its impact. The flood event of 2010 in both districts influenced people to save money for following flood events. The measures were considered more important than financial aid due to transparency issues.

Change in livelihood pattern was used as an adaptation approach. In 2010, it was partially considered in Jhang, but after 2014, people employed additional occupation or totally changed their profession. It is analyzed that people started to work as unskilled laborers during and after flood. Some utilized this in addition to farming, and some changed farming as secondary occupation due to land loss and degradation. In Muzaffargarh, the trend of alternative/change in occupation remained almost constant due to lack of job opportunities as explained earlier.

#### **6.4.1.5 Social assets**

Flood warning (from local people, radio, TV or government officials) was less important in 2010 but in 2014 people scored it as 25, which shows that all the respondents received the flood warning and saved their resources. It is analyzed that people received flood warning 1-3 days in advance due to which they could not harvest their standing crops. Some have also reported that limited time of flood warning did not allow them to even save their household items. On the contrary, attendees considered it extremely urgent measure compared to others because it can save human lives, reduce partial starvation, save their livelihood assets and reduce their dependence on loans, financial aids and alternative employments.

Migration, both temporary and permanent, was witnessed in both study districts. More focus was given to temporary migration especially in Muzaffargarh. Local community usually moved to flood dykes, main roads (nearest highways) or relatives whichever was nearer to their residence, due to fear of looting. Affectees refrained from moving to relief camps which were established far from affected settlements and lacked in facilities (sanitation, animal shed, cooking facilities, storage facilities and others). Government had plans to increase the height of flood dykes but the community suggested widening them so as to accommodate more people thereon. Permanent migration, albeit rare, was adopted by people having sufficient financial resources. Nevertheless, majority was reluctant to migrate permanently as they have farmlands and other livelihood assets in flood plains. Lack of livelihood opportunities in safer locations restricted flood victims to migrate permanently.

#### **6.4.2 Suggested capacity measures**

Some capacity measures were suggested by the attendees of PRA and some were presented by the author (see Figure 24). The measures implemented by the flood victims were linked with suggested measures that could further enhance or reduce community capacity (see Table 13). An immense increase was noticed for requirement of skill development, training for flood preparedness, and making community organization. The attendees considered vocational training more important for alternative employment to diversify livelihood instead of depending on

panchayat<sup>6</sup> to organize relief and employment activities as these are considered as biased. Additionally, it would help in reducing partial starvation, dependence on loans, and would mean more earning members and better knowledge of alternative crops and resilient structures.

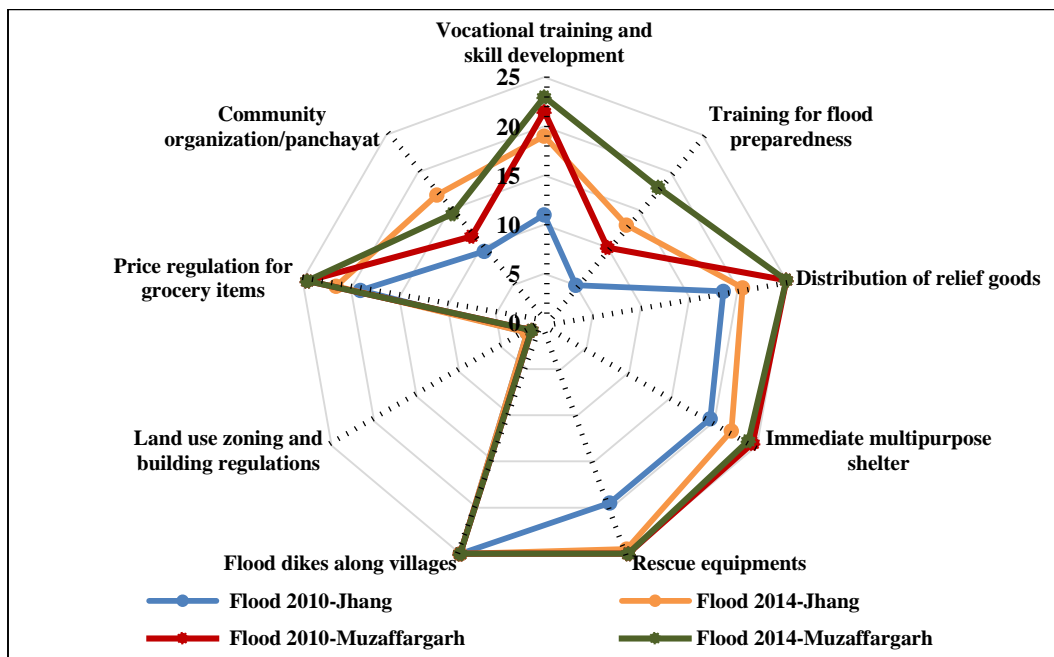


Figure 24: Comparison of coping and adaptation measure suggested by the communities as per their needs in 2010 and 2014 flood disasters  
Source: Author's own, 2015.

All the communities felt the need to get training for flood preparedness after flood event of 2010. Therefore, attendees of PRA stressed the provision of rescue equipment (boats, life jackets and vehicles) in advance. Moreover, residents highlighted the need of multipurpose shelter (having all allied facilities) within the close proximity of existing settlement for migrating temporarily during flood period. Distribution of relief goods (food items and NFIs) were not managed efficiently and flood victims and especially vulnerable groups could not get relief goods due to mismanagement of relief goods and influx of non-flood victims. This issue forced people to buy food and NFIs, if available, at double the normal price. In this regard, the community suggested regulation of prices during flood to allow them to buy food within their financial resources.

The need for flood dykes along villages was suggested as highly urgent measure in both flood events and in both districts with the score of 25. Flood dykes can reduce the dependence on every relevant adaptation measure. It is noted that land use zoning and building regulations were least considered as adaptation measures. In view of communities, land use zoning would relocate the clusters, which was unacceptable as their livelihood was associated with these areas. Flood dykes were seen as appropriate options which could protect them from future flood hazards in the long term without relocation.

<sup>6</sup> Panchayat is a group of people of rural elites in every village having decision making power in different village matters, and that has relationship with public and government representatives.

Table 13: Relationship of suggested capacity measures with implemented measures which can increase/reduce dependence on implemented measures

Measures adopted by community/Suggested measures	Vocational training and skill development	Training for flood preparedness	Effective distribution of relief goods	Immediate multipurpose shelter	Rescue equipment	Flood dikes along villages	Price regulation
Partial starvation	X		X			X	X
Additional earning members	X					X	
Alternative/flood resilient crops	X					X	X
Selling land and livestock		X	X	X		X	
Flood resilient structures	X					X	
Loans (relatives/land lords/banks)	X	X	X		X	X	X
Personal savings		X			X	X	
Cash for Work/ Food for Work	X						
Alternative/change in occupation	X		X			X	X
Early warning		X			X		
Temporary migration				X	X	X	
Permanent migration						X	
	X	Increase dependence		X	Reduced dependence		

Source: Authors own, 2015.

Just like change in vulnerability, use and need of capacity measures also changed with the flood events. Major changes were seen in flood resilient structures and crops, personal saving, change in livelihood pattern, early warning and temporary migration. Most of the measures were taken on individual basis and were autonomous, whereas planned measures were limited to financial aid and early warning. In response to vulnerability associated with income, most of the measures were linked to increase in livelihood resources. It seems that media and NGOs attention is an important capacity measure for communities in Muzaffargarh. However, there were physical, financial and social/institutional limitations associated with some of the capacity measures. For example, pecca houses with improper construction techniques due to lack of knowledge and financial constraints; gaining loans and financial aid due to cast and relationship; occupational change with limited skills which is also indicated by Birkmann, (2011). Communities suggested several measures which could reduce dependence on existing capacity measure and hence reduce their future vulnerability. Recovery plan for 2014-flood suggested several measures (Chapter 4, Section 4.1.1.3), urgency of which was also felt by community but its non-compliance resulted in increase in vulnerability. Flood dyke is considered as a measure which can reduce dependence on most of other measures but it is difficult to implement because of financial limitations. This measure also entails several environmental constraints.

## 6.5 Linking vulnerability and implemented capacity measures

Linking of vulnerability and implemented capacity measures showed extent of community dependence on each measure to reduce vulnerability of respective element/factor (see Table 14). It is observed that most of the employed capacity measures were related to financial assets which in

turn reduced loss of livelihood sources. In this regard, additional earning members, financial aid, loans and personal saving were given vital importance. Dependence on financial aid from government was considered more important than loans due to presence of handsome amount without interest. At the same time, delay and transparency issues in aid distribution also increased dependence on savings and additional earning members for same elements. Furthermore, other capacity measures, early warning and temporary migration also dominated its utility for saving financial assets. These options were the only ones which could reduce susceptibility of vulnerable groups and loss of life. It implies that community only emphasized those measures which increased their financial capacity to recover and maintain their sources of income.

Table 14: Matrix showing linkages of vulnerable elements/factors with implemented capacity measures

Community elements/factors\Implemented coping and adaptation measures	Partial starvation	Additional earning member	Alternative/flood	Selling land and livestock	Flood resilient structures	Financial aid from government	Loans (relatives/land lords/banks)	Personal savings	Cash for Work/ Food for Work	Alternative/ change in occupation	Early warning	Temporary migration	Permanent migration
Loss of human life											X	X	
Children/women/elderly and disable											X	X	
Loss of standing crops		X	X			X	X	X		X	X		
Farmland loss due to erosion or degradation		X				X				X			X
Loss of house		X		X	X	X	X	X					X
Loss of personal belongings (cash, bed, clothing, cutlery, food)	X			X		X	X	X	X		X	X	
Loss of fertilizers/pesticides						X	X	X			X	X	
Loss of ploughing tools						X	X				X	X	
Loss of harvested crops for sale	X	X			X	X	X				X	X	
Loss of livestock and fodder		X				X					X	X	
Occupational loss	X	X		X		X	X	X	X	X			X
Increase in price of grocery items and seeds for alternative crops	X	X				X	X	X					

Source: Author's own from field survey, 2015

## 7 HOUSEHOLD SURVEY TO ASSESS VULNERABILITY AND CAPACITY

The participatory method for assessing vulnerability and capacity indicates changes in vulnerability level and priorities for capacity measures. Although, PRA provides in-depth information on different aspects of vulnerability at community level, but it is considered to be biased in certain aspects such as, flood victims follow local public representative or government officials as well as exclude the poor based on caste and income. Moreover, it does not give sufficient quantitative information on elements and factors of vulnerability and capacity. For example, children drop out of school, deaths and disabilities with respect to age structures, how much land and income losses occurred. Therefore, household survey was conducted in order to apprehend the vulnerability and capacity issues at household level (see Annexure G, Figure 51 and 52). In this chapter, analysis of two study districts is carried out in which some issues are examined for flood event of 2014. Cross tabulation, comparative graphs, and correlation analysis are done across human, natural, physical, financial and social assets.

### 7.1 Vulnerability, coping and adaptation in social and institutional context

#### 7.1.1 Human insecurity

The life losses, disability and injury due to flood was noted in both districts. The loss of life and injuries were slightly less in 2014 as compared to 2010. The household survey indicated that 9 persons from district Jhang and 5 from district Muzaffargarh lost their life. Figure 25 demonstrates that most of the flood victims, suffering disabilities/injuries and loss of life, were children under the age of 15 and women from 15 to 60 years of age as women are responsible to look after the children in normal and emergency situation (see Annexure G, Figure 53).

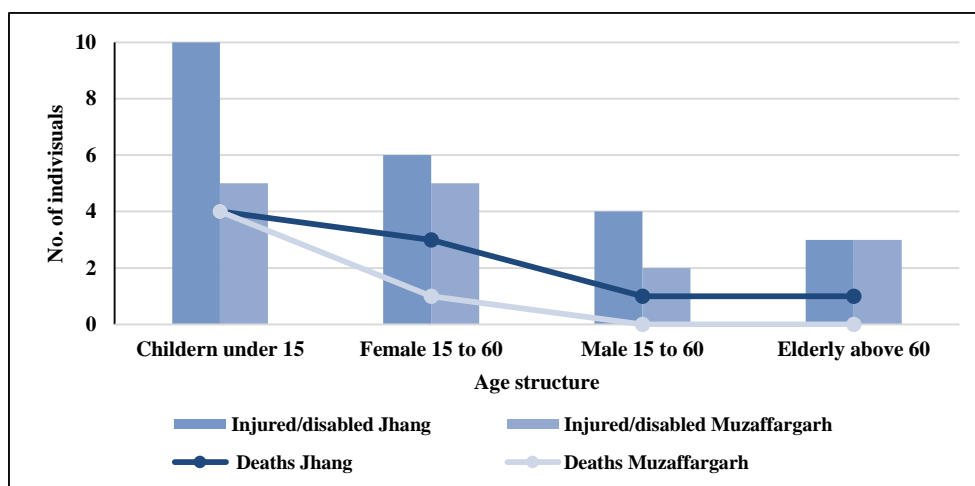


Figure 25: Deaths and disabilities/injuries in 2014-flood with respect to age structure in Jhang and Muzaffargarh

Source: Household survey, 2015.

Further, it was noticed that type of family influenced the deaths, disabilities/injuries (see Table 15) and children drop out of school in the households. Houses with joint family structure with large



family size having large number of children and female members (average 5.6 females in Jhang and 6.7 in Muzaffargarh per house) were more vulnerable to flood related life losses and injuries, which is also proven with correlation analysis (Annexure A, Table 27). In a flood event, it is difficult for head of households to look after every member, especially children, who often play in flood waters (Annexure G, Figure 54). Therefore, losses and injuries among children were greater in both study areas.

Table 15: Cross tabulation of family type, deaths and disabilities/injuries collectively for both study areas

Type of Family	No. of deaths	No. of individuals disabled and injured				Total
		1	2	3	None	
Joint 55.8%	1	5.0%	3.3%	0.0%	2.5%	10.8%
	None	12.5%	3.3%	0.8%	28.3%	45.0%
	Total	17.5%	6.7%	0.8%	30.8%	55.8%
Nucleus 44.2%	None	4.2%	0.0%	0.0%	40.0%	44.2%
	Total	4.2%	0.0%	0.0%	40.0%	44.2%

Source: Household survey, 2015.

### 7.1.1.1 Health issues

All the surveyed households were exposed to different diseases during and after the flood. The majority of population in Jhang and Muzaffargarh suffered skin problems (see Figure 26). Malaria and dengue fever was reported due to growth of mosquitos in stagnant water. Hepatitis and diarrhea spread due to lack of clean drinking water, especially in Muzaffargarh. It increase the vulnerability of households by putting additional financial burden for medicines.

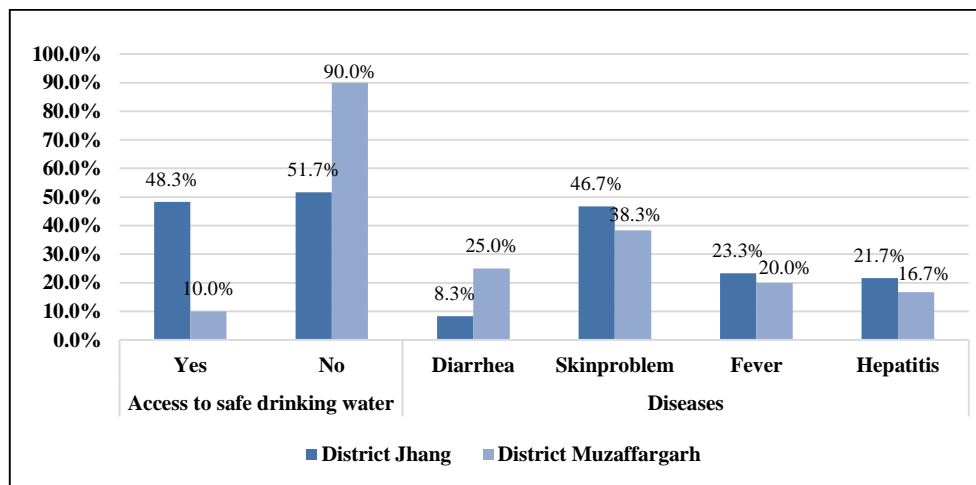


Figure 26: Diseases caused during and after the flood event of 2014 in district Jhang and Muzaffargarh

Source: Household survey, 2015.

### 7.1.2 Interruption in children education

The floods had a significant impact on children education. Collectively, in both districts, average number of children per house is almost 5.5, out of which 2.4 children in Jhang and 2.8 in Muzaffargarh were attending school before flood. These numbers were reduced to 1.9 and 2.2 respectively after the flood event of 2014. Overall, on average, 44% and 49% of children in Jhang and Muzaffargarh respectively were attending school before the flood, which reduced to 35% and 39% respectively after the flood. Major difference was seen in households where 3 to 4 children

went to school before the 2014-flood – such households were 32% and 30% in Jhang, and Muzaffargarh respectively before the 2014-flood, but reduced to 20% and 21% in respective districts after the flood (Figure 27).

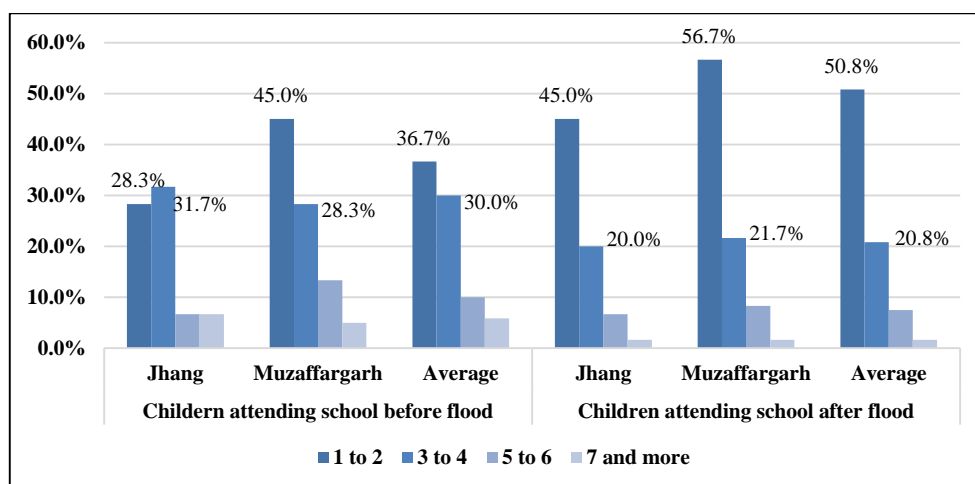


Figure 27: Comparison of children attending school before flood and after 2014-flood in study districts  
Source: Household survey, 2015.

Furthermore, houses where more than 3 children were attending school exhibited a greater ratio of school dropout after flood. Table 16 depicts that 30% of households where 3 to 4 children attending school before flood became 17.5% after 2014. Similarly, 6% of households, where 7 or more children attended school before flood reduced to 5 to 6 children after flood. It shows that before the flood event more children attended school as compared to post 2014-flood. It indicates that school dropout was mainly in larger households. Three reasons for this decline appear to be: firstly, many households sent their children to work to recover from the flood losses; secondly, flood victims who had limited resources to cope and adapt to flood were not able to afford school for their children, and, lastly, due to the loss and damage of the nearest school.

Table 16: Collective comparison of children going to school before and after flood for Jhang and Muzaffargarh

School going children before flood	School going children after flood					Total
	No one	1 to 2	3 to 4	5 to 6	7 and more	
No one	17.5%	-	-	-	-	17.5%
1 to 2	0.8%	35.8%	-	-	-	36.7%
3 to 4	0.8%	11.7%	17.5%	-	-	30.0%
5 to 6	-	2.5%	3.3%	4.2%	-	10.0%
7 and more	-	0.8%	-	3.3%	1.7%	5.8%
<b>Total</b>	19.2%	50.8%	20.8%	7.5%	1.7%	100.0%

Source: Household survey, 2015.

### 7.1.3 Social relationships

#### 7.1.3.1 Network with community members

All the surveyed households had good relationship with each other in the community. It is analyzed from Table 17 that 50% of households received help from their neighbors or relatives living within the settlement. Majority of help during flood was taken for shifting of household items, family members and harvested crops to safe places. In Muzaffargarh, loans were also taken

from wealthy members of community after the flood for buying of food indicating meager financial conditions of flood victims to buy food for long run. Majority of households did not possess enough financial resources to help others but their support in the form of evacuation reduced the vulnerability of physical and human assets.

Table 17: Comparison of community help for district Jhang and Muzaffargarh

District	Time of help	Form of community help			Total	
		No help	Loan for food	Loan for reconstruction		Evacuation
Jhang	During flood	-	-	-	35.0%	35.0%
	After flood	-	8.3%	1.7%	-	10.0%
	No help	55.0%	-	-	-	55.0%
	Total	55.0%	8.3%	1.7%	35.0%	100.0%
Muzaffargarh	During flood	-	-	-	26.7%	26.7%
	After flood	-	23.3%	-	-	23.3%
	No help	50.0%	-	-	-	50.0%
	Total	50.0%	23.3%	-	26.7%	100.0%

Source: Household survey, 2015.

### 7.1.3.2 Connectedness with government institutions

The connectedness with government institutions (municipality, DMAs, banks and other) and their officials increased the community capacity to cope and adapt (see Section 7.2.5). It is analyzed that 87% households in Jhang and 92% in Muzaffargarh were not connected with the government institutions.

## 7.1.4 Flood warning as adaptation measure

### 7.1.4.1 Time and source of warning

The survey showed that 100% of households received flood warning in 2014 but time and sources of warning differed. Figure 28 depicts that major source of flood warning was local villagers who disseminated the information of flood collected from different sources in community. In Jhang, maximum households received warning from local villagers. Electronic and print media played a key role in disseminating flood warning as 39% households in Jhang and 34% in Muzaffargarh received warning from this source. The role of local government in distributing such information among flood hazardous settlements was limited in Jhang, but in Muzaffargarh, 27% of households received warning from local government. Majority of people received warning one or two days before the flood mainly through media in Jhang, and two to three days prior to flood mainly by local government in Muzaffargarh.

The flood warnings varied with time and source. The late flood warnings in Jhang were due to lack of information dissemination from different sources to local government. The households did not possess the electronic channels (TV, radio) and received warning from electronic media available in corner shops. On the contrary, influence of media coverage and massive damages in 2010-flood disaster improved the performance of local government in Muzaffargarh. Moreover, since district Jhang is geographically located before Muzaffargarh, flood occurrence in Jhang alerted local government and media in Muzaffargarh due to which warning was therein disseminated comparatively earlier than Jhang.

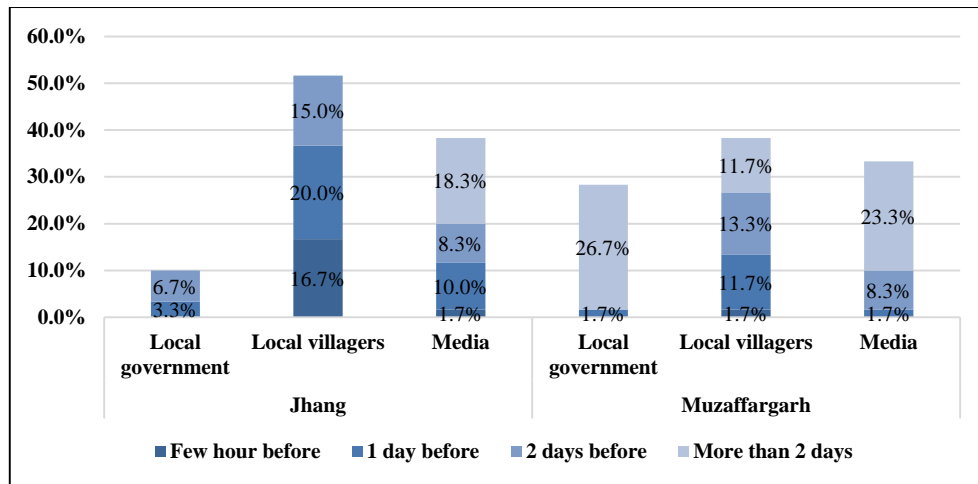


Figure 28: Comparison of source of flood warning versus time to receive the warning in Jhang and Muzaffargarh  
 Source: Household survey, 2015.

### 7.1.4.2 Response to flood warning

The response to flood warning varied among households. Figure 29 indicates that 37% households in Jhang and 44% in Muzaffargarh did not respond to flood warning due to late delivery, fear of looting, and shifting problems. Almost 7.5% of household did not move to safe places due to fear of theft of household items. Moreover, an average of 15% in both communities underlined the difficulties in shifting personal belongings from village to safe place which required hiring means of transport on high fares. Before and during flood, villagers who moved to safe place mainly chose temporary migration to flood dykes (26%) (see Annexure G, Figure 55) and houses of relatives in nearby villages while few selected relief camps (9.2%) and nearest highways for temporary stay.

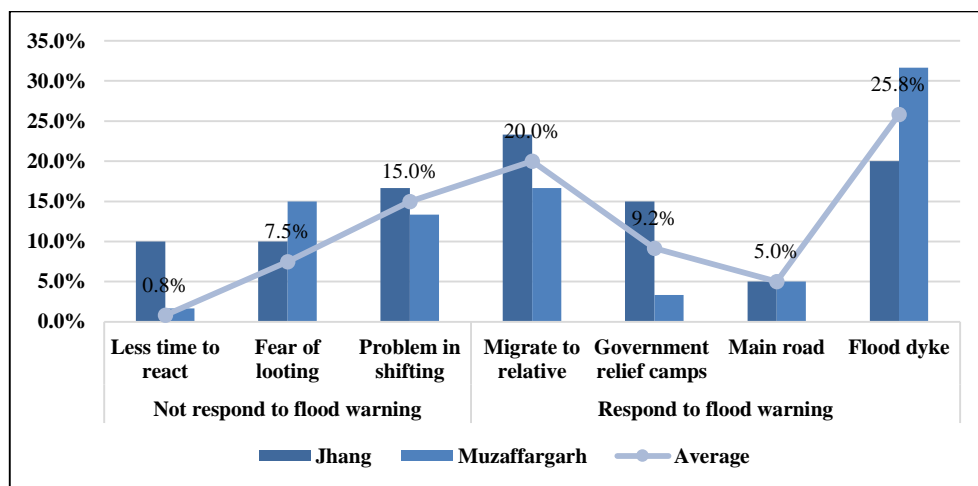


Figure 29: Response of households against flood warning in district Jhang and Muzaffargarh  
 Source: Household survey, 2015.

In short, vulnerability to life losses, disabilities and injuries was reduced as compared to 2010 due to households having adopted different coping measures to reduce their vulnerability. Social networks seemed important in the form of help from neighbors for evacuation and dissemination

of early warning. Sending children to work and response to early warning helped to reduce the vulnerability of human, social and physical assets. Delays in disseminating flood warning resulted in adoption of “staying home” (as coping measure) which does not seem to be affective as it caused loss of life, house and personal belongings, as well as temporary and permanent injuries (see Annexure G, Figure 56). It is observed the lack of institutional capacity to assess and disseminate timely flood warning increased the vulnerability of a majority of community. Coping measures of temporary migration to nearest flood dykes and houses of relatives were mainly considered by people. However, problems were reported in migrating to relatives where hosts were unable to arrange enough space and food and manage them with their belongings and livestock. It created chaos and unhealthy conditions in houses thus increasing social and financial vulnerability of host families.

## 7.2 Disruption of livelihood and associated coping and adaptation measures

### 7.2.1 Occupational susceptibility and shift

The flood disrupted the occupation of local people; farmers were especially the most vulnerable in this regard. Occupational changes were noticed after flood event of 2014 for those involved in farming as their main income source due to long term impact of on their farmlands and loss of standing crops for one season (usually 4-6 months). The results were almost similar for both districts where farming reduced to 31% from 50% (see Figure 30). Farmers started to work as wage laborers due to selling of land, its erosion and degradation.

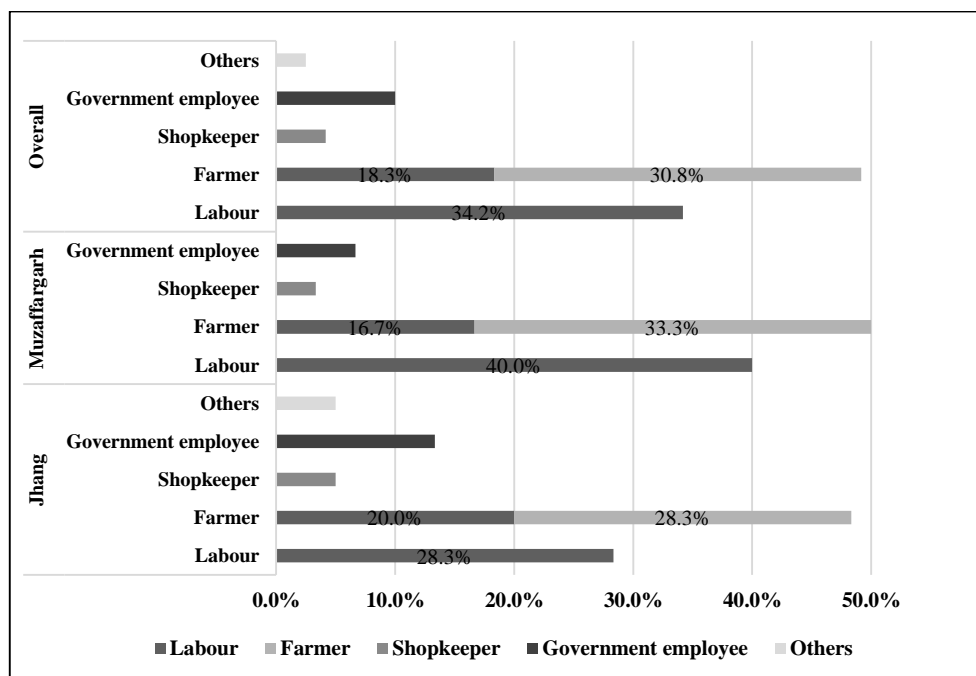


Figure 30: Comparative analysis of occupation before and after flood in Jhang and Muzaffargarh. Total length of bar show the occupation before flood and distribution within bars indicate occupation after flood  
Source: Household survey, 2015.

It is interesting to find that villagers involved in occupation other than farming also owned agriculture land indicating secondary occupation. Change in occupation especially from farming to

other indicates that farmers changed their primary occupation in order to adapt to flood hazards. Moreover, it is found that lack of other vocational skills forced people to choose wage labor as occupation as it does not require any technical training.

Flood victims, especially farmers, due to loss of income source (crops, farmland, shop and other), started to work as wage laborers in the locality and some worked for landlords. However, majority of jobs during flood were undertaken by wage laborers. Due to limited job opportunities in locality, 11.7% wage laborers and 6.7% farmers shifted temporarily to city during flood (Table 18). It is reported that majority of flood victims did not possess enough resources to shift to city along with their families. Additionally, very few people possessed additional technical skills (plumber, electrician) but deficient job opportunities hampered use of these skills. Furthermore, correlation analysis (Annexure A, Table 27) indicated that majority of flood victims stayed in the same occupation after flood wherein they were indulged during flood.

Table 18: Comparison of occupation before and during flood collectively for Jhang and Muzaffargarh district

Occupation before flood	Jobs during flood						Total
	Utilize vocational skills	Wage labor near village	Wage labor to city	Work for landlord	Doing nothing	Same as before	
Wage labor	1.7%	9.2%	11.7%	0.8%	10.8%	-	34.2%
Farmer	-	9.2%	6.7%	0.8%	31.7%	0.8%	49.2%
Shopkeeper	1.7%	-	-	-	2.5%	-	4.2%
Government employee	-	-	-	-	4.2%	5.8%	10.0%
Others	0.8%	-	-	-	1.7%	-	2.5%
<b>Total</b>	<b>4.2%</b>	<b>18.3%</b>	<b>18.3%</b>	<b>1.7%</b>	<b>50.8%</b>	<b>6.7%</b>	<b>100.0%</b>

Source: Household survey, 2015.

## 7.2.2 Agriculture land ownership

Ownership of agriculture land is vital for livelihood in rural areas of Punjab, and is an opportunity to cope and adapt to flood hazard. According to Figure 31, 72% of respondents in Jhang and 80% in Muzaffargarh owned some agriculture land. Those holding more than 3 acres of land before flood event suffered major land losses in both study districts which demonstrates that large land groups were severely affected by the flood. Overall in both study districts, 23% of households lost a part of their land but none became landless. Furthermore, 11% of households possessing land area of 7-9 acres before flood lost half of their land after flood. It is noticed that erosion did not seem to be the major reason (describe in Chapter 6) for reduction in the area but selling of land to cope with floods. Moreover, correlation analysis demonstrates that ownership of land was one of the major resources for coping with flood disaster in 2014. Therefore, flood victims with more land area, lost more land as compared to farmers having small land holdings. At the same time, selling land also made large land holders more vulnerable to future flood hazards. Flood victims with land area less than 1 acre refrained from selling their land and depended on other strategies instead.

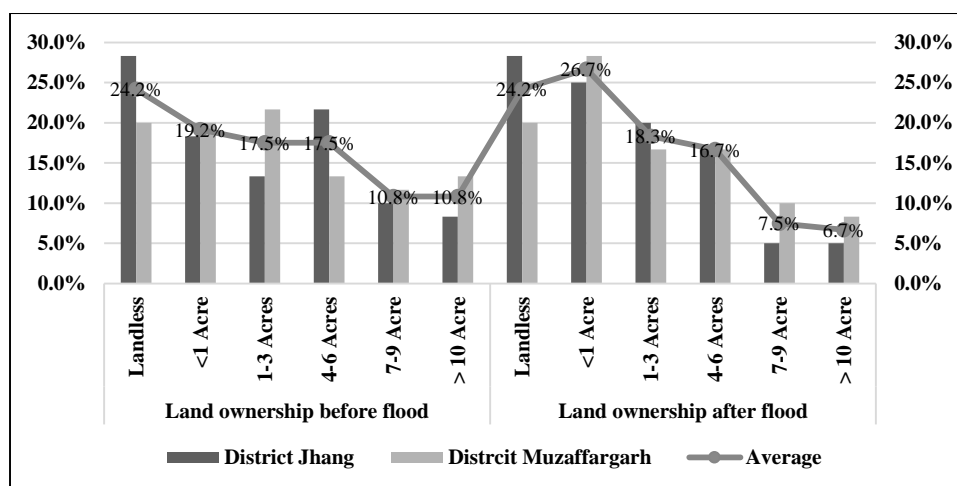


Figure 31: Agriculture land ownership before and after flood in Jhang and Muzaffargarh  
Source: Household survey, 2015.

### 7.2.3 Alteration in income level

The income level was impacted in negative as well as positive ways in both districts after the flood event of 2014. It is evident from Table 19 that 60% of households were negatively affected by flood in terms of income losses. The percentage of households earning more than PKR 20,000 per month before flood came down to 6.7% from 20%. The major reasons for loss in income were loss of crops and destruction of farmland in Jhang and Muzaffargarh.

Table 19: Comparative analysis of income level before and after flood collectively for Jhang and Muzaffargarh

Family income (in PKR)-Before flood	Family income (in PKR)-After flood					No income	Total
	<5000	5001-10000	10001-15000	15001-20000	>20000		
<5000	0.8%	4.2%	-	-	-	-	5.0%
5001-10000	16.7%	10.8%	8.3%	-	-	-	35.8%
10001-15000	-	12.5%	5.0%	0.8%	-	-	18.3%
15001-20000	0.8%	0.8%	11.7%	6.7%	0.8%	-	20.8%
>20000	-	-	6.7%	6.7%	5.8%	-	19.2%
No income	-	-	-	-	-	0.8%	0.8%
<b>Total</b>	<b>18.3%</b>	<b>28.3%</b>	<b>31.7%</b>	<b>14.2%</b>	<b>6.7%</b>	<b>0.8%</b>	<b>100.0%</b>

Source: Household survey, 2015.

Flood did not impact the family income of 26% percent of households. These households either possessed a permanent employment in government or private sector. On the contrary, 14% of households experienced an increase in income after the flood event of 2014. The increase is only observed among households involved in occupation of wage labor. It is examined that after the flood event of 2014, wage laborers found jobs more frequently due to reconstruction activities. Some earning members found jobs in reconstruction of main roads, dykes, bridges offered by private contractors working for the government. Therefore, occupational change from farming to wage labor was observed after flood event of 2014 (Figure 30). The finding suggests that flood disaster increased the vulnerability of majority of households by reducing their income but at the same time provided the opportunity to some households to cope and adapt to flood with increased family income.

## 7.2.4 Additional earning members

Increase in number of earning members was observed in both the study districts. Before 2014-flood, average number of earning members per household was 1.6 in Jhang and 1.8 in Muzaffargarh, which increased to 1.9 and 2.0 persons respectively after flood. Overall, in district Jhang 20% and in Muzaffargarh 13% increase was observed. Households depending on one earning member before flood reduced significantly after flood as same households had two or more earning members after flood. Therefore, after 2014-flood, households with 3 and 4 earning members increased (Figure 32). The additional earning members as an adaptation measure was adopted by 23% of households collectively in both districts. The measure played a minor role in stabilizing the income source of households during and after flood. Moreover, increase in earning members was found to have a direct relation with number of literates in a household (Annexure A, Table 27) which shows that additional earning members were mostly school going children of under 15 years of age which, as a result, hampered their education.

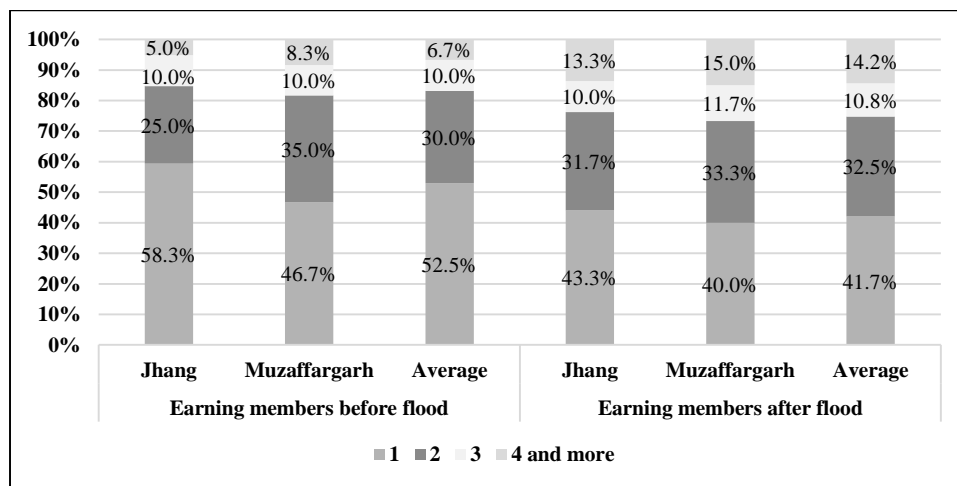


Figure 32: Comparison of earning members before and after 2014-flood for district Jhang and Muzaffargarh.  
Source: Household survey, 2015.

## 7.2.5 Financial aid from government as coping measure

Procedure and criteria of financial aid distribution is briefed in Chapter 4. The financial aid was provided on the basis of standing crop losses and house damage. Consequently, many households relied on financial aid to recover their income source. Despite of similar flood intensity, magnitude, losses and damages in both study districts, a big difference was observed in cash grant received in Muzaffargarh and Jhang districts (Table 20). It is due to the fact that focus of administration and media was always on Muzaffargarh during flood, and hence more cash grants were distributed therein to show government performance. Additionally, it was found that few local villagers (in government job) were connected with officials of other departments which helped in getting financial grants more quickly by by-passing the system (Figure 33). The study also revealed that the surveyors collecting loss and damage data for compensations made deal with villagers, less affected by flood, to share their financial aid. Some marginalized and deserving people were neglected in the survey due to caste and rivalry issues.



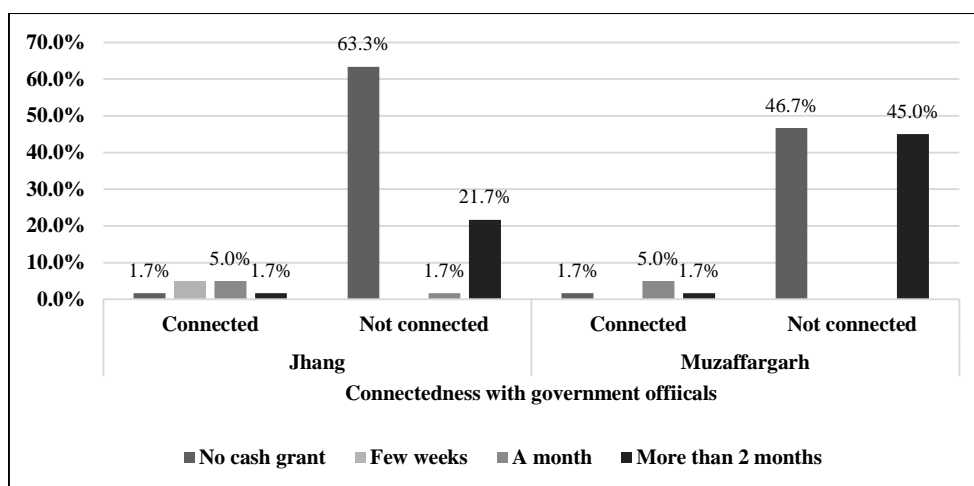


Figure 33: Influence of connectedness with government officials on time of getting financial cash grant.  
Source: Household survey, 2015.

### 7.2.5.1 Household resources vs financial aid

In response to 2010 flood, communities had started to build resources in the form of cash savings, employment and livestock. After flood disaster of 2014, 50% of household did not possess enough resources to revive their livelihood activities, and most of them were those households having family income less than PKR 10,000 (see Table 20). It also indicates that government cash grants were distributed without considering the resource base of different households in adapting to flood. 43% of households received cash grant from the government out of which 18% of flood victims had enough resources and high level of income to cope and adapt which suggests transparency problems in distribution of cash grants.

Table 20: Overall comparative analysis of financial aid from government, available resources to cope and adapt and income level before/during flood

Government financial aid	Form of resources	Family income before flood					No income	Total
		<5000	5001-10000	10001-15000	15001-20000	>20000		
Received 43.3%	No resources	3.3%	11.7%	3.3%	2.5%	1.7%	-	22.5%
	Savings	-	3.3%	2.5%	3.3%	5.0%	-	14.2%
	Employment	-	0.8%	-	3.3%	1.7%	-	5.8%
	Other	-	-	0.8%	-	-	-	0.8%
	<b>Total</b>	3.3%	15.8%	6.7%	9.2%	8.3%	-	43.3%
Not received 56.7%	No resources	1.7%	17.5%	7.5%	2.5%	1.7%	0.8	31.7%
	Savings	-	1.7%	3.3%	6.7%	9.2%	-	20.8%
	Employment	-	0.8%	0.8%	1.7%	-	-	3.3%
	Other	-	-	-	0.8%	-	-	0.8%
	<b>Total</b>	1.7%	20.0%	11.7%	11.7%	10.8%	0.8%	56.7%

Source: Household survey, 2015.

It is found that flood disaster significantly increased vulnerability of community livelihood by destroying their income sources especially for farmers. At the same time, coping and adaptation responses were observed including selling agriculture land, changing primary and secondary occupation, increase earning members, savings, and reliance on cash grants. It is evident that households with sufficient resources and connectedness with the government cope and adapt to flood more easily and quickly. These responses had positive as well as negative impacts on flood

victims. Selling land and involving children in employment activities helped in coping with post flood situation in the short-run but increased household vulnerability in the long run. In short, several measures were adopted by the households for livelihood restoration which indicates their capacity to cope and adapt, but the same also instigated additional vulnerabilities.

### 7.3 Vulnerability, coping and adaptation to physical assets

The flood events severely damaged houses of local community and physical infrastructure of small rural settlements. The flood victims made adjustments during reconstruction of their houses to make them more resilient to future floods.

#### 7.3.1 Housing

##### 7.3.1.1 Loss and damage to houses

The settlements surveyed in study districts are located in flood plains. Hence, 100% of houses were affected by the flood but the extent of damage was different. It is observed that house type (mud, semi pecca or pecca) did not influence the extent of damage. In flood plains, all types of houses were vulnerable. Majority of houses were constructed from mud in both study districts which were fully destroyed. In Muzaffargarh, extent of damage to houses stayed within the limit of 75% to 100%. After the 2010 flood, people constructed pecca houses with a perception that flood will not affect their houses but 2014-flood event played havoc with this physical asset.

##### 7.3.1.2 Adjustments in house reconstruction

The analysis of type of houses before 2014 and those constructed after 2014 flood disaster was carried out. It was found that before flood, 67% of households in Jhang and 75% in Muzaffargarh had mud houses (see Table 21). After the 2014 flood disaster, villagers tried to reconstruct houses which could withstand future flood disaster. After flood, the mud houses reduced to 42% in Jhang and 43% in Muzaffargarh, and pecca houses increased to 20% and 30% from 15% and 22% in both districts respectively. Some households constructed mud houses that previously were pecca or semi-pecca houses. The reasons for this are found to be: pecca houses could not withstand high floods in floodplains; they were expensive to reconstruct, also, flood washed away the expensive building; mud houses were easy to reconstruct, and construction material was extremely cheap and locally available; and, as a means to qualify for government cash grant.

Table 21: Comparison of house constructed before flood and after flood in district Jhang and Muzaffargarh

District	Type house before flood	Type of house after flood				Total
		Mud house	Semi pecca	Pecca	Homeless	
Jhang	Mud houses	38.3%	3.3%	5.0%	20.0%	66.7%
	Semi pecca	3.3%	8.3%	3.3%	3.3%	18.3%
	Pecca	-	-	11.7%	3.3%	15.0%
	Total	41.7%	11.7%	20.0%	26.7%	100.0%
Muzaffargarh	Mud houses	38.3%	11.7%	13.3%	11.7%	75.0%
	Semi pecca	1.7%	1.7%	-	-	3.3%
	Pecca	3.3%	-	16.7%	1.7%	21.7%
	Total	43.3%	13.3%	30.0%	13.3%	100.0%

Source: Household survey, 2015.

Flood victims utilized several resources for their house reconstruction. Figure 34 shows that five different sources were used for construction of houses. Government cash grant and bank loans were major resource in Muzaffargarh due to massive distribution of government aid whereas saving and loan from land lords were given importance in Jhang. Households had increased their capacity to reconstruct after the flood by saving some money throughout the year. On the contrary, taking bank loans to reconstruct houses, albeit a coping measure, increased households' financial vulnerability when it came to reimburse the loans with high interest. On the other hand, maximum resources were utilized for construction of mud houses due to their cheap construction and being within available amount of saving, financial aid from government, and loans.

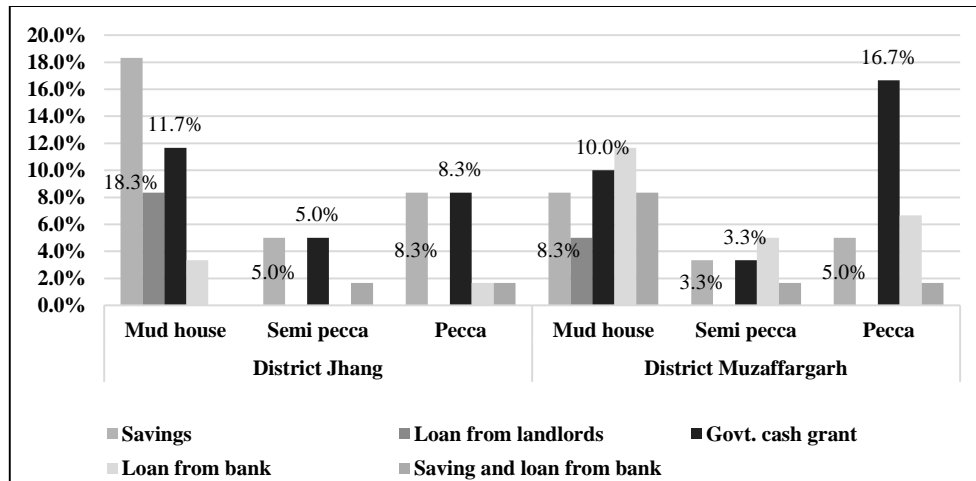


Figure 34: House reconstruction source of households in district Jhang and Muzaffargarh.  
Source: Household survey, 2015.

During reconstruction, different types of resilient measures were adopted by community within their financial capacity which are analyzed as per occupation of households (Figure 35). Majority of mud houses were constructed by laborers and farmers without any resilient measure, reasons for which are discussed earlier. Almost 14% of households increased the height of platform and 5% increased the depth of foundation and used bitumen on walls. These measures were mainly implemented in Muzaffargarh district due to continuous learning with each flood event, media influence and NGO attention. Farmers and government employees with sufficient financial resources constructed pecca, some of them (approximately 24% in both districts) still held a perception that such construction would withstand future floods without adopting other resilient measures. However, resilient measures were not affordable for different occupational groups even in the construction of pecca houses, despite cash grants, savings and loans which were limited for implementation of such measures. Furthermore, flood made 20% of households homeless in study districts, who are living in tents due to deficient resources for reconstruction.

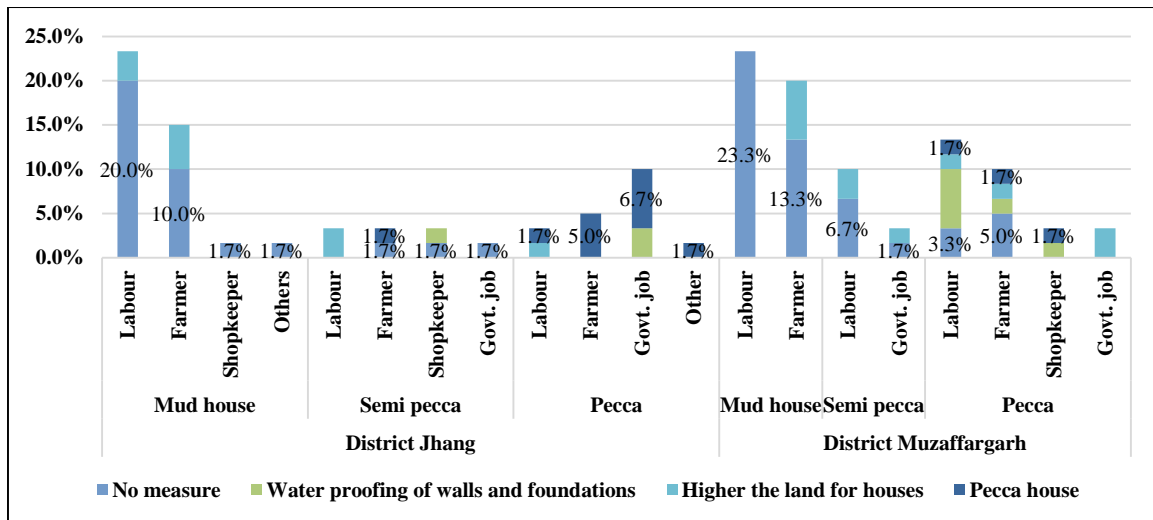


Figure 35: Resilient measures incorporated in different type of houses by flood victims in various occupation.  
Source: Author's own, 2015.

### 7.3.2 Village infrastructure

The community physical infrastructure such as village roads, drainage system, and some electricity poles was not restored after 2010 and 2014 flood disasters. According to household survey, major reasons were ignorance and corruption in the funds allocated for recovery of rural areas by local politician with the involvement of government officials. Ignorance in the perspective that most of the development programs were focused on urban areas. The lack of restoration of infrastructure facilities increased vulnerability of people by causing health problems and hampering shifting of belongings before flood (see Chapter 6, Section 6.3.2).

The destruction of houses in the flood plain of districts Jhang and Muzaffargarh was irrespective of type of houses. It is due to the fact that construction techniques were inappropriate on one hand, and, on the other hand, communities did not have enough financial resources to hire technical manpower to reconstruct proper houses. Still, few households incorporated flood resilient measures in reconstruction within available resources. These measures are incorporated by only those with large farmlands and high family income. Nevertheless, lack of knowledge and wrong perception especially in Jhang is hurdle in building capacity for this physical asset. Similarly, usefulness of some resources (loans) is questionable. Loans together with deficient restoration of village infrastructure are found to have increased community vulnerability against floods.

## 8 TRIANGULATION OF QUALITATIVE AND QUANTITATIVE ANALYSIS

Triangulation combines different methods to see the strengths and weaknesses, and, similarities and differences (Golafshani, 2003). In this chapter, triangulation is done in order to analyze the resemblances and differences in results of PRA and household survey conducted to assess vulnerability and capacity of flood affected communities. Furthermore, recovery process from 2010 to 2014 flood event has been elaborated for both study districts indicating vulnerability and resilience to several aspects.

### 8.1 Similarities and differences in PRA and household survey

Several similarities and differences were observed after analyzing only those aspects studied in both methods. The similarities were observed mainly in elements susceptible to flood and factors that contribute to vulnerability (Table 22). On the contrary, majority of differences were noticed in the exploitation of capacity measures to reduce flood vulnerability (Table 23). The interpretation of results has already been discussed in Chapter 6 and 7, but the differences in the results of PRA and household survey were not debated in those chapters.

Table 22: Similarities in the results of PRA and household survey

Criteria	PRA	Household survey
<b>Human and social assets</b>	<ul style="list-style-type: none"> <li>Higher life losses, disabilities and injuries in Jhang, and lesser in Muzaffargarh.</li> <li>Damages to schools in the vicinity hampered children education.</li> <li>Lack of access to &amp; trust on public institutions enhanced vulnerability.</li> <li>Additional earning members (sending children to work) seemed less important as an adaptation response.</li> <li>Relationship within community seemed to be less important in increasing vulnerability.</li> </ul>	<ul style="list-style-type: none"> <li>Life losses, permanent and temporary injuries were more in Jhang in 2014 as compared to Muzaffargarh.</li> <li>Damage of educational facilities disturbed education of children.</li> <li>Deficient connectedness with government institutions and officials had significant negative influence on building capacity to cope and adapt.</li> <li>Number of earning members increased but appeared not that important.</li> <li>Social relationship appeared to be insignificant in increasing vulnerability in Jhang and Muzaffargarh in 2014.</li> </ul>
<b>Physical assets</b>	<ul style="list-style-type: none"> <li>Lack of village infrastructure contributed to extreme vulnerability in both districts in form of health and mobility issues.</li> <li>Structures were ranked as extremely high vulnerable to floods in both districts.</li> </ul>	<ul style="list-style-type: none"> <li>Lack of village roads caused evacuation problems and lack of drainage system increased community susceptibility.</li> <li>All the houses in residential cluster were exposed and affected by flood.</li> </ul>
<b>Financial and natural assets</b>	<ul style="list-style-type: none"> <li>Occupational loss was massive in Jhang and Muzaffargarh making local villagers more vulnerable to future floods.</li> </ul>	<ul style="list-style-type: none"> <li>Almost 90% households experienced occupation loss which significantly increased vulnerability to cope and adapt.</li> </ul>

Source: Author's own, 2015.

In regard to the differences in the PRA and household survey, there are few factors which could have impacted the results. Firstly, there are chances that attendees of PRA session were rural elites possessing adequate resources to respond to floods whereas rural poor were excluded due to caste and income issues (which is one of the major social problem in rural areas in Pakistan). Therefore, health issues were less important in PRA where attendees might have sufficient financial sources

to access health facilities, or adequate personal savings to reconstruct resilient structures. Secondly, the presence of public representatives, government officials and affected rural elites might have altered the response of other attendees, for example, responses concerning receiving financial aid. Thirdly, household survey was conducted randomly where both destitute and resourceful flood victims were questioned which indicated some additional causes of vulnerability and measures to adapt, hence the results differs from PRA.

Table 23: Differences in the results of PRA and household survey

Criteria	PRA	Household survey
<b>Human and social assets</b>	<ul style="list-style-type: none"> <li>Age structure and lack of awareness caused life losses, injuries and disabilities</li> <li>Health issues due to water contamination and other reasons for Jhang and Muzaffargarh seemed to be less important.</li> <li>Early warning appeared extremely important and adopted by 100% of community in 2014.</li> </ul>	<ul style="list-style-type: none"> <li>Family size also influenced the life losses and injuries in addition to age structure.</li> <li>During and post flood, health problems were reported by 100% of households surveyed due to decline in water quality.</li> <li>Early warning seemed not important and ignored by several households.</li> </ul>
<b>Physical assets</b>	<ul style="list-style-type: none"> <li>Flood resilient structure was highly considered as adaptation measure in Jhang and Muzaffargarh after 2014.</li> </ul>	<ul style="list-style-type: none"> <li>Different resilient measures did not seem to be important due to several limitations</li> </ul>
<b>Financial and natural assets</b>	<ul style="list-style-type: none"> <li>Dependence of financial aid as coping measure to disrupted income sources was considered high important in 2014 (80% attendees received aid).</li> <li>Utilizing personal saving as coping measure in 2010 was less and extremely high in 2014</li> <li>Loss/destruction of agriculture land due to erosion and degradation was considered extremely high vulnerable.</li> <li>Reduction in income (100% attendees) due to loss of crops, shops and livestock was contributing to extreme vulnerability.</li> <li>Occupational change was high in Muzaffargarh and moderate in Jhang.</li> </ul>	<ul style="list-style-type: none"> <li>Government cash grant as coping measure was moderate where average of 50% received cash grant.</li> <li>Personal saving seemed to be less important even in 2014.</li> <li>Loss of farmland was mainly due to selling a part of it to recover the livelihood losses.</li> <li>Alteration in family income of only 60% households and appeared not extremely affected by flood.</li> <li>The shift in primary occupation seemed moderate in both study districts.</li> </ul>

Source: Household survey, 2015.

The similarities and differences in both methods produced different results and provided additional information which was missing in either PRA or in household survey. The level of vulnerability or urgency of a capacity measure was different in both methods. Therefore, changes in severity of vulnerability and urgency for capacity measures could not be significantly examined. Despite this, both methods concluded that flood affected communities in Jhang and, explicitly Muzaffargarh, have developed capacities on their own to cope and adapt to flood hazards and reduce vulnerability, particularly, in elements and factors associated with their financial assets (see Section 8.2). However, there are long term and short term negative impacts of few coping and adaptation measures. Consequences of these capacity measures are examined through the results of PRA, household survey and analysis of formal and informal changes (Table 24). In this regard, combination of capacity measures are needed (Birkmann, 2011) which can increase overall resilience of society. For example, change in occupation require skill development programs and creating off-farm job opportunities in aftermath of flood.

Table 24: Direct and indirect consequences of coping and adaption measures on people and institutions

Coping/adaptation measures	Consequences
Partial starvation	Increased health issues Increased vulnerability of women, children and elderly
Additional earning members	Disruption of children education. Psychological effect on children.
Selling land and animals	Short term adaptation but long term impact due to loss of permanent source of income.
Loans from banks and landlords	Difficulty in reimbursement of loan on high interest due to insufficient earning.
Change in occupation	Difficulty in finding job due to lack of skills Increased spending on long commuting due to deficient jobs in the vicinity
Media influence	Pressurize the government which sometimes created problems in prioritizing actions.
NGOs attention	Attention of NGOs in one specific area increased vulnerability of other areas.

Source: Author's own, 2015.

## 8.2 Recovery process in study districts

An abstract representation of recovery process is carried out based on the results of all the assessments. Recovery process considers different flood events and measures utilized to recover from the impacts of flood. Two thresholds are drawn one is in blue colour indicating the provision of basic physical and social infrastructure which is needed for normal life standard that build peoples' capacity to cope and adapt to flood disasters. Second threshold indicates the level of development (physical and social infrastructure) prevailing before 2010 flood disaster. The recovery process is diagrammed separately for Jhang and Muzaffargarh.

### 8.2.1 Recovery process: District Jhang

In Jhang, the flood event of 2010 caused massive damage to community assets and development was reduced to minimum. Communities tried to cope to flood impacts using various capacity measures. With the passage of time, flood victims reconstructed houses and restored livelihood better than before but at a slow pace due to deficient resources and financial constraints, and limited attention of local government, media and NGOs. It also hampered reaching the previous development level and thus created a gap (see Figure 36). The floods of low magnitude in 2012 and 2013 increased vulnerability, but at the same time, provided leaning experience in the form of utilizing alternative crops and developing habits of saving. In response to the flood event of 2014, ignorance of flood warning due to expectation of flood of low magnitude resulted in massive damages. Nevertheless, learning from the past resulted in quicker recovery than before due to utilization of different coping and adaptation measures. The occurrence of 2015-flood in the month of May (not a usual flooding season), reduced community capacity due to lack of early warning and destroyed their crops.

### 8.2.2 Recovery process: District Muzaffargarh

The recovery process in Muzaffargarh is significantly influenced by NGOs, media and government attention. The massive loss and damages in 2010 attracted media and NGO attention which indirectly influenced the performance of the government in 2010 resulting in quick recovery which was closer to the development already in place before the flood. This factor together with flood events of 2012 and 2013 provided flood victims with leaning and awareness which resultantly

reduced losses and damages in 2014. Several measures were taken by the flood victims, but some had negative consequences in the long term due to which the shape of the curve is not as sharp as in 2010 (Figure 37). Moreover, the work of some NGOs was limited to 2010-flood event (Chapter 4, Section 4.1.2.2), but existing NGOs focused on Muzaffargarh despite the fact that flood damages and losses were similar in both study districts. It is due to the fact that working priorities of NGOs are shaped by news in electronic and print media which is also limited to Muzaffargarh.

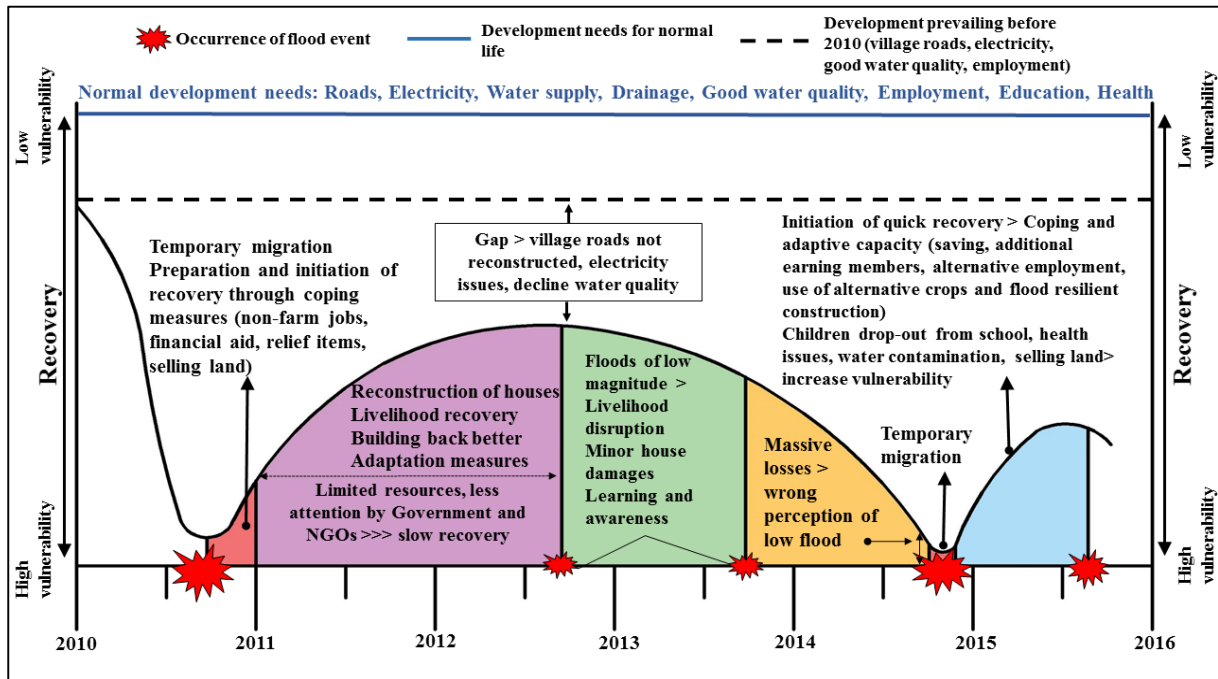


Figure 36: Recovery process of district Jhang against different flood events  
Source: Author's own, 2015 based on Birkmann, 2008.

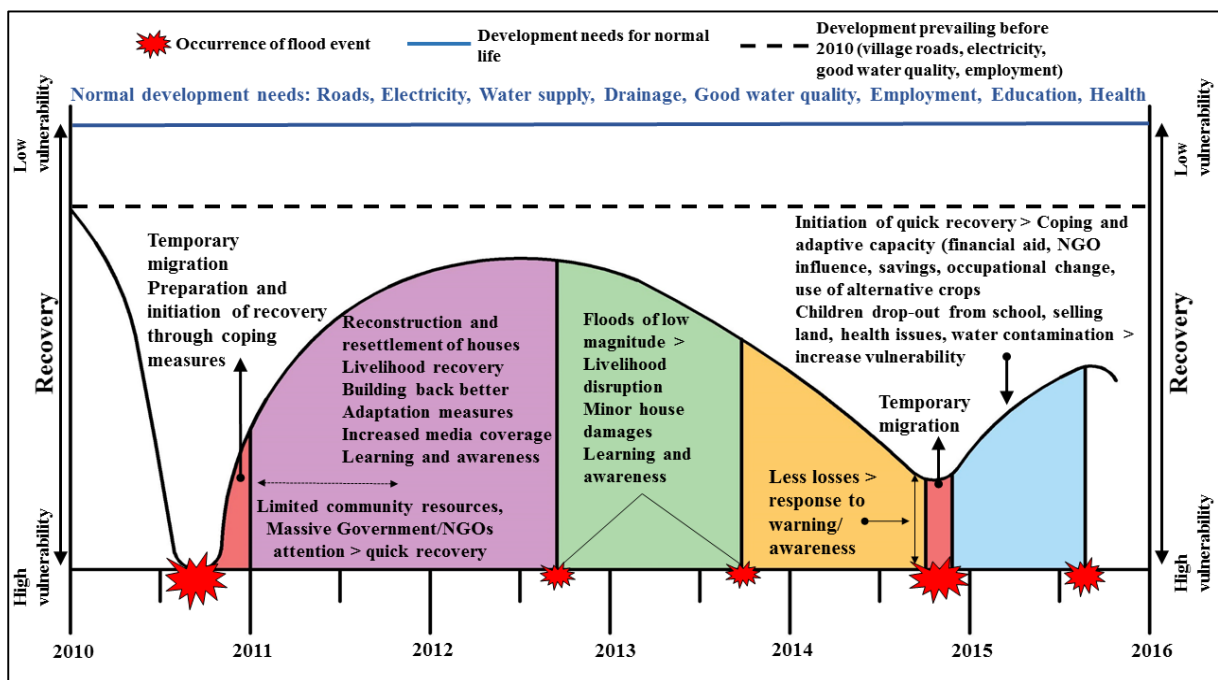


Figure 37: Recovery process of district Muzaffargarh against different flood events  
Source: Author's own, 2015 based on Birkmann, 2008.



## 9 CONCLUSIONS AND RECOMMENDATIONS

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### 9.1 Conclusions

The frequency of flood disaster has increased in the last six years especially in the province of Punjab. This grim situation seems to be the impact of climate change aggravated by human induced factors. It has inflicted massive damages to human life, community assets and economy. Review of literature indicated that vulnerability assessment in Punjab was limited to district level, and assessment of vulnerability of community assets as well as measures embraced by communities at grass root level was absent. This research has examined the planned and unplanned changes (by analyzing community assets) after 2010 flood event and their influence on vulnerability and capacity of flood affected communities using PRA, household survey, and interviews.

Regarding government intervention, interviews with PDMA and spatial planning department officials disclosed many planned changes after 2010-flood disaster. Legislation, policies, plans, vulnerability assessment framework, financial aid mechanism were important government interventions. These formal changes seem to be less effective due to top-down approach. Lack of technical man power; disaster management knowledge; inadequate technology for performing disaster management functions; proper training; and financial constraints hampered the implementation of several plans and projects. Hence, government interventions in increasing community capacity were limited to financial aid and early warning. These measures also remained the victim of political biasness, mismanagement, lack of coordination and communication between departments. Moreover, spatial planning legislation promoted the preparation of plans and regulations for flood zones. Nevertheless, existing land use zoning and building regulations seemed ineffective to mitigate flood risk as these codes were limited to urban areas and inappropriate for rural areas.

PRA results highlighted that vulnerability of elements and factors have changed with each flood event as well as urgencies to cope and adapt. The vulnerability of immovable assets (infrastructure, houses, water quality etc.) has increased or remained constant, but reduced significantly for moveable assets (personal belongings, harvested crops, ploughing tools etc.). The syndrome concept (see Figure 17) indicated existence of complex relationships within and between various vulnerability dimensions that fluctuate vulnerability of related elements and factors. (e-g, for certain assets, lack of physical infrastructure reduce capacity to cope and adapt and, at the same time, awareness increases it for the same assets). In the context of capacity measures, financial aid seemed important in Muzaffargarh and early warning was important in both districts. Community has embraced coping and adaptation measures autonomously within their capacities (resilient houses and alternative crops) but lack of local knowledge and training have failed these capacity measures undertaken by flood victims.

According to household survey, loss of human life and disabilities (usually happened to children and females); loss/damage of house and household items and harvested crops are associated with dissemination time of early warning, knowledge, awareness & training and strength of relationship with neighbors. The survey unveiled that flood warning was communicated few days ahead and

did not seem important to people to react in the stipulated time which in turn reduced their capacity to cope. After the floods, households mainly sought financial resources to reconstruct houses and restore their livelihood. In this respect, financial aid, loans, selling land, occupational shift and addition of earning members were means to cope and adapt to flood impacts. Nevertheless, transparency issues in dissemination of financial aid underlined the importance of personal saving for flood victims. Moreover, 2010 and 2014 floods did not only had negative impacts, but also offered opportunity to increase family income by providing more frequent job opportunities in reconstruction phase.

The comparison of both the methods indicated many similarities and differences. Similarities were mainly observed in vulnerability assessment whereas results of capacity measures differed significantly. Despite differences, the results show that coping and adaptive capacities have been developed at community and individual level which demonstrate unplanned changes. The research highlighted that people with high income and sufficient resources (farmland and livestock) had more capacities to cope and adapt. Most of coping and adaptation measures were undertaken to revive livelihood. However, few coping and adaptation measures had negative outcomes (e.g., loans put flood victims further into debt, additional earning member resulted in promotion of child labor, inappropriate construction techniques made structures vulnerable, increased health issues due to partial starvation etc.) and hence added to the existing vulnerability. It also indicates that provision of physical infrastructure and local knowledge and awareness might be vital in increasing their capacities to cope and adapt (Chapter 6). Still, there are several social, physical, financial and institutional limitations associated with coping and adaptation which need to be addressed in plans and strategies in dealing with flood hazards.

Triangulation of qualitative and quantitative analysis indicated that households in district Muzaffargarh, albeit experiencing massive damage, had more capacity to cope and adapt to floods. It is noted that, informal changes like media mobilization and attention/networking of NGOs were the main drivers in evolving community capacities to deal with floods, reducing several losses in the aftermath of 2014-flood. It provided significant awareness and learning together with improving performance of the government. Therefore, district Muzaffargarh was much better in recovery process and demonstrated better coping and adaptive capacity than Jhang (see Figure 37). It suggests that more the losses and damages in one district in one event, more capacity it can gain to fight flood in future flood event. However, focusing attention on one area by NGOs, media and government and neglecting other less affected areas increases the vulnerability of the latter for future floods as happened in Jhang.

Owing to the limitations (related to data availability, time, finance and local weather conditions), this study could not address few research questions properly. The results of the research could not significantly address the changes (primarily because of differences in the result of PRA and household survey) in severity of vulnerability of community assets and urgencies of measures as changes might be due to the flood characteristics as well as the capacity of people to cope and adapt. However, this research study contributed to identification of vulnerability of community assets and factors contributing towards it, and measures to cope and adapt. It gives an idea of what is important for community to increase their capacity and what loopholes exist in government

systems that escalate community vulnerability. Thus, findings of this study, to some extent, may help government in reviewing its working and prioritizing their actions as per needs of flood victims.

## 9.2 Recommendations

The vulnerability reduction of community assets requires the understanding of complex relationship between different dimensions of vulnerability. In addition to this, increasing community resilience in recovery process requires the additional capacity measures to reduce the negative consequence of implemented measure (Birkmann, 2011). In this regard, there is an urgent need for horizontal coordination and communication between government line departments, private organizations and communities to link formal and informal responses in order to reduce future flood vulnerabilities. For example: the network of NGOs and its working should be controlled by PDMAs so that NGOs can be evenly distributed in all the flood affected areas. Change in occupation should be linked with government's vocational training programs to develop skills in severely affected flood victims.

PDMAs should coordinate with local spatial planning institutes to ensure incorporation of DRR in development. The involvement of flood victims in plan making is vital. Moreover, in-depth study of local coping and adaptation strategies and their potentials and weaknesses needs to be urgently addressed and incorporated in disaster management and spatial plans of the areas. Political will, transparency, monitoring and evaluation in this regard will be imperative in implementation of these plans, programs and projects to reduce the future vulnerability.

The research in field of vulnerability and capacity assessment is limited in Punjab. There are several topics which needs to be addressed. This study can be further extended by analyzing the impact of "proximity of urban centers" on the vulnerability and capacity of flood affected communities. During the field survey, it is noticed that communities away from urban centers are characterized with different level of vulnerability compared to those living close to urban centers. Secondly, role of media and NGOs in developing capacities of communities and influencing the government performance would be an interesting topic to discover. Jhang and other districts massively affected in 2014 flood could be taken as a case study to verify whether or not media and NGOs actually influence the vulnerability, capacity and government performance. Furthermore, in-depth investigation of short term and long term consequences of coping and adaptation measures would be another addition to the literature which has not been explored in the context of flood hazards in Pakistan.

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# ANNEXURES

## Annexure A

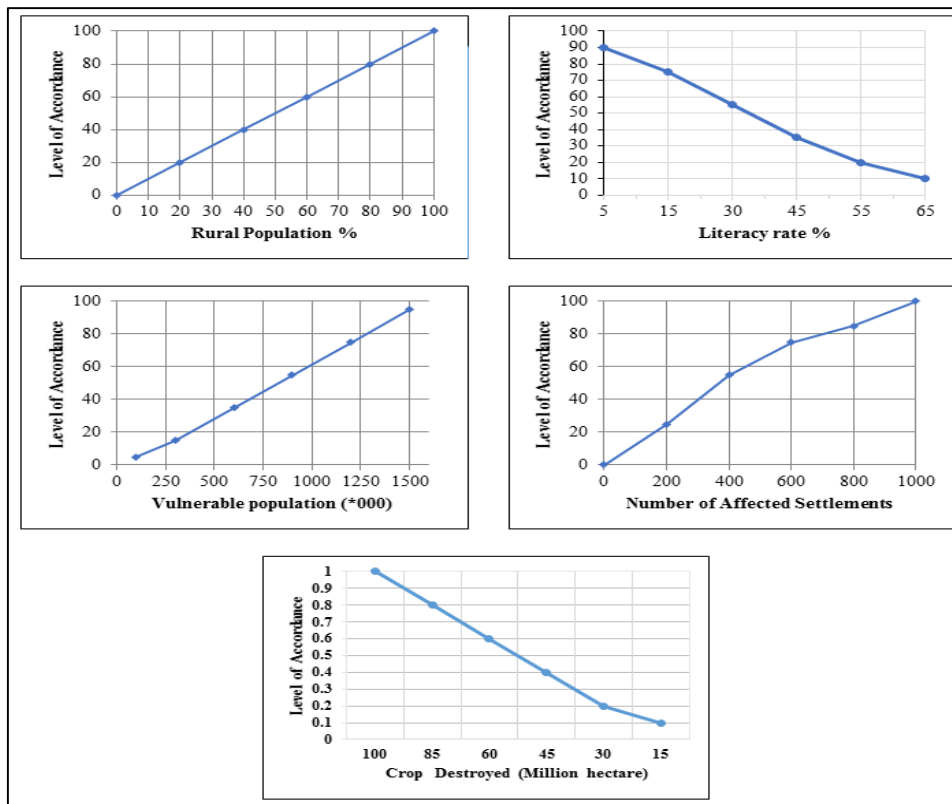


Figure 38: Graphs for level of accordance to determine PUV  
Source: Author's own, 2015.

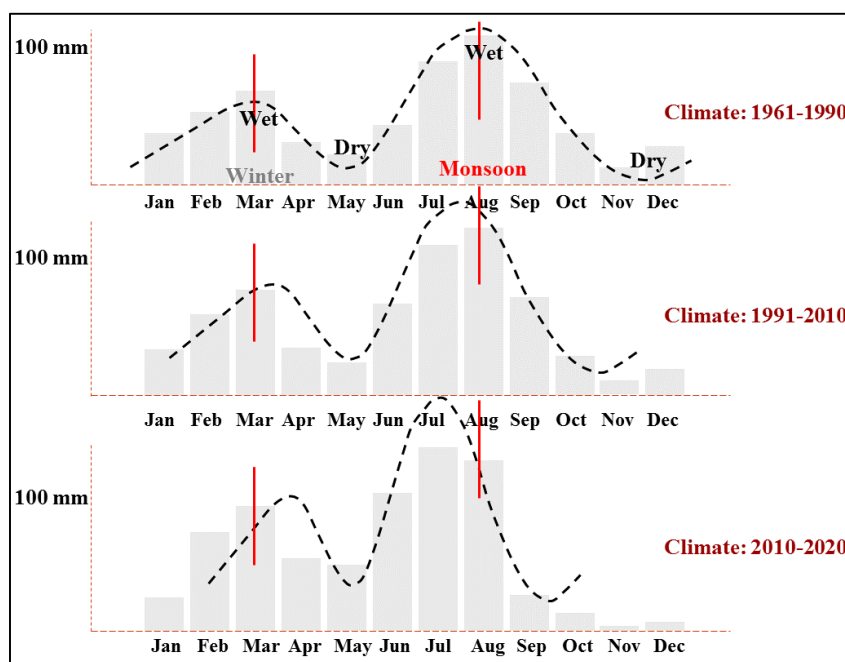


Figure 39: Changing monsoon pattern and increased precipitation  
Source: Hanif, 2011.

Table 25: Detailed description of settlements surveyed in district Jhang

Criteria/ Characteristic of settlements	Bela Jhabana	Goniyana
<b>Location</b>	Latitude: 31°17' North Longitude: 72°17' East Union council: Pukkewala Water body: River Chenab in west	Latitude: 31°28' North Longitude: 72° 8' East Union council: Phabarwala Water body: River Jehlum in west
<b>Distances to nearest location and facilities</b>	Distance to Jhang city: 4km Distance to River: 2km Distance to school: Inside the settlement Distance to health center: 4km east Distance to main road: 2.5km east	Distance to Jhang city: 38km Distance to River: 1km Distance to school: 1km Distance to health center: 15km east Distance to main road: 17km east
<b>Demographic</b>	Population: 1500 approx. Avg. HH size: 7.5 Male to female ratio: 0.45 Female headed HH: 5% Child headed HH: 2% Elderly people: 25%	Population: 1700 approx. Avg. HH size: 8 Male to female ratio: 0.52 Female headed HH: 2% Child headed HH: 2% Elderly people: 30%
<b>Housing and infrastructure in settlement</b>	Number of houses: 200 approx. Type of houses: Mud houses Material for house construction: Mud and brick Number of schools: 1 Number of health facilities: Nil Electricity coverage: 100% Gas, water supply, drainage system: Nil Public transport facility: Nil	Number of houses: 220 approx. Type of houses: Mud houses Material for house construction: Mud and brick Number of schools: Nil Number of health facilities: Nil Electricity coverage: 100% Gas, water supply, drainage system: Nil Public transport facility: Nil
<b>Flood characteristics and damages</b>	Flood frequency: Every 2 to 3 year Houses destroyed: 100% Deaths and disabilities: 10 persons Infrastructure damages (electricity, village road): 100% Flood protection: Nil	Flood frequency: Every 2 year Houses destroyed: 100% Deaths and disabilities: 25 persons Infrastructure damages (electricity, village road): 100% Flood protection: Nil

Source: Household survey, 2015.

Table 26: Detailed description of settlements surveyed in district Muzaffargarh

Criteria/ Characteristic of settlements	Doaba	Thatta Qureshi
<b>Location</b>	Latitude: 30° 7' North Longitude: 71°15' East Union council: Taleri Water body: River Chenab in east	Latitude: 29°55' North Longitude: 71°11' East Union council: Thatta Qureshi Water body: River Chenab in east
<b>Distances to nearest location and facilities</b>	Distance to Jhang city: 7.5km Distance to River: 0.5km Distance to school: 1.5km Distance to health center: 4km south-west Distance to main road: 2 km south	Distance to Jhang city: 20km Distance to River: 1km Distance to school: Inside settlement Distance to health center: 8km south-west Distance to main road: 5km west
<b>Demographic</b>	Population: 1500 approx. Avg. HH size: 8 Avg HH per house: 2 Male to female ratio: 0.40 Female headed HHs: 3% Child headed HHs: 1% Elderly people: 30%	Population: 1600 approx. Avg. HH size: 8 Avg HH per house: 2-3 Male to female ratio: 0.45 Female headed HH: 4% Child headed HH: 2% Elderly people: 20%
<b>Housing and infrastructure in settlement</b>	Number of houses: 190 approx. Type of houses: Mud houses Material for house construction: Mud and brick Number of schools: Nil Number of health facilities: Nil Electricity coverage: 100% Gas, water supply, drainage system: Nil Public transport facility: Nil	Number of houses: 200 approx. Type of houses: Mud houses Material for house construction: Mud and brick Number of schools: 1 Number of health facilities: Nil Electricity coverage: 100% Gas, water supply, drainage system: Nil Public transport facility: Nil
<b>Flood characteristics and damages</b>	Flood frequency: Every 2 year Houses: 100% Deaths and disabilities: 5-8 persons Infrastructure damages (electricity, village road): 100% Flood protection: Nil	Flood frequency: Every 2 year Houses: 100% Deaths and disabilities: 20 persons Infrastructure damages (electricity, village road): 100% Flood protection: Nil

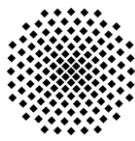
Source: Household survey, 2015.

Table 27: Correlation matrix acquired from analysis of household survey

	Type of Family	Number of literate	Disabilities/injuries due to flood	Died in Flood	Earning members after flood	Occupation after flood	Jobs during flood	Family income after flood	Ownership of agriculture land	Resources to cope and adapt	Government cash grant	Type of house after flood
<b>Type of Family</b>	1.000	-0.356	0.368	0.31	-0.625	.102	.006	-.148	.086	.029	-.001	.104
<b>Number of literate</b>	-0.356	1.000	-0.258	-.086	0.393	.159	.068	0.298	-.128	-0.181	.026	.032
<b>Disabilities/injuries due to flood</b>	0.368	-0.258	1.000	0.34	-0.427	-0.187	-.148	-0.224	.121	.158	-.044	.093
<b>Died in Flood</b>	0.31	-.086	0.34	1.000	-0.257	-.039	-.128	-.085	.009	.062	-.088	.047
<b>Earning members after flood</b>	-0.625	0.393	-0.427	-0.257	1.000	-.124	-.104	0.195	-0.207	-.127	.102	-.144
<b>Occupation after flood</b>	.102	.159	-0.187	-.039	-.124	1.000	0.591	0.247	-.130	-0.323	-.091	.042
<b>Jobs during flood</b>	.006	.068	-.148	-.128	-.104	0.591	1.000	0.204	-.112	-0.206	-.012	.086
<b>Family income after flood</b>	-.148	0.298	-0.224	-.085	0.195	0.247	0.204	1.000	-0.291	-0.527	.056	-.116
<b>Ownership of agriculture land</b>	.086	-.128	.121	.009	-0.207	-.130	-.112	-0.291	1.000	0.354	0.179	.165
<b>Resources to cope and adapt</b>	.029	-0.181	.158	.062	-.127	-0.323	-0.206	-0.527	0.354	1.000	.054	0.227
<b>Government cash grant</b>	-.001	.026	-.044	-.088	.102	-.091	-.012	.056	.179*	.054	1.000	.026
<b>Type of house after flood</b>	.104	.032	.093	.047	-.144	.042	.086	-.116	.165	0.227	.026	1.000

Source: Household survey, 2015.

## Annexure B



**Masters in Infrastructure Planning  
University of Stuttgart, Germany**

**Assessing Vulnerability and Capacity of Flood Affected Communities in Punjab, Pakistan**  
*(Interview scheduled for PDMA/NDMA)*

**Project Advisor:**

Prof. Dr.-Ing. habil. Jörn Birkmann (+49 711 68566332)

Prof. Dr. Obaid Ullah Nadeem Mian (+92 300 4356564)

**Project Advisee:**

Ali Jamshed

**Name of Respondent:** \_\_\_\_\_

**Designation of respondent:** \_\_\_\_\_

**Contact:** \_\_\_\_\_

**Questions regarding awareness**

1. Are you aware if any flood hazard zoning maps prepared? Are these maps circulated? (please provide copy)
2. Have any land use zoning or building regulations (for rural and urban areas) been made considering flood hazard zoning? (Please provide copy)
3. PDMA Disaster Contingency Plan 2014 suggest to make plans for evacuation routes. Are you aware if any plans made for evacuation routes and identification of flood shelter? (Provide copy)
4. Are these plans circulated among communities and local level authorities?
5. Are you aware of measures to promote nature conservation which results in enhancing the resilience of the communities? If yes, what are those measures?
6. Are you aware of the document “Guidelines for Climate Compatible Construction & Disaster Risk Reduction in Rural Punjab”? If YES, have recommendations of the document been implemented before or in the aftermath of 2013 and 2014 floods to reduce vulnerability?
7. Are you aware of any Flood Model being prepared by DMAs or NGOs for reducing vulnerability of communities? If yes, what are your views on these models?

**Vulnerability assessment**

8. Is there any specific methodology developed for the assessment of vulnerability by PDMA/NDMA? (if yes, provide copy). If No, how PDMA is assessing the vulnerability?
9. Has any system of indices or indicators been developed by the government or partner organization for assessment of vulnerability at local or national/provincial level in Pakistan/Punjab?
10. Does priority of people is considered while doing vulnerability assessment or other preparation of other disaster management guidelines? If yes, how? Kindly provide any evidence.
11. Why “Model Village” strategy is not implemented in the aftermaths of 2014 floods?
12. In your opinion, what are the reasons for increased/same vulnerability level of flood affected areas in last five floods?
13. In your opinion, what is needed to reduce the vulnerability of flood affected areas?

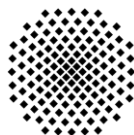
**Capacity measures**

14. In your opinion, how community/individual behavior acts as an adaptation option against reducing vulnerabilities?
15. Is there any insurance system (public and private) for people living in flood plains or being affected by the flood?
16. Is there any role of spatial planning/rural planning in managing flood disaster and reducing vulnerability? If YES, what initiatives have been taken in this regard?
17. What has been done so far for the preparedness of communities regarding future floods?
18. Have awareness raising campaigns regarding DRR or adaptation measures been carried out by the government? If YES, what type of information is given?

19. Have any topic related to flood hazard management is added in school curriculums? If yes, in which manner and up to what extent? Please provide copy.
20. Have emergency response/community based disaster management training is given to concerned official and communities?
21. Have specific funding in annual budgets is considered for disaster management and increasing the capacity of institutions?
22. In your opinion what are the most important elements for institution capacity?
23. What problems DMAs facing in increasing their capacity?
24. What elements of "Recovery Need Assessment 2014-2016" have been implemented?

Recovery elements/Adaptation option	Implemented		Name of tehsil/village where implemented
	Yes	No	
<b>Housing</b>			
Housing reconstruction centers			
Resilience aspects in reconstruction			
Technical training and awareness on safe construction			
Formation of village committees			
Women participation in training and construction			
Consideration of environmental impacts			
<b>Agriculture</b>			
Flood resilient crops			
Perennial/Alternative crops			
Climate smart agriculture			
Kitchen gardening			
Reforestation of rangelands			
Raised bed for food godowns (increased food storage)			
Micro insurance			
<b>Critical Physical Infrastructure (CPI)</b>			
Community based infrastructure development			
Resilient elements in infrastructure (raised roads, water drainage schemes, dikes and storage ponds)			
<b>Livelihood</b>			
Creation of Employment Information Center			
Employment Intensive Infrastructure Program			
Cash for work/Food for work			
Vocational training/skill development			
Non-farm livelihood			
Gender based livelihood opportunities			
<b>Community Empowerment</b>			
Community based early warning system			
Community based disaster risk management			

## Annexure C



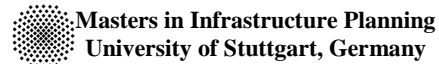
**Masters in Infrastructure Planning  
University of Stuttgart, Germany**

**Assessing Vulnerability and Capacity of Flood Affected Communities in Punjab Pakistan**  
*(Interview scheduled for DO(SP)TMAs/TOP&C)*

**Name of Respondent:** \_\_\_\_\_  
**Designation of respondent:** \_\_\_\_\_  
**Contact details (Email, Cell No. and Office No.):** \_\_\_\_\_

1. Is there any role of local planning agency (for example District Planning Agency /TMA) in managing flood hazard? If yes, please provide a brief detail?
2. What role District Planning Agency/TMA played in managing past flood disasters?
3. Are there any initiatives taken by District Planning Agency/TMA after the past floods to reduce the vulnerability of communities? If yes, what are those measures?
4. Does Provincial Disaster Management Authority (PDMA) or District Disaster Management Authority (DDMA) coordinate with you in managing previous or future flood disaster? If yes, what was the task assigned?
5. Have you attended any training session on disaster management or disaster risk reduction techniques?
6. If yes, then who organized it?
7. If not, what kind of capacity building of /District Planning Agency/TMAs is needed in this regard?
8. Have development plan or land use classification plan being prepared while integrating future flood hazards? If yes what is included regarding flood risk reduction?
9. Have any land use zoning and building regulations been prepared by planning agencies or PDMA especially for flood affected areas? If yes, please provide the copy or link to the document?
10. To what extent laws and regulations regarding land use in flood prone areas are implemented?
11. What type of constructions/development are you experiencing in flood zones/affected areas in urban settlements?
12. What type of constructions/development are you experiencing in flood zones/affected areas in rural settlements?
13. How are you dealing with such type of developments considering the future flood risk?
14. Are infrastructure or development schemes been constructed keeping in view the future flood risk? If yes, what measures are taken?
15. Are the buildings in urban areas been constructed considering the future flood risk? If yes, what measures are taken?
16. Are the buildings in rural area been constructed considering future flood risk? If yes, what measures are taken?
17. In your opinion what planning measures should be taken at community level to reduce vulnerability and increase their adaptive capacity?
18. Has your area fully recovered from 2010 or later flood (2011, 2012, 2013 or 2014)?
19. If not, why?
20. What measures did you adopt to make your area recover from the 2010 or later flood (2011, 2012, 2013 or 2014)?

## Annexure D



## Assessing Vulnerability and Adaptive Capacity of Flood Affected Communities in Punjab Pakistan

Questionnaire #: \_\_\_\_\_

Project Advisor: Prof. Dr.-Ing. habil. Jörn Birkmann (+49 711 68566332); Prof. Dr. Obaid Ullah Nadeem Mian (+92 300 4356564)

Project Advisee: Ali Jamshed

Name of Interviewer									
District		Tehsil			UC & Village				
<b>RESPONDENT PROFILE</b>									
Name		Age:		Gender		M		F	
1. Education	Primary	Middle	Matric	Inter	Graduation	Illiterate	Technical		
<b>HUMAN and SOCIAL ASPECTS</b>									
2. Type of Family		Joint			Nucleus				
3. No. of Households		1		2		3		4&more	
Members		Present	Literate	Illiterate	Disabled	Died in flood	Member of association		
4. Children under 15									
5. Female 16-60yrs									
6. Male 16-60yrs									
7. Elderly +60									
8. Which type of membership?		Farmer association		Village welfare society		Youth union		Women association	Other (specify)
9. School going children		Before flood			After flood				
10. Good relations with community		Yes	No	11. Community help in flood season		Before flood	During flood	After flood	No help
12. How did they help you?		Loan for food		Loan for reconstruction		Evacuation		Other (specify)	
13. Form of relationship with public representatives and local government officials				Good		Bad		No relationship	
14. Is it easy to access them?		Yes	No	15. Were they available/in contact during and after flood?			Yes	No	
16. Did they help you?		Yes	No	17. How did they help you?		Early warning	Evacuation	Relief camp	Cash grant
18. Diseases faced after flood		Diarrhea	Skin problem	Fever	Hepatitis	Other (specify)			
19. Health facilities are sufficient against mentioned diseases			Yes	No	20. Nearest health facility affected by flood		Yes	No	
21. What is needed in health facility		Ambulance	Emergency room	24 hour service	Proper medicine	Other (specify)			

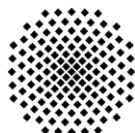
<b>FINANCIAL/ECONOMIC ASPECTS</b>									
22. Earning members in your household	Before flood				After flood				
	1	2	3	>3	1	2	3	>3	
23. Occupation	Wage labor		Farmer	Shopkeeper	Livestock/poultry	Govt.		Other (specify)	
Before flood									
After flood									
24. Reasons for change	Loss of farmland		Loss of livestock		Increase wage in off farm		Other (specify)		
25. Other skills which you utilize for a living	Skilled labor	Bee keeping	Land management		Technical (e-g welding, carpenter)		Other (specify)		
26. Did you utilize these skills during/after flood for living?					Yes		No		
27. In no, what else did you do during/after the flood for living?		Unskilled labor near village	Unskilled labor to other city		Work for land lord	Work at relief camp management	Doing Nothing		
28. Family income		<5000	5001-10000	10001-15000	15001 <20000	>20000			
Before flood									
After flood									
29. If income reduced, what are the reasons?	Loss of crops	Loss/ of farmland	Loss of livestock	Loss of shop	Loss of crops and farmland	Loss of farmland and livestock			
30. Ownership of land	Yes	No	31. If yes, type of land		Agriculture	Barren		Other	
32. How much	<1 acre	1-3acre	4-6acre	7-9acre	10 and above				
Before flood									
After flood									
33. Did you have adequate resources to buy food and reconstruct your house after flood?								Yes	No
34. If yes what was the resources			Savings		Employment		Other (specify)		
35. Did you receive any cash grant from government?								Yes	No
36. If yes, how long it took you to get this amount after the flood disaster?				Few days	Few weeks	A Month	More than 2 months		
37. How did you use it?		House reconstruction	Giving back loan	Buying food	Buying seeds	Other specify			



HYSICAL & NATURAL ASPECTS										
<b>38 House ownership</b>	Owned		Rented		Relative		Other (specify)			
<b>39. Plot area</b>	<5Marla	5-10 Marla	11-15Marla	16-20Marla	>20Marla					
<b>40. Location of house</b>	Flood plain		Adjacent to main road		Next to dyke		Other (specify)			
<b>41. Reason</b>	No other place		Inherited		Safe from flood		Farmland		Other (specify)	
<b>42. House damage due to flood</b>	2010 flood		2014 flood		Both 2010 & 2014					
<b>43. Extent of damage</b>	25%		50%		75%		100%			
<b>44. Type of house:</b>	Katcha		Semi pecca		Pecca					
Before flood										
After flood										
<b>45. Have you fully reconstructed your house</b>	Yes				No					
<b>46. If yes how did you reconstruct your house?</b>	Savings		Loans from others		Govt. cash grant		NGO grants		Loan from bank	Bank loan and saving
<b>47. In case, NGO/Govt. reconstructed house and village infrastructure, did they provide you labor?</b>	Yes				No					
<b>48. If Yes, what did you get in return?</b>	Cash		Food		Cloths		Animal		Nothing	
<b>49. Have you incorporated disaster resilient measures for house and infrastructure construction?</b>	Yes				No					
<b>50. What are those measures?</b>	Water proofing of walls and foundations		High land for house and streets		Pecca house		Other (specify)			
<b>51. Village infrastructure fully restored?</b>	Yes				No					
<b>52. If no, reasons</b>	Lack of community resources		Ignorance of govt.		Corruption		Other (specify)			
<b>53. Awareness of local building regulations?</b>	Yes				No					
<b>54. Safe access to main road?</b>	During flood				After flood					
	Yes		No		Yes		No			
<b>55. Access to water</b>	Yes		No		Yes		No			
<b>56. Source of water</b>	Well		Hand pump		Pond/River		Piped water supply		Tanker	
<b>57. Is the water drinkable?</b>	Yes				No					
<b>58. Measure adopted to clean it</b>	Boiling		Filter		Chemical		Other (specify)			
<b>59. After the flood of 2010, did you take any precautionary measures (especially nature conservation) to deal with future floods?</b>	Yes				No					
<b>60. If yes, enlist those measures (Afforestation, )</b>										

FLOOD MANAGEMENT										Annexures
<b>61. Did anyone warn you about flood?</b>	Yes				No					
<b>62. If yes, then who</b>	Govt.		NGO		Local Villager		Media		Other (specify)	
<b>63. When did flood warning communicated</b>	Few hours before		1 day before		2 days before		More than 2 days			
<b>64. Did you go to the safe place/shelter after warning?</b>	Yes				No					
<b>65. If no, Reasons?</b>	Less time to react		Fear of looting		Damage access road		Other (specify)			
<b>66. If yes, specify the safe place shelter for you</b>	Migrate to relatives		Govt. school		Govt. hospital		Tent by Govt			
	Tent by NGO		Main road		Flood dike		Other (specify)			
<b>67. Did you get proper utilities in shelter? And what was your satisfaction level about the quality of each? (select from following table)</b>										
<b>Utilities</b>	<b>Provided</b>	<b>Not Provided</b>	<b>Satisfied</b>	<b>Dissatisfied</b>	<b>Indifferent</b>	<b>Delivery time (days)</b>				
Food										
Nonfood items										
Sanitary facility										
Water supply										
Electricity										
Telecom										
Health										
Education										
Mosque										
Corner Shops										
Security										
<b>68. Enlist, if there are measures which have been adopted by the government or by you for managing of future floods (flood gauge, flood dykes, barrages)?</b>										
<b>69. Are you consulted in any activity related to flood disaster management?</b>										
<b>RISK PERCEPTION</b>										
<b>70. In your opinion, what are the causes of floods?</b>										
<b>71. Do you believe that flood like 2010 can occur again?</b>										
<b>72. Do you think this is the safe place to live and will not be flooded in the future?</b>										
<b>74. What changes you have observed in your lifestyle or opted in community after the flood of 2010?</b>										
<b>75. In your opinion what can be done to reduce vulnerability in your area?</b>										
<b>86. Do you trust in government that they will do something for you to deal with flood?</b>										

## Annexure E



Masters in Infrastructure Planning  
University of Stuttgart, Germany

Assessing Vulnerability and Capacity of Flood Affected Communities in Punjab Pakistan  
(Village Profile from Key Informants)

**Project Advisor:**

Prof. Dr.-Ing. habil. Jörn Birkmann (+49 711 68566332)

Prof. Dr. Obaid Ullah Nadeem Mian (+92 300 4356564)

**Project Advisee:**

Ali Jamshed

Name of Respondent: \_\_\_\_\_

Contact: \_\_\_\_\_

Village name and Location:			Population:			
Total area:			Village founded in:			
Average household size:			Average number of households per house:			
Vulnerable groups/individuals (%)	Female headed households:	Child headed households:	People with disabilities:	Elderly people (60+):		
Distance of village from the nearest river/canal/source of flood:			Nature of flood protection/embankment provided:			
Number of houses:			Number and intensity of extreme floods village faced:			
Number of people died and disabled (2010 and onward):			Number of houses damaged: (partially and fully):			
Material used for house construction:			Type of houses and number of storeys of majority of houses:			
Availability of:	Electricity	Gas	Telecommunication	Drainage system	Village access road	Water supply
% of houses						
Male to female ratio:			Number and level of schools:			
Distance to schools:			Number/nature and level of health facilities:			
Distance to health facilities:			Distance to nearest market:			
Distance to nearest UC office or office of government/public representative:			Distance to main road:			
Availability of public transport facility:			Availability of and distance to flood shelter:			
Distance to nearest rescue facility (RESCUE 1122):			Distance to nearest police station:			
Distance to work place of majority of residents:			Mode of transport used by majority of residents:			

## Annexure F

Table 28: Vulnerability assessment for two different communes of district Jhang in respect of two flood events  
 \* Level of vulnerability: 25-21 Extremely High Vulnerable (EHV), 20-16 High Vulnerable (HV), 15-11 Medium Vulnerable (MV), 10-6 Low Vulnerable (LV), 5-1 Very Low Vulnerable (VLV)

\*\* Factors that contribute to vulnerability

Vulnerable elements and issues/factor that contribute to vulnerability experienced and suggested by community	A = Bela Jhabana		Overall weighted index-2010	*Vulnerability level-2010	B = Gonyana		Overall weighted index-2014	*Vulnerability level-2014
	Flood event 2010				Flood event 2014			
	A	B			A	B		
<b>Human assets</b>								
Loss of human life	14	19	17	HV	17	20	19	HV
Increased share of vulnerable groups (children /women/ elderly and disable)	19	20	20	HV	23	25	24	EHV
Loss of educational material	12	20	16	HV	20	24	22	EHV
**Health issues (illness, disability, diseases)	11	13	12	MV	14	15	15	MV
**Level of education	4	2	3	VLV	6	3	5	VLV
**Lack of local knowledge/awareness	16	19	18	HV	15	16	16	HV
<b>Natural assets</b>								
Effect on water quality	16	21	19	HV	25	25	25	EHV
Loss/damage of standing crops	25	25	25	EHV	25	25	25	EHV
Loss of natural vegetation	2	4	3	VLV	5	5	5	VLV
**Loss of farmland due to degradation or erosion	18	20	19	HV	22	23	23	EHV
<b>Physical assets</b>								
Loss of house	20	25	23	EHV	25	25	25	EHV
Loss of household items and personal belongings (beds, clothing, cutlery, cash, jewelry, food items)	17	22	20	HV	15	19	17	HV
Sanitation facilities (latrine, bath)	20	23	22	EHV	25	25	25	EHV
Loss/damage of food storage place	5	14	10	LV	10	21	16	HV
Loss of fertilizers/ploughing tools	9	19	14	MV	12	19	15	MV
Tube wells or water pumps	22	25	24	EHV	25	25	25	EHV
Loss of village physical infrastructure (village roads, electricity, drains)	23	25	24	EHV	25	25	25	EHV
Loss/damage of main roads	4	2	3	VLV	9	15	12	MV
Loss of transport mode (cycle, motor cycle)	2	3	3	VLV	5	7	6	LV
**Lack of access to physical infrastructure	19	22	21	EHV	23	25	24	EHV
<b>Financial assets</b>								
Loss of harvested crops for sale	18	25	22	EHV	15	20	18	HV
Loss of livestock and fodder	10	20	15	MV	21	23	22	EHV
Employment/occupational loss	16	16	16	HV	22	20	21	EHV
**Increase in price of grocery items and seeds for crops	18	20	19	HV	23	24	24	EHV
<b>Social assets</b>								
Loss/damage of mosque	20	25	23	EHV	25	25	25	EHV
Loss/damage of health center/dispensary	19	18	19	HV	10	11	11	MV
Loss/damage of schools	13	20	17	HV	24	25	25	EHV
**Lack of access to public institutions (education, health, government offices) due to relationships, income, cast etc.	25	25	25	EHV	25	25	25	EHV
**Lack of trust b/w Govt. and communities	15	12	14	MV	19	17	18	HV
**Loss of social relationship	12	14	13	MV	8	11	10	LV

Source: Field survey, 2015

Table 29: Vulnerability assessment for two different communes of district Muzaffargarh in respect of two flood events

\* Level of vulnerability: 25-21 Extremely High Vulnerable (EHV), 20-16 High Vulnerable (HV), 15-11 Medium Vulnerable (MV), 10-6 Low Vulnerable (LV), 5-1 Very Low Vulnerable (VLV)

\*\* Factors that contribute to vulnerability

A = Doaba

B = Thatta Qureshi

Vulnerable elements and issues/factor that contribute to vulnerability experienced and suggested by community	Flood event 2010		Overall weighted index-2010	*Vulnerability level-2010	Flood event 2014		Overall weighted index-2014	*Vulnerability level-2014
	A	B			A	B		
<b>Human assets</b>								
Loss of human life	21	24	23	EHV	15	20	18	HV
Increased share of vulnerable groups (children/women/elderly and disable)	22	24	23	EHV	18	21	20	HV
Loss of educational material	25	25	25	EHV	22	25	24	EHV
**Health issues (illness, disability, diseases)	15	17	16	HV	12	15	14	MV
**Level of education	6	6	6	LV	14	12	13	MV
**Lack of local knowledge/awareness	23	24	24	EHV	20	19	20	HV
<b>Natural assets</b>								
Effect on water quality	22	22	22	EHV	24	25	25	EHV
Loss/damage of standing crops	25	25	25	EHV	25	25	25	EHV
Loss of natural vegetation	5	6	6	LV	2	5	4	VLV
**Loss of farmland due to degradation or erosion	24	24	24	EHV	20	24	22	EHV
<b>Physical assets</b>								
Loss of house	25	25	25	EHV	25	22	24	EHV
Loss of household items and personal belongings (beds, clothing, cutlery, cash, jewelry, food items)	19	24	22	EHV	15	19	17	HV
Sanitation facilities (latrine, bath)	25	25	25	EHV	25	23	24	EHV
Loss/damage of food storage place	22	15	19	HV	14	12	13	MV
Loss of fertilizers/ploughing tools	22	19	20	HV	12	15	13	MV
Tube wells or water pumps	25	25	25	EHV	25	25	25	EHV
Loss of village physical infrastructure (village roads, electricity, drains)	25	25	25	EHV	25	25	25	EHV
Loss/damage of main roads	23	21	22	EHV	3	4	4	VLV
Loss of transport mode (cycle, motor cycle)	9	11	10	LV	5	7	6	LV
**Lack of access to physical infrastructure	25	25	25	EHV	25	25	25	EHV
<b>Financial assets</b>								
Loss of harvested crops for sale	25	25	25	EHV	17	22	20	HV
Loss of livestock and fodder	21	24	23	EHV	19	20	20	HV
Employment/occupational loss	24	25	25	EHV	23	23	23	EHV
**Increase in price of grocery items and seeds for crops	22	22	22	EHV	23	25	24	EHV
<b>Social assets</b>								
Loss/damage of mosque	25	25	25	EHV	24	25	25	EHV
Loss/damage of health center/dispensary	21	23	22	EHV	10	6	8	LV
Loss/damage of schools	24	25	25	EHV	22	21	22	EHV
**Lack of access to public institutions (education, health, government offices) due to relationships, income, cast etc.	25	25	25	EHV	25	25	25	EHV
**Lack of trust b/w Govt. and communities	20	21	21	EHV	23	23	23	EHV
**Loss of social relationship	15	14	15	MV	6	13	10	LV

Source: Field survey, 2015.

Table 30: Assessment of different measures to increase adaptive capacity for two different communities of district Jhang in respect of two flood events

\*Level of urgency: 25-21 Extremely urgent, 20-16 Urgent, 15-11 Moderate, 10-6 Low, 5-1 Very low

\*\*Suggested measures

A = Bela Jhabana B = Gonyana

Measures/options that is used or suggested by to enhances adaptive capacity keeping in view of past extreme flood events	Flood event 2010		Overall weighted index 2010	*Urgency level	Flood event 2014		Overall weighted index 2014	*Urgency level
	A	B			A	B		
<b>Human assets</b>								
Timely rescue operation	14	21	18	Urgent	18	24	21	Extremely urgent
**Constant availability of doctor/nurses in nearest health center	5	6	6	Low	7	7	7	Low
Partial starvation	11	17	14	Moderate	15	20	18	Urgent
**Need to create awareness and spread knowledge	8	10	9	Low	16	12	14	Moderate
**Need for vocational training and skill development	12	10	11	Moderate	18	20	19	Urgent
**Need for community training and preparedness	3	7	5	Very low	11	15	13	Moderate
**Need for effective distribution of relief goods	17	20	19	Urgent	20	21	21	Extremely urgent
Additional working person in household	6	4	5	Very low	11	11	11	Moderate
<b>Natural assets</b>								
Need/use of alternative/flood resilient crops	20	18	19	Urgent	24	23	24	Extremely urgent
Need for compensation in form of seeds/livestock etc.	13	19	16	Urgent	17	21	19	Urgent
Selling land and animals	15	19	17	Urgent	16	20	18	Urgent
**Need for land allocation to landless and vulnerable	18	16	17	Urgent	21	20	21	Extremely urgent
Use of Bio-waste as fertilizer	4	7	6	Low	5	4	5	Very low
**Afforestation and vegetation	2	1	2	Very low	2	3	3	Very low
Cutting trees and selling them	8	12	10	Low	10	14	12	Moderate
<b>Physical assets</b>								
Flood resilient measures in house and related community facilities	12	11	12	Moderate	17	17	17	Urgent
**Need for identification of evacuation routes	14	17	16	Urgent	21	22	22	Extremely urgent
**Need for immediate multipurpose shelter	19	20	20	Urgent	22	22	22	Extremely urgent
**Need for identification of refuge points	10	15	13	Moderate	14	19	17	Urgent
**Need for rescue equipment (boats, life jackets, vehicles) in advance	18	21	20	Urgent	24	25	25	Extremely urgent
**Need for community storage facility at high grounds	3	4	4	Very low	5	6	6	Low
**Need for small dams on rivers	22	25	24	Extremely urgent	25	25	25	Extremely urgent
**Need for flood dikes along settlements/villages	25	25	25	Extremely urgent	25	25	25	Extremely urgent
**Flood ponds	4	5	5	Very low	5	5	5	Very low
**Land use zoning and building regulations	2	2	2	Very low	3	1	2	Very low
**Access/proximity to public facilities (health center, education)	12	17	14	Moderate	15	19	17	Urgent
**Access/proximity to local markets	11	21	16	Urgent	16	24	20	Urgent
<b>Financial assets</b>								
**Immediate need for building material	17	17	17	Urgent	21	22	22	Extremely urgent
Loan from relatives/land lords/banks for food, house reconstruction and other purposes	12	10	11	Moderate	15	12	14	Moderate
Compensation from government in form of cash	15	14	15	Moderate	19	19	19	Urgent
Selling household items	7	5	6	Low	10	7	9	Low
Practice of doing savings (cash, jewelry) or use of savings for flood adaptation	10	8	9	Low	21	22	22	Extremely urgent
Cash for Work/ Food for Work	17	17	17	Urgent	5	2	4	Very low
Alternative employment/change in occupation	8	10	9	Low	14	16	15	Moderate
**Need for price regulation for grocery items and seedlings for crops	18	20	19	Urgent	20	23	22	Extremely urgent
<b>Social assets</b>								
Social relations/networks	12	8	10	Low	18	15	17	Urgent
**Community organization/panchayat	7	12	10	Low	15	19	17	Urgent
**Trust b/w authorities and communities	4	3	4	Very low	8	8	8	Low
Early warning (local people, radio, television)	18	16	17	Urgent	25	25	25	Extremely urgent
Temporary migration	17	5	11	Moderate	24	12	18	Urgent
Permanent migration	3	6	5	Very low	8	13	11	Moderate

Source: Field survey, 2015.

Table 31: Assessment of different measures to increase adaptive capacity for two different communes of district Muzaffargarh in respect of two flood events.

\*Level of urgency: 25-21, Extremely urgent, 20-16 Urgent, 15-11 Moderate, 10-6 Low, 5-1 Very low

\*\*Suggested measures

Measures/options that is used or suggested by to enhances adaptive capacity keeping in view of past extreme flood events	Flood event 2010		Overall weighted index-2010	Urgency level	Flood event 2014		Overall weighted index-2014	Urgency level
	A	B			A	B		
<b>Human assets</b>								
Timely rescue operation	19	25	22	Extremely urgent	11	24	18	Urgent
**Constant availability of doctor/nurses in nearest health center	12	13	13	Moderate	13	13	13	Moderate
Partial starvation	20	23	22	Extremely urgent	19	20	20	Urgent
**Need to create awareness and spread knowledge	21	20	21	Extremely urgent	24	23	24	Extremely urgent
**Need for vocational training and skill development	21	22	22	Extremely urgent	22	24	23	Extremely urgent
**Need for community training and preparedness	12	8	10	Low	17	19	18	Urgent
**Need for effective distribution of relief goods	25	25	25	Extremely urgent	25	25	25	Extremely urgent
Additional working person in household	14	12	13	Moderate	13	12	13	Moderate
<b>Natural assets</b>								
Need/use of alternative/flood resilient crops	20	21	21	Extremely urgent	25	25	25	Extremely urgent
Need for compensation in form of seeds/livestock etc.	20	23	22	Extremely urgent	20	24	22	Extremely urgent
Selling land and animals	20	22	21	Extremely urgent	19	21	20	Urgent
**Need for land allocation to landless and vulnerable	21	22	22	Extremely urgent	23	24	24	Extremely urgent
Use of Bio-waste as fertilizer	4	5	5	Very low	3	2	3	Very low
**Afforestation and vegetation	2	2	2	Very low	4	6	5	Very low
Cutting trees and selling them	13	15	14	Moderate	10	17	14	Moderate
<b>Physical assets</b>								
Flood resilient measures in house and related community facilities	12	11	12	Moderate	13	16	15	Moderate
**Need for identification of evacuation routes	20	21	21	Extremely urgent	21	22	22	Extremely urgent
**Need for immediate multipurpose shelter	24	25	25	Extremely urgent	23	25	24	Extremely urgent
**Need for identification of refuge points	20	22	21	Extremely urgent	21	24	23	Extremely urgent
**Need for rescue equipment (boats, life jackets, vehicles) in advance	25	25	25	Extremely urgent	25	25	25	Extremely urgent
**Need for community storage facility at high grounds	8	7	8	Low	8	8	8	Low
**Need for small dams on rivers	25	25	25	Extremely urgent	25	25	25	Extremely urgent
**Need for flood dikes along settlements/villages	25	25	25	Extremely urgent	25	25	25	Extremely urgent
**Flood ponds	7	4	6	Low	8	4	6	Low
**Land use zoning and building regulations	1	2	2	Very low	1	2	2	Very low
**Access/proximity to public facilities (health center, education etc.)	15	18	17	Urgent	16	20	18	Urgent
**Access/proximity to local markets	14	24	19	Urgent	16	25	21	Extremely urgent
<b>Financial assets</b>								
Immediate need for building material	24	25	25	Extremely urgent	24	25	25	Extremely urgent
Loan from relatives/land lords/banks for food, house reconstruction and other purposes	14	14	14	Moderate	18	15	17	Urgent
Compensation from government in form of cash	23	24	24	Extremely urgent	21	20	21	Extremely urgent
Selling household items	10	5	8	Low	12	9	11	Moderate
Practice of doing savings (cash, jewelry) or use of savings for flood adaptation	7	8	8	Low	20	22	21	Extremely urgent
Cash for Work/ Food for Work	22	24	23	Extremely urgent	6	4	5	Very low
Alternative employment/change in occupation	19	20	19	Urgent	16	17	17	Urgent
**Need for price regulation for grocery items and seedlings for crops	24	25	25	Extremely urgent	24	25	25	Extremely urgent
<b>Social assets</b>								
Social relations/networks	16	14	15	Moderate	18	18	18	Urgent
**Community organization/panchayat	10	13	12	Moderate	13	16	15	Moderate
**Trust b/w authorities and communities	10	9	10	Low	15	13	14	Moderate
Early warning (local people, radio, television)	17	16	17	Urgent	25	25	25	Extremely urgent
Temporary migration	23	20	22	Extremely urgent	23	21	22	Extremely urgent
Permanent migration	9	8	9	Low	11	12	12	Moderate

Source: Field survey, 2015

Annexure G

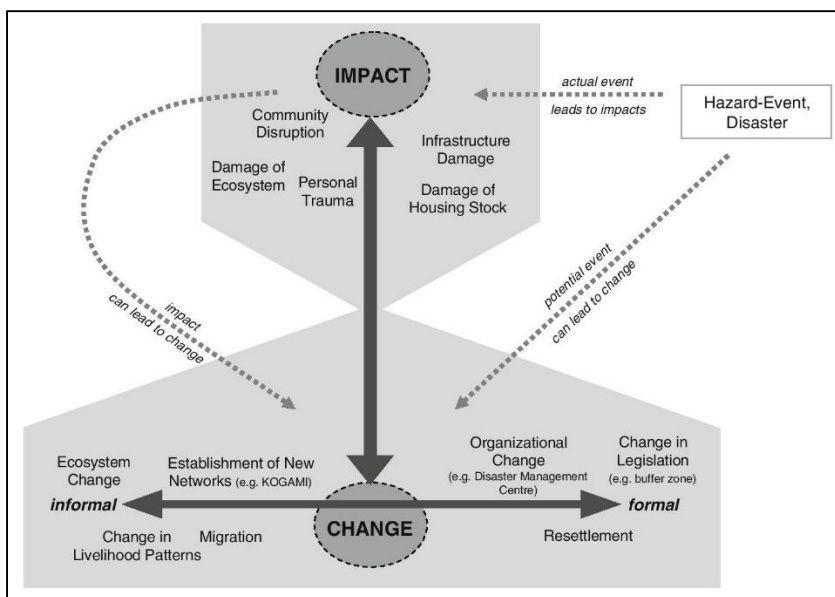


Figure 40: Framework for analysis of change occurred due to impacts of disturbances in form of formal and informal responses for the resilience of societies.  
Source: Birkmann et al.,(2008).

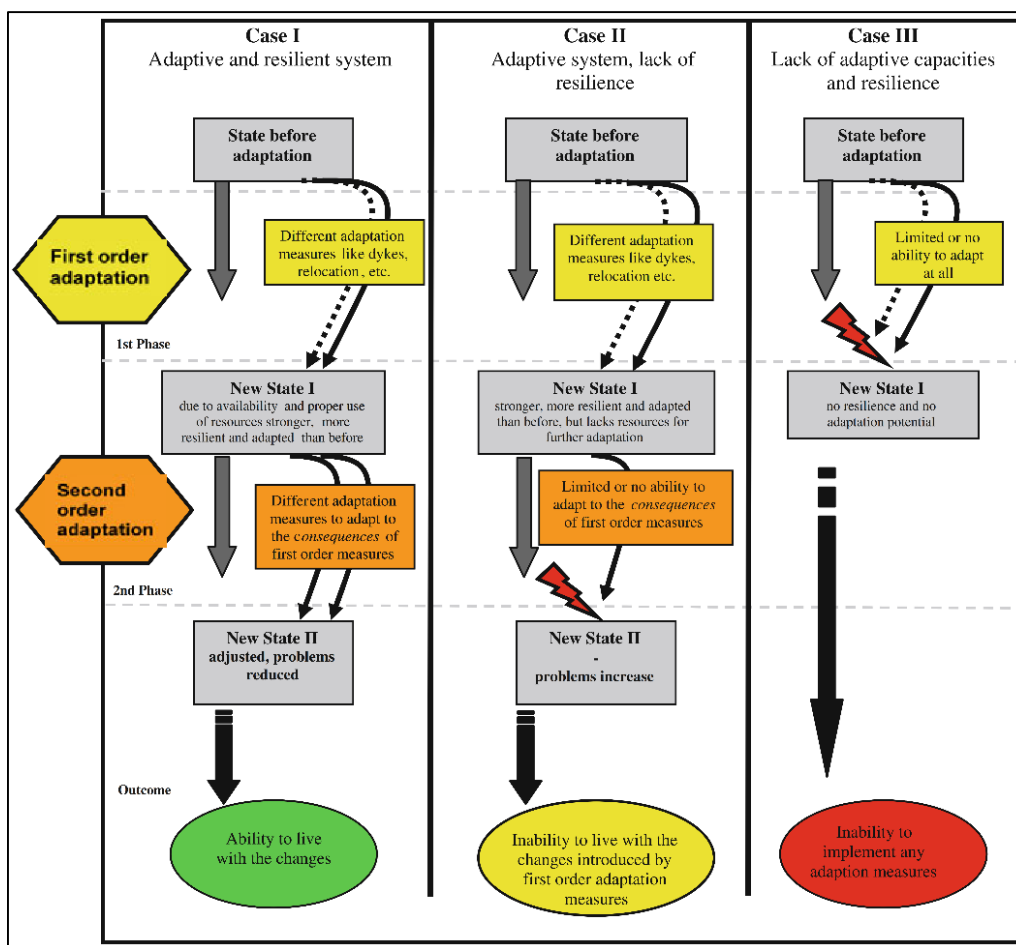


Figure 41: Three cases to explain first and second order adaptation  
Source: Birkmann, 2011.

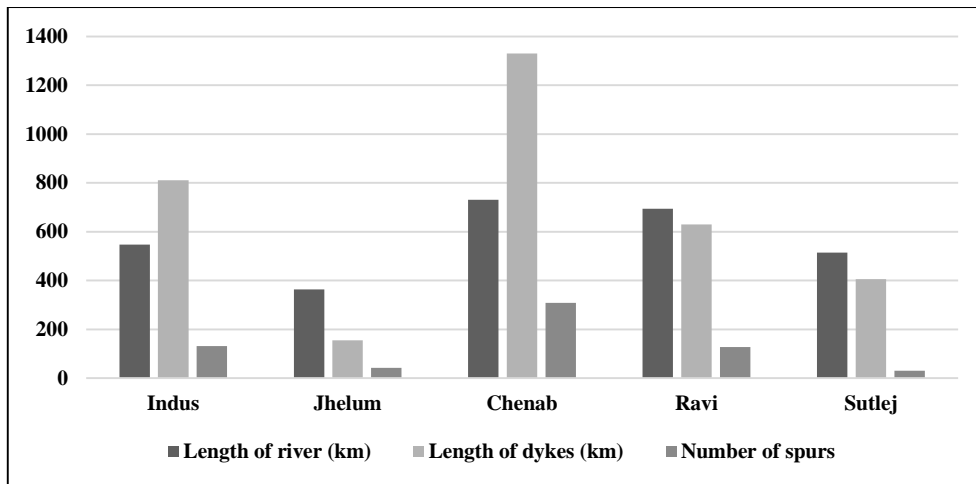


Figure 42: Details of different flood control measures along five major rivers in Punjab, Pakistan  
 Source: Modified from PDMA, 2014.



Figure 43: Overview of a model village



Figure 44: Conducting PRA in district Jhang.



Figure 45: Conducting PRA in district Muzaffargarh.



Figure 46: Untreated waste water along flood dyke



Figure 47: Mud house destroyed by flood.



Figure 48: Stagnant flood water





Figure 49: Raised platform of house



Figure 50: Reconstruction of pecca house without raising platform and plinth level.



Figure 51: Conducting household survey in Jhang



Figure 52: Conducting household survey in Muzaffargarh



Figure 53: Vulnerability of women and children due social settings and lack of swimming capabilities



Figure 54: Children jumping in flooded water

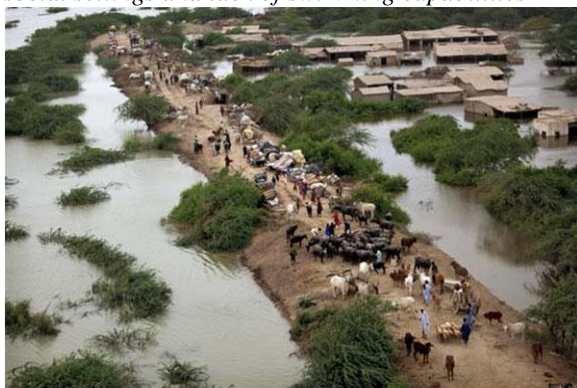


Figure 55: Temporary migration on flood dykes



Figure 56: Staying at home as coping measure with associated vulnerabilities

Source: Author's own, 2011, 2015; FFL, 2010; MCC, 2010; Toosi, 2014.