

**Vulnerability and Adaptability to GLOF and Flash Floods - A Case  
Study of Tehsil Mastuj, Chitral**



By

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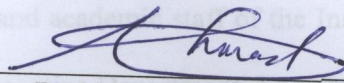
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## CERTIFICATE

This is to certify that this thesis entitled: **“Vulnerability and Adaptability to GLOF and Flash Floods-A Case Study of Tehsil Mastuj, Chitral”**. submitted by Rahim Aman Shah is accepted in its present form by the Department of Environmental Economics, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree in **Master of Philosophy in Environmental Economics**.

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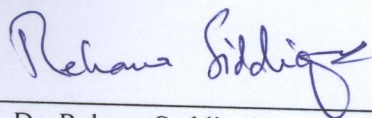
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## **LIST OF ABBREVIATIONS**

AKRSP	Aga Khan Rural Support Program
AKPBS	Aga Khan Planning and Building Service
AKAH	Aga Khan Agency for Habitat
BLSO	Biyar Local Support Organization
CERT	Community Emergency Response Team
DART	Disaster Assessment Response Team
FF	Flash Floods
GLOF	Glacier Lake Outburst Floods
GBC	Gilgit Baltistan and Chitral
HKH	Hindu Kush Himalayas
HACI	Household Adaptive Capacity Index
HH	Household
HHH	Household Head
NWM	Non-working Members
NGO	Non-Government Organization
SRSP	Sarhad Rural Support Program
TI	Terminal Illness

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## ABSTRACT

Disasters relating climate change are becoming everyday event throughout the globe, but the mountainous areas are facing the real challenge of climate change. With the change in temperature, natural calamities like floods are becoming more frequent phenomenon. These natural disasters affect the life pattern of people living in the vulnerable zone. Chitral is also on the front line of natural disasters be it Glacier Lake Ourburst Floods (GLOF), Flash Floods (FF), spell of drought or Earth Quake. This study was undertaken to investigate two things, firstly the household adaptive capacity index (HACI) to cope with such environmental changes and secondly to figure out the possible adaptation strategies that the inhabitants of the area practiced during flood events. The HACI of the 56.5% of the sampled population show vulnerability due to low level of incomes, high dependency ratio, reliance of natural resources for energy use and living in areas that are not properly connected with road networks and other government facilities. Despite these facts, the strong social connections in the area and the development work by Non-Government Organizations (NGOs), in energy sector and other relief related works, have a strong positive effect in reducing the vulnerability of the area. Yet, the adaptation strategies are very poor given the socio-economic conditions of the people. Severe Floods left the people with options of either leaving the area permanently in the form of permanent migration or to resort to fleeing the area during floods and returning to their permanent residence to reconstruct/rebuilt the houses and be ready for future calamities.

# CHAPTER 1

## INTRODUCTION

### 1.1 Background of the Study

An important challenge that the world facing today is, the climate change and its impacts especially on water resources. Climate change causes melting of snow and glacier in the mountains, uncertain change in precipitation causes floods, extreme heat wave in the plain areas, extreme cold weather in the mountains, rising sea level and biodiversity loss (Shakir, Rehman, & Ehsan, 2010). Extreme weather events has been witnessed due to the climate change like floods, storms and other natural disasters that have become part of everyday life (Smit & Pilifosova, 2003). In response, people along with the government around the world are taking certain measures to cope with newly posing events. Hence, these Adjustment in the social, economic and ecological systems due to actual change or expected future event that can affect or have an impact on the current situation is discussed as an important counter measure in the literature under the title of adaptation (Adger, Arnell, & Tompkins, 2005).

Certain extreme events like glacier recession and floods like flash and Glacier Lake Outburst Floods (GLOFs) have been the worst effect of the global warming as depicted by the scientific researches. The forecast is that the glaciers would disappear by 2050 where half of them are already lost by the 21<sup>st</sup> Century (Chatterjee et al, 2011). The Himalayan Region, also known as the “Water Tower of Asia”, covers 7 million Km approximately and contain some of the largest pieces of glaciers outside the artic world. It fill 10 of the most largest rivers of the Asian subcontinent (Xu et al., 2009). In this respect, the change in the pattern of climate and its relationship with the global warming is a serious issue of the 21<sup>st</sup> Century. Data from 49 stations in the

Himalayan region revealed that the average temperature of the areas has increased by 1<sup>o</sup> C since 1970 (Chatterjee et al., 2011).

Glacier Lake Outburst Flood (GLOF) is the discharge of water which is under pressure and can cause a catastrophic effect. GLOF can have two conditions, upstream flooding and downstream flash flooding as result of dam failure. This downstream flash flooding creates significant threat to life, property and other infrastructures and can damage crops, lands, infrastructure and life if happened without any prior alert signal (Din et al., 2014). The reason, which make this phenomenon important, is that GLOFs erode or cover the surface, leaving it uninhabitable and thus make the adaptation costly and difficult.

Pakistan is no exception and so facing the same challenge of climate change and global warming as rest of the world (Din et al., 2014). There have been a number of incidents of glacier related floods in the northern areas, however, glaciers caused flooding in Northern areas are more frequent in the recent past. Glacier lake debris flow was first witnessed on 14<sup>th</sup> August 1975 in Reshun area that damaged the wooden bridge of the area along with wiping out of several houses and crops. In 2007, a debris flow was triggered by a snow avalanche in the Sonoghur village that swept more than 200 houses, displacing more than 400 families. The debris flow covered almost 30% of the settlement area of the village forcing mass evacuation and resettlement of people. Similarly, in July 26, 2010 a snow avalanche in the Booni Gol catchment area caused a debris flow of catastrophic nature (Khan et al., 2013).

With this background, the study investigates this issue with special reference to Chitral and aims to uncover the factors influencing; household's vulnerability, their

adaptive capacity and the coping strategies assumed, with respect to flooding and GLOF in the affected areas of Chitral.

## **1.2 Problem Statement:**

The most common form of natural disasters in the Hindu Kush Himalaya (HKH) region are the flash floods and they are devastating at times with high mortality rate (Shrestha & Bajracharya, 2013). Despite this fact, flash floods have not received the attention of policy makers. Generally flash floods are not considered as separate class and normally dealt with the same strategies as riverine floods. The high intensity localized rain fall along with long duration of monsoon rains in the HKH region are the most important causes for the flash floods in the mountainous areas. Incidences have happened in central Nepal in 1993 and in China city of Niujuangou in May 2010. Similarly, GLOF are also common in HKH region. The sediments of the glacier moraine may cause morphological change in river channels and can be a factor of devastating loss in the form of life and property at a very long distance (Shrestha & Bajracharya, 2013).

It is important to note here that glaciers are significant elements of nature along with being the only source of continuous fresh water flow which are under threat due to global warming. The predicted change in temperature for Pakistan was 0.6 °C during the period 2001-2010, but the actual temperature change recorded at 0.93 °C whereas the northern mountains heated up to 1.3 °C (Rasul et al., 2011). Pakistan located in South Asia and forms the junction of world famous mountain ranges of HKH in the north. As these mountains contain the HKH glaciers, such rise in temperature is an alarming signal for the formations of glacier lakes, their expansion and the outburst

flooding of such lakes. In these mountain areas, more than 5000 glaciers feed the rivers.

Recent incidents indicate the vulnerability of the people living in northern areas. According to ICIMOD (2005) about 2,500 glacier lakes have been formed due change in temperature and among them 52 have been declared as dangerous for GLOF in coming years (Rasul et al.,2011). GLOFs are climate change induced hazards that are most common in Gilgit-Baltistan (GB) and Chitral areas and over the last 200 years this Norther Region of GB has witnessed more than 35 GLOFs. During 2008-2009 five GLOF incidence happened in the Gojal valley of Hunza and the most recent is the incident of Attabad and the formation of Attabad Lake (Din et al., 2014). The glacier located in Booni Gol near Chitral in the mountain range of Hindukush generated flood in 2010, this was caused by heavy monsoon down pour and caused huge erosive damages to the channel along settlement and crops. Passu lake outburst was due to the same mechanism with the outburst frequency in the interval of 2 to 5 years (Rasul et al., 2011). On 16<sup>th</sup> of July 2015 riverine flash floods along with GLOFs of very high intensity hit different areas of District Chitral and Tehsil Mastuj areas. These floods caused damage to livestock, destroyed buildings, houses and other assets, damaged roads, bridges, irrigation infrastructure, water supply channels, standing crops, schools, hospital and mosques etc. (Handicap international, 2015)

Therefore, it is important to find out the vulnerability status, economic effects and the coping strategies adopted by the people living in the affected areas. This study would provide an in-depth analysis of the situation from two aspects. Firstly, the vulnerability and hence the adaptive capacity of the household. Secondly, the copying strategies adopted by the households and their determinants.

### **1.3 Research Objective:**

1. To calculate household's adaptive capacity index.
2. To identify the coping strategies and to know factors influencing household adaptive capacity

### **1.4 Research Question:**

1. What factors influence household's adaptability after being hit by Glacier Lake Outburst Flood (GLOF) and Flash floods?
2. What are the coping strategies adopted and factors that influence the selection of a specific coping strategy?

### **1.5 Significance of the study**

The main aim of the study is to calculate Household Adaptive Capacity Index (HACI) for the households affected by the glacier lake outburst flood and flash floods. Secondly to study the adaptive measures/coping strategies taken in response to GLOF and FF by the people of the area based on previous experiences. Both the objectives are calculated independently and are mutually exclusive. From these findings the study will help policy makers to make a scientific analysis of the area under threat of GLOF that could be used for informed policy making in future.



## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

Before going into details, it is important to analyze the nature of disasters and its effects in different areas of the world. This section hence firstly presents the studies discussing the extent and frequency of events. Following that the next subsection discusses the empirical evidence on the said subject.

#### **2.2 General background**

There has been reduction in the agriculture productivity over the past few decades due to damages to the ecosystem of the areas by climate change events. The increased incidents of rainfalls accompanied by huge glacier melting has increased the onset of flash and GLOF in the Upper Indus Basin areas of the country. This is evident by the GLOF events in Gojal valley of Hunza from 2008-2009 and most recently by the 2015 events of GLOF in Chitral that cost huge losses in the form of destroyed crop land of hundred acres, loss of livestock, infrastructure and loss to human lives. At the same time the change in rain patterns and escalating temperature is effecting the water availability and thus could affect the agricultural productivity of the area (Hussain et al., 2016).

Weather related events like flash floods, GLOF, storms, heat wave and other climate change related events have been the major reason (90%) of disasters worldwide. Total of 6,457 events related to weather were reported which claimed the lives of 606,000 people with 4.1 billion rendered injured and homeless and in need for any emergency help worldwide. About 47% of disasters related to weather is flooding with 2.3 billion people being effected with majority (95%) of them living in Asia (Rasheed, 2015).

In the Himalayan regions GLOF can be a great threat. This type of flood can cause damages in the form of live losses, damages to property, livelihood etc. over the past year the HKH region has experienced many GLOF incidences. As many as 14 GLOFs have been reported in Nepal, events of about 30 in the Tibet region in China, about 21 occurrences of GLOFs in Bhutan and adjoining areas and these are now becoming a frequent incident in Pakistan and about 5 incidences have been witnessed in the Hunza area during 2007 and 2008 (Khanal, Hu, & Mool, 2015).

At times the increasing temperature may have a positive effect on the agriculture of the area. Production of agricultural goods like wheat and maize may increase reducing the poverty and increasing the well-being of the local inhabitants. But at the same time increasing rainfall and temperature increases the possibility of flash and GLOF in the area. To mitigate these possible dangers necessary measures of adaptation are required to prepare the local communities for the future flash and GLOF events and to increase the ability to cope with such incidences (Syed Sajidin, 2013). Similarly Khan, writes that the disastrous floods have the capacity to cause huge damage to the physical conditions of the area as well as the economy of the area and in worst cases it might cause mass evacuation or human casualties (Khan, 2011).

Adaptation behaviors of Communities and Households in Extreme Climatic Events in Quang Nam Province, Vietnam was discussed by Tran, Tuan, and Tinh (2010). Their research says that today's world, climate change is the most burning issue and the problems of climate change in the developing world is more in poor communities of the developing nations. For the removal of barriers in the way of adaptation to these communities, understanding of the local adaptive capacities are very important so that these act as bridge and improve the local adaptation to climate related incidences.

Based on the survey at household level, suggestions were given for the improving housing sector so that human life and property could be saved, establishment of rescue team and better emergency information system along with planning for disaster, climate awareness in the area, upgradation of infrastructure of rural areas and income of the household to be increased with improvement in the productivity of the local productions (Tran, Tuan, & Tinh, 2010).

The adaptive capacity is not fixed and it is context specific and therefore changes from country to country, from communities to communities, varies among different social groups, individuals and also varies over times. The forms and levels of adaptation are many and can be classified in different ways like: stimulus related to time such as anticipatory, concurrent or reactive. It may also be an intend like planned or autonomous, space oriented like local or widespread, and lastly by form like behavioral, technological, financial, institutional (Smit & Wandel, 2006)

### **2.3 Empirical Studies:**

The capacity to adapt of men and women in the villages of Meatu and Iramba in Tanzania is influenced by the factors like gender of the respondent, age of head of the household, education level, size of the household, land ownership, labor of the household, assets contained in the house, and income level of the HH. All these factors were statistically significant and important in predicting the capacity of the household to adapt to the changing climatic changes (Ibrahim, 2014).

For a pastoralist society, the determinants of vulnerability are the gender of head of household, the age, dependents in the family, the marital status, the linkages between social groups, the warning system. Furthermore, the access to extension service provided in the area, income source, size and diversity and structure of herd, the

mobility of herd, distance from the market, the employment level and status, the coping mechanism and facilities to credits are also having important impact on vulnerability. Similarly, factors that influence the adaptive capacity are resource access, the market structure and infrastructure, linkages with the organization of the community, savings of the locals, loans, and the health status of the households (Opiyo, Wasonga, & Nyangito, 2014)

Two of the important things that affect the recovery time from any natural disaster is the roads of the area and facilities like water system, these are important elements of vulnerability. Along with that the very limited options for the livelihood and particularly the dependence on tourism in the Khao Lak village of Thailand and lack of diversity of income options caused a higher sensitivity to the area (Willroth, Diez, & Arunotai, 2011).

The income resources that do not depend on climatic conditions like salaried jobs, no farm skilled jobs like carpenter, driver etc., jobs or laboring in any other country, these are the sources of income which are not related to natural resource so the climate has a negligible effect on these sources. Similarly the ability of household to read the change in the rainfall is also an important determinant of adaptation so the flow of information through community members could be a source of promoting adaptation within community (Piya, Maharjan, & Joshi, 2013).

Two of the important determinants of the adaptation are the income level and the education, both have a positive effect on the climate change adaptation whereas old age has a negative impact. The wisdom of the household about the climate change and the occupation also clout the climate change adaptation (Shongwe, Masuku, & Manyatsi, 2014)

From the reviews, incidences of GLOF and flash floods have increased over the period and the frequency of such calamities have increased for the last few years. The occurrences of these incidences have increased in Chitral. The flood events repeated in the years 2010, 2012, 2013, 2014, and 2015. Flash Floods have posed a great threat to the lives and property of the people living in this area. Moreover, literature has highlighted some of the very important determinants of vulnerability and adaptive capacity. Building upon the given literature, this study will present the situation analysis of District Chitral. Given the situation discussed before, it becomes important to have in depth research on changing climatic condition in northern areas and learn about the possible adaptations made or required to minimize the losses.

## **CHAPTER 3**

### **DATA AND METHODOLOGY**

#### **3.1 Introduction**

This chapter outlines the details about method of study used for the calculation Household adaptive capacity index (HACI), method of estimation used, data source and sampling technique.

#### **3.2 Data**

Data for the calculation of Household adaptive capacity index (HACI) and for the regression analysis has been obtained from primary source through questionnaire. Main type of information gathered were Demographic information, Socio Economic Situation, Event Information, Coping Strategies, information about income (See Appendix II for Questionnaire).

#### **3.3 Methodology**

The methodology adopted in this study is based upon the Mwamba (2012) for the calculation of HACI. The study constructed the vulnerability index using variables of the household economic wellbeing and stability factors; which will be reconstructed for our study area. Hence, household adaptive capacity will be measured for Chitral following Mwamba (2012). The given methodology is elaborated as Appendix I and summarized here as Table 3.1 & 3.2. Further, this study also presents the measures adopted and factors influencing a given coping strategy following the extreme climate events in the study area.

<b>Table 3.1: Measurement Scale Applied to Variables of internal Sub-Index</b>				
<b>Household Adaptive Capacity Index (HACI)</b>	<b>Sub-indices (min., max. values)</b>	<b>Variables (min., max. values)</b>	<b>Values. Labels</b>	
HACI (-11,8)	<b>(I) Economic wellbeing &amp; stability (0,4)</b>	Income diversification (0,4)	0. No Source of Income 1. One income source 2. Two income sources 3. Three income sources 4. Four or more income sources	
	<b>(II) Dependency ratio (-4,0)</b>	Members with terminal illnesses (-2,0)	0. None -1. One -2. Two or more	
		Non-working members (-2,0)	0. None -1. (1 - 3 non-working adults) -2. (3 - 6 non-working adults)	
	<b>(III) Interconnectivity in higher level processes (0,4)</b>	Geographical scope of social capital contacts (0,2)	0. None 1. (1 - 2 contacts) 2. (3 and above contacts)	
		Number of social categories a household relies on during shocks (0,2)	0. No family members 1. 1 Family 2. 2 or more family members	
	<b>(IV) Susceptibility to Environmental changes (-7, -1)</b>	Farming contribution to wellbeing (-3,0)	-1. Less than 35 % -2. 35 - 70 % -3. Over 70 % 0. If no income from farming	
		Cooking energy source (-3, -1)	-1. Wood fuel + gas/electric -2. Charcoal + Kerosene -3. Exclusively wood fuel	
		Water source for domestic use (-1,0)	0. Piped water -1. Spring/stream water	
		<b>(V) Awareness level &amp; actions taken (0,1)</b>	Ability to describe environmental change (0,1)	0. No 1. Yes
	<b>Source: Adopted from Mwamba 2012</b>			

HACI	<b>(VI) Institutional &amp; Infrastructural environment (-4,5)</b>	Common property access (0,1)	Common property access (0,1)	0. No 1. Yes
		Public services access available in the affected area (-2, 2)	Access road type (-1,1)	-1. Earth 0. Murram/Gravel 1. Tarmac/metal
			Government role (-1,1)	-1. Negative effect 1. Positive effect
		Household location (-2,2)	Distance from access road (-2,2)	-2. > 1000 m -1. 501 - < 1000 m 0. 101 – 500 m 1. 51 - < 100 m 2. 0 - < 50 m
<b>Source: Adopted from Mwamba 2012</b>				

The HACI is a function of variables like economic wellbeing & stability, dependency ratio, interconnectivity in higher level processes, susceptibility to environmental changes, awareness level & actions taken as well as the prevalent institutional & infrastructural environment-factors considered as external influences affecting household adaptive capacity. The absolute minimum value of HACI is -15 (biggest possible negative value with -11 from Internal Sub Index and -4 from External Sub Index), which will show maximum vulnerability and minimum adaptive capacity, while the absolute maximum is +13 (consistent with the biggest possible positive value from, +8 from Internal Sub Index and +5 from External Sub Index) showing maximum adaptive capacity and minimum vulnerability.

### **3.4 Study Area:**

Chitral is located in the Khyber Pakhtunkhwa province in the north west of Pakistan. Chitral shares its border with Ghizer on the east side, with Dir and Swat on the South, Nuristan of Afghanistan in the West and on the North West a small area of Wakhan separates Chitral from a direct road link with Tajikistan Area of Central Asia. The mountain ranges that surround Chitral are Hindukush range in the North West, Hindu



Raj range by the East South and by the beautiful Shandur Karakorum range in between. The area is located at an alleviation of about 1070 m in the Arandu area in the south and at 7,960 m at the Terichmir area. The District has two administrative units (Tehsil Chitral and Tehsil Mastuj), 24 Union Councils and 523 villages in these (Wali Muhammad Khan & Salman Uddin, 2015). . The land cover of Chitral consists of mountains and glaciers. 62% of the land of Chitral is used for grazing, while 7.7% consists of agriculture and forest area and the remaining 30.3% is covered by glaciers and snow peaked mountains and rocks (Rasheed, 2015).

The main livelihood of the people of Chitral is Agriculture. Most of the area of Chitral is single crop zone almost 60%, while double cropping is also done in some parts of upper and lower Chitral. Wheat, Barley and Maize serve as the main cash crops of the area. (Wali Muhammad Khan & Salman Uddin, 2015). The climate change and global warming has started creating problems for this area as Chitral is situated in area which has been considered prone to multiple hazards. The people of the area lose their hard-earned means of living every year in the form of loss of property and infrastructure due to natural calamities. Natural calamities like GLOFs, earthquake, flash floods, landslides, debris flows, soil erosions, heavy rains and riverbank collapses are the most common natural hazards in this district (Shrestha & Bajracharya, 2013). In 2015, floods affected five UCs and twenty-one villages of the district and damaged property and infrastructures worth millions of rupees. The main causes of these damages were flash floods caused mainly by short duration heavy rains in the mountain. The melting of glaciers affects the communities and the watersheds in the Himalayan areas and other mountainous areas nearby (AKRSP, November 2008).

### 3.5 Sampling Design

Primary data was collected from 200 respondents using purposive sampling technique from the recently affected villages of Reshun, Greenlasht, Brep and Muzgol of Tehsil Mastuj, District Chitral. The given areas are purposively selected as these were badly affected by the GLOF and Flash floods in the years 2015 and 2016.

<b>Table 3.3 : Sample Size</b>			
S. No	Village	Total number of households	Sample size
1	Reshun	3038	84
2	Green Lasht	401	11
3	Brep	2780	76
4	Muzgol	1049	29
	<b>Total</b>	<b>7268</b>	<b>200</b>

Source: Bureau of Statistics Planning & Development Department Government of KP 2015

### 3.6 Regression Analysis:

Once the factors influencing HH's vulnerability are known, it is important to identify the coping strategies adopted by the HH's to minimize current damages and reduce changes of future losses. In response to extreme climate events, HHs resort to certain coping strategies like saving money, temporary arrangements and permanent migration. Therefore, this study will enquire about the measures taken (as coping strategies) after floods and GLOFs in affected areas of Chitral. It is also important to identify factors which can influence the choices of certain coping strategies. The following regression equation (adapted from Notenbaert, 2012) will be estimated for the analysis of factors influencing the choice of given coping strategy by the household.

$$Y_i = \alpha + \beta X_i + \epsilon_i$$

Where  $Y_i$  stands for the following household's coping strategies<sup>1</sup> like:

- a) Permanent Migration from flood zone
- b) Use of Safe Shelter Homes during the floods (alternative settings as temporary arrangement)

While  $X_i$  is the vector of independent variables for the regression analysis. The set of independent variables along with brief description is presented in Table 3.4 below. As the dependent variable is binary in nature, therefore logistic regression technique would be used for estimation.

<b>Table 3.4: Variable Composition</b>			
<b>S. No</b>	<b>Variable name</b>	<b>Type</b>	<b>Variable explanation</b>
<b>List of Dependent Variables indicating HH's coping strategies</b>			
2	Migration from flood zone	Dummy, binary	If HH has migrated=1, otherwise 0
3	Use of Safe Shelter Homes	Dummy, binary	If HH has safe shelter homes to occupy during floods=1, otherwise 0
<b>List of Explanatory Variables</b>			
<b>A</b>	<b>Geographic Factors</b>		
	Distance to water (Drinking and cooking)	Continuous	Kilometer
<b>B</b>	<b>Demographic Factors</b>		
1	Age of HH head	Continuous	Years
2	HHH years of education	Continuous	Years
<b>C</b>	<b>Socioeconomic Factors</b>		
1	Access to rangeland	Dummy, Binary	Dummy: 1 = Yes, and 0 =No
2	Access to forests	Dummy, Binary	Dummy: 1 = Yes, and 0 =No
3	Income diversification index	Index	Index
4	Role of Government	Dummy, Binary	Dummy: 1 = Yes, and 0 =No
5	Times hit by flood	Continuous	Number

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<sup>1</sup> "Savings" as a coping strategy was dropped later due to limited number of observations

## CHAPTER 4

### RESULTS AND DISCUSSION

#### 4.1 Demographic Situation:

Survey was done in the villages that were badly affected by the Flash floods and GLOF of 2015 and 2016. Household heads (HH) were targeted for survey interviews, however, in the absence of HH, an adult member was interviewed. The age of the respondents ranged from 17 years (only one case) to a maximum of 85 years with the following distribution:

<b>Age Range (Years)</b>	<b>Frequency</b>	<b>Percentage</b>
17-40	49	24.5
41-60	109	54.5
61 and above	42	21
<b>Total</b>	<b>200</b>	<b>100</b>

This variation in age difference has helped to take the perception of different aged individuals. All the respondents were the inhabitants of the area and had been living there since their birth. The educational status of the respondents ranged from no formal education (17 cases) to graduation (43 cases) with only few individuals with higher level of education i.e. master's degree level (5 cases). All the individuals interviewed were male and this is the limitation of the study due to the traditional nature of male dominancy as the head of the family. With the passage of time, the education facilities have increased, hence, HH members have usually higher level of education than the HH head. According to the survey results, the educational level of the household members ranges from primary education (metric) to higher level of education. The basic family system is joint nevertheless with the passage of time

nuclear families has also emerged. Family size ranged from single family with minimum 3 individuals to joint families having as many as 17 individuals.

#### 4.2 Main Causes of GLOF and FF.

The effects of climate change are evident across the globe and every country is facing the problems of climate change in the form of erratic rain patterns, extreme temperatures, loss of biodiversity, change in ecosystem patterns and many more. For the mountainous areas climate change poses a great threat in the form of Flash flood (FF) and possible GLOF due to increase in temperatures. According to the people of

<b>Cause</b>	<b>Percentage</b>
Unequal pattern of rain	31.6
Climate change and glacier melting	18.3
Population growth	5.8
Encroachment along water channels	2.2
Overgrazing	24.1
Deforestation	16.3
Other	1.6
<b>Total</b>	<b>100</b>

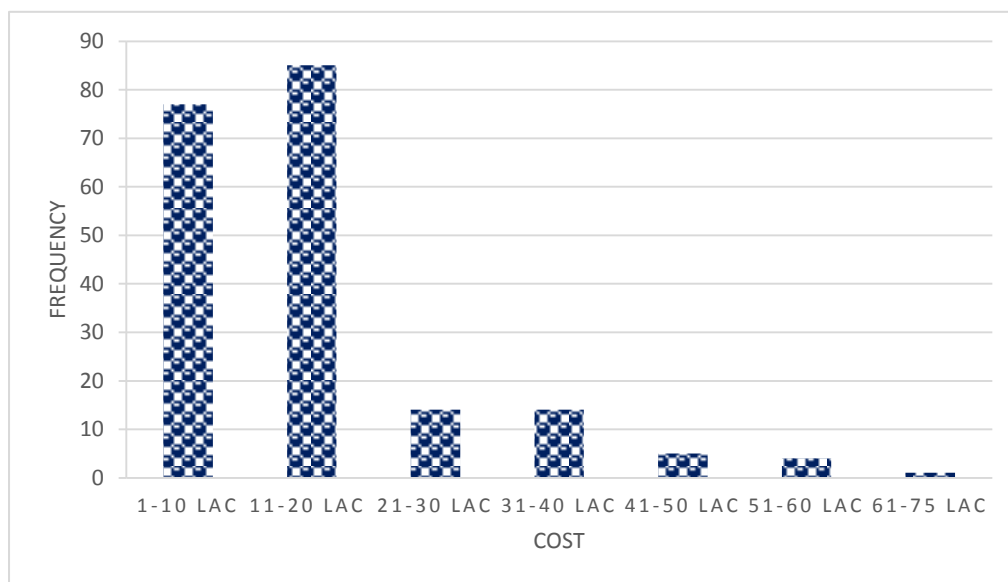
the area the main reason for GLOF and FF are:

Three main reasons of floods in the area as per the sampled HH are, unequal patter of rain (31.6%), Overgrazing (24.1), Climate change and glacier melting (18.3%), Deforestation (16.3%).

#### 4.3 Economic Losses due to GLOF and FF

From 2001 to 2016 there has been 57 incidences of flood events in Pakistan. These floods affected 46 million people causing 6,584 deaths along with 10,718 injuries and rendering 13,550 as homeless. The total damage of these incidence is 18 million USD (Source: <http://www.emdat.be/>).

Chitral has also faced severe flooding in the year 2005, 2010, 2015 and 2016. The most recent incidences of floods were devastating and caused a huge loss. As per survey data of 200 HH the economic losses in term of monetary value ranged from a small value of one lac to more than 50 lacs. This is shown in the Figure 4.1 as below:



**Figure 4.1: Economic Losses Due to GLOF and FF**

The graph shows that 80% (162) of the sampled HH have faced an economic loss of one lac to 20 lacs due to these floods and GLOFs. These were the minimum losses faced while the remaining HH have faced losses ranging from 21 lacs up to 75 lacs due to GLOF and FFs.

#### **4.4 Descriptive Analysis of Household Adaptive Capacity Index (HACI)**

The descriptive analysis is based on the Framework designed in the Research and Methodology section, [Table 3.1 sub-index sections I to V & 3.2 Sub index (VI)] with tabulated figures and explanation of variables given in Appendix I (see Appendix I for detail). Having discussed the basic characteristics of the household, given below are the details of the adaptive capacity of the HH living in the affected areas. The HH's adaptive capacity rests on a number of factors which are mentioned

along with their contributing maximum and minimum sub-indices in Methodology section. The given frame work is used for the calculation of HACI for the 200 household with their frequencies and sub-indexes for each unit and then calculated the HACI. Following are the details of units and their sub index values for the calculation of the HACI.

#### 4.5 Economic Wellbeing and Stability

The economic wellbeing and stability rests on the components of income sources of a family. A diverse income source means more sources to depend for the earning. The scale for the economic wellbeing and stability with value 0 show no economic wellbeing while 4 indicates maximum level of wellbeing and no vulnerability (*as discussed in Table 3.1 sub-index I*).

##### 4.5.1 Income Diversification of Household:

Income diversification plays an important role in the stability of a family, the more diverse sources of incomes a family has, the better off the family is as compared to others. If a family has only one earning source and the source is affected by any natural calamity, the family has low capacity to cope as compared to family having

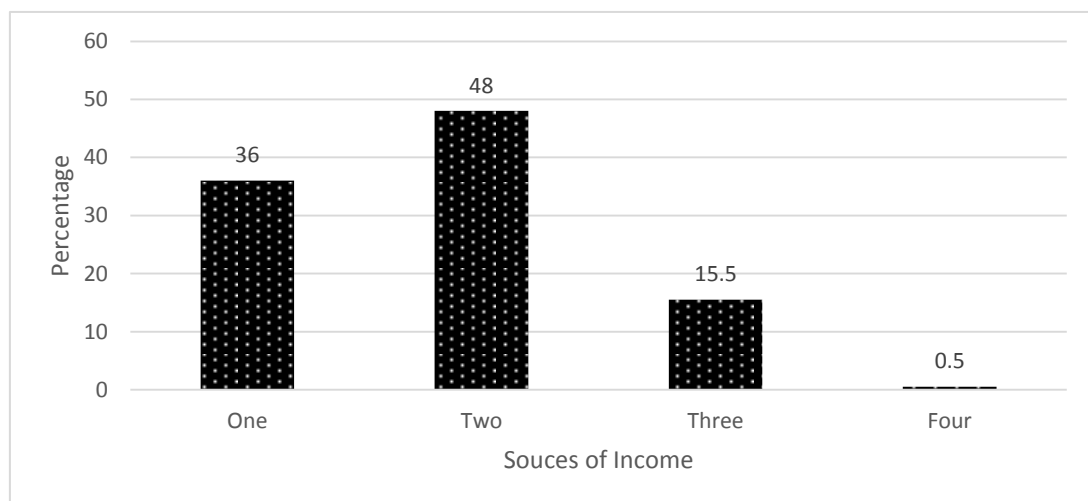


Figure 4.2: Sources of Incomes

more than one source.

The graph clearly indicates that majority of the population have more than one sources of incomes and hence are in a better position as compared to the other section of the population who rely on only one source of income (36% of the population). The contribution of one income source to the sub index is 1. The contribution of two incomes is 2 and this accounts for the 48% of the population while only 15.5% have a contribution of 3 points to the sub index with three source of incomes (*as discussed in Table 3.1 sub-index I*).

#### 4.5.2 Sub index of Economic wellbeing & stability

<b>Sub Index Values</b>	<b>Frequency</b>	<b>Percent</b>
1	72	36
2	96	48
3	31	15.5
4	1	0.5
<b>Total</b>	<b>200</b>	<b>100</b>

The maximum Sub index value that could be achieved for the economic wellbeing is 4 while minimum value is 0. Given above statistics we can say that more than half of the sampled population, having only one or two sources of income, is more vulnerable as compared to those who possess more than two sources. From the given accumulated sub index 84% of the population have only 2 sub-index value and are more vulnerable to changing environmental patterns and natural calamities in Chitral as compared to the sub-index value 3 or 4 with minimum vulnerability.

#### 4.6 Dependency Ratio

Non-working members and family members with terminal illness increase the vulnerability of a family as both cost the extra sum of money that could be saved for



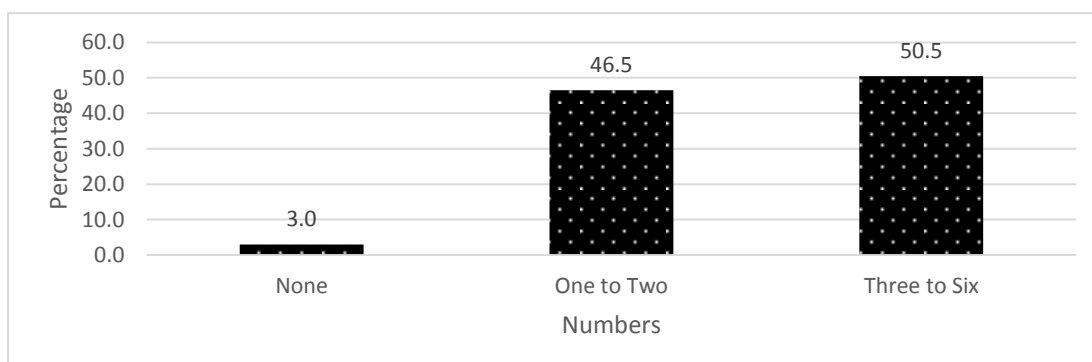
future use. The dependency ratio is calculated from the cumulative figures of Nonworking members and prevalence of terminal illness like TB, Blood Pressure, and Heart Problems etc. in the family (*as discussed in Table 3.1 sub-index II*).

#### 4.6.1 Nonworking Members:

The non-working members of the family increase the vulnerability of the family as they are dependent on the earning members for their living. Due to traditional norm of the area the existence of early age marriages and high ratio of birth still prevails in some areas of the District. The number of dependent individuals along with the frequency and percentage is given as:

Non-Working Members	Frequency	Percent
None	6	3.0
One to Two	93	46.5
Three to Six	101	50.5
<b>Total</b>	<b>200</b>	<b>100</b>

Half of the population has dependency ratio of 3-6 persons making the dependent percent to 50.5% while the dependency of the remaining is 1-2 persons making them more resilient as compared to the previous ones. Only 3% of the population are self-sufficient with zero dependency ratios making them as the most resilient section of the society. The contribution of these values to the sub index of dependency ratio are - 1 for one to two non-working members and -2 for three to six non-working members while HH with no nonworking member have 0 contribution in the calculation of the



**Figure 4.3: Non-working Members**

sub index.

#### 4.6.2 Member with Terminal Illness

The occurrence of terminal illness in a family weakens the adaptive capacity of the family because of the dependency of the ill persons on the other members of the family. At the same time, it affects the adaptive capacity of the family in terms of monetary value, as terminal illness requires continuous care and regular visits to hospital facilities.

<b>Table 4.5: Terminal Illness</b>		
<b>Number of persons</b>	<b>Frequency</b>	<b>Percent</b>
One person	3	1.5
None	197	98.5
<b>Total</b>	<b>200</b>	<b>100</b>

The natural environment of the area and availability of pure and natural items have a positive effect on the health of the people. Therefore, the ratio of terminal illness is very low in these areas as compared to other regions of the county. As low as only 1.5% of the sample were reported with some terminal illness while 97% of the population does not have any such illness. The presence of one terminally ill person in a family contributes -1 value to the sub index while 0 is assigned for a household with no such cases. Prevalence of more ill persons in a family is a sign of higher vulnerability as compared to families with one or no cases of terminal illness. The above table shows that the number of terminally ill in HH is very low hence indicates a low vulnerability on this front in Chitral. The level of vulnerability increases with the increase in number of terminally ill persons in the family, nevertheless from the given data it is clear that the locals of the area are healthy and having a very low level of vulnerability in respect of terminal illness.

### 4.6.3 Sub Index of Dependency Ratio

As discussed, the total Dependency ratio is the aggregate of the values of Nonworking members and the existence of Terminal illness in the family.

<b>Table4.6: Cumulative Frequency of Dependency ratio</b>		
<b>Sub Index values</b>	<b>Frequency</b>	<b>Percent</b>
-3	2	1
-2	100	50
-1	98	49
<b>Total</b>	<b>200</b>	<b>100</b>

The maximum and minimum values, the dependency ratio could have, were “-4” to “0” (*as discussed in Table 3.1 sub-index II*), showing maximum vulnerability to no vulnerability, respectively. However, from the combined effect of non-working members and terminal illness, the calculated values for the sampled data show a maximum vulnerability range of -3 with only 1% of the population, while half of the sample shows a vulnerability of -2 and 49% show vulnerability of -1 as given above. This shows that on account of terminal illness and nonworking members, the area is more robust and do not have extreme values. Yet there are factors that negatively affect the HH’s adaptive capacity on the front of dependency ratio.

The sub index shows that dependency ratio of 51% of the population contributes points -2 to -3 to the final HACI. They are facing a high level of dependency ratio and thus show a very high level of vulnerability that reduces the adaptive capacity of the households. While remaining 49% contributes -1 to the sub index, comparatively less vulnerable. Out of a population of 200 only 98 have better dependency ratio while 102 are more vulnerable to climatic changes and uncertain events.

## 4.7 Interconnectivity in Higher Level Processes

Interconnectivity in higher level processes includes the contribution of Geographical scope of social capital contacts and other social categories relied during shocks [*as discussed in Table 3.1 sub-index (III)*]. A detailed explanation is given as

### 4.7.1 Geographical Scope of Social Capital

A strong bond and good relations within tribes and within friends always help in bad times. Households having good social contacts are more adaptive and less vulnerable as compared to those who like to live in isolation.

<b>Table 4.7: Social Capital Contacts</b>		
<b>Social Capital Contacts</b>	<b>Frequency</b>	<b>Percent</b>
None	6	3
One to Two Contacts	8	4
Three or above Contacts	186	93
<b>Total</b>	<b>200</b>	<b>100</b>

Given above data 93% of the households have three or more (dependable) contacts while only 7% have either one to two or no contacts at all. This is due to the traditional norms of the area as the people living there have relations and active contacts within; whether they are relatives, tribes man or else. This is the unique culture of the area that people live in harmony and help each other in times of need.

Household with no contacts contribute 0 in the calculation of sub index while those with 1-2 contacts contribute 1 point and those with three or more social capital contacts contribute 2 points to the calculation of the sub index of inter connectivity.

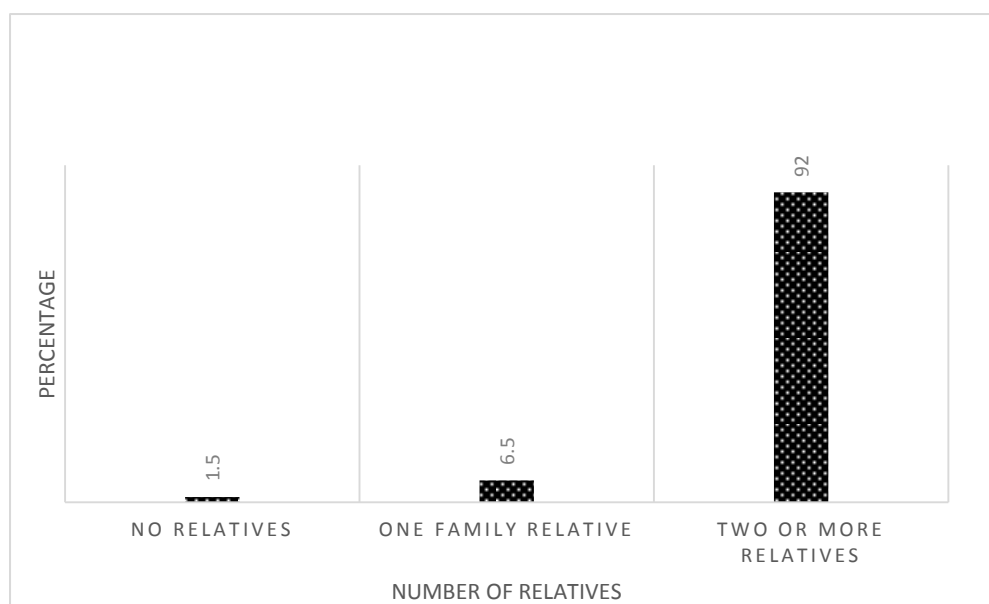
From the above given table it is clear that more than 90% contribute 2 points while the remaining contributes 1 and 0 respectively.

#### 4.7.2 Social Categories Relied during shocks

Families with strong family support have the capacity to cope with difficult times much easier and within short span of time, therefore good relations with social categories are important.

<b>Social Categories</b>	<b>Frequency</b>	<b>Percent</b>
No Relatives	3	1.5
One family relative	13	6.5
Two or more relatives	184	92
<b>Total</b>	<b>200</b>	<b>100</b>

As mentioned above, the social circle is very strong and the figures shows the same with 92% of the sampled population having two or more family relative while 6.5% have only one family relation within the area. Very limited percentage of 1.5 reported no relatives living in the area. The contribution of 2 points is assigned for families having more than one relation while 0 for no family relation.



**Figure 4.4: Social Categories Relied During Shocks**

From the Figure the maximum value is for two or more relative and accounts for 92% while remaining two categories show contribution of 6.5% and 1.5% respectively.

This shows that majority of the households are in less vulnerable position given the traditional norms and cultural attributes of having more family relative to help in worse conditions.

#### 4.7.3 Sub Index of Interconnectivity in Higher Level Processes

The values calculated above is used to construct the sub index for the interconnectivity of higher level processes. The maximum and minimum range constructed were 0 showing lowest capacity and 4 showing maximum capacity to adapt. This will further be used for the calculation of the Household adaptive capacity index.

<b>Scale</b>	<b>Frequency</b>	<b>Percent</b>
0	0	0
1	3	1.5
2	4	2
3	18	9
4	175	87.5
<b>Total</b>	<b>200</b>	<b>100</b>

The range of values for the interconnectivity in higher level process was 0-4 with 0 being the lowest and 4 the maximum level showing higher adaptive capacity and lowest vulnerability.

The above figures calculated by the frequency distribution of both factors of sub index III in Table 3.1, show that the dependence on family relative and other social circles like tribes and friends is very strong having a total sub index of more than 90% showing at least three or more social contact to rely on during shocks. The remaining 10% have either one or two contacts to rely on and thus are more vulnerable to unforeseen events as compared to others. The area under research has once again performed better on this front as well

## 4.8 Susceptibility to Environmental Changes

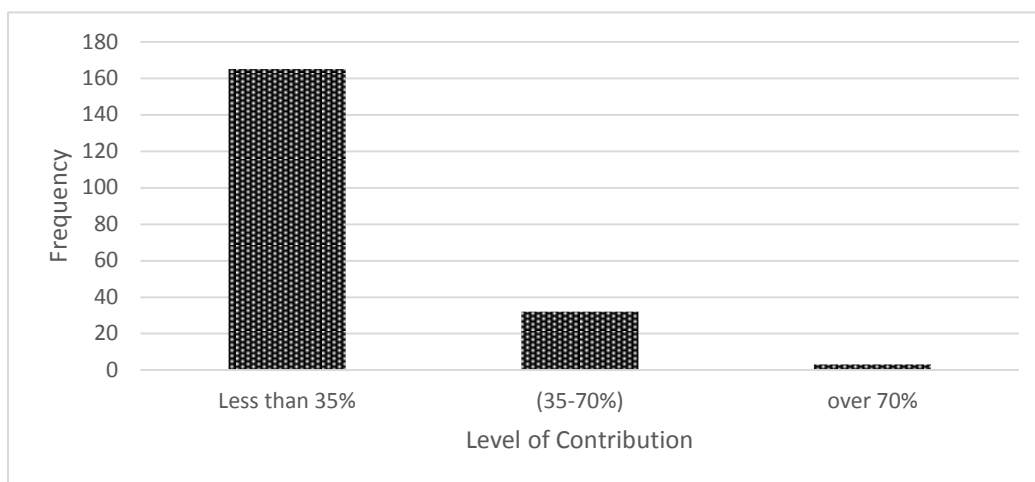
Nature plays an important role in determining the socio-economic status and wellbeing of humans. The susceptibility to environmental changes takes this environmental factor into account while looking into the vulnerability and adaptive capacity for the research area. This includes the contribution of farming in day to day life, source of water, and cooking resources (*as discussed in Table 3.1, sub index IV*).

### 4.8.1 Farming Contribution to Wellbeing

As mentioned earlier in the introduction, only 7.7% of the area of Chitral is used for Agriculture and forests. Almost every individual is somehow engaged with farming. Wheat is the major crop in areas of single farming whereas in some areas maize is also cultivated. Livestock also play an important role in the lives of these people and is also a major source of food for winter season.

<b>Farming Contribution</b>	<b>Frequency</b>	<b>Percent</b>
Less than 35%	165	82.5
(35-70%)	32	16
over 70%	3	1.5
<b>Total</b>	<b>200</b>	<b>100</b>

Majority of the population use farming to meet the basic need of wheat and the fodder requirement and do not dependent solely on Agriculture for their living. Table 4.10 above shows that for 82.5% of the sampled population, the contribution of farming is less than 35% of their total wellbeing while 16% were dependent on agriculture for their 35-70% wellbeing. Only 1.5% reap more than 70% of their wellbeing from agro sector. The dependence of less than 35% gives a value of -1 while for the rest of the share the sub index values are -2 and -3 respectively. This has been graphically given as:



**Figure 4.5: Contribution of Agriculture into wellbeing**

The dependence on agriculture shows maximum vulnerability which can affect the family adversely if climatic conditions change erratically.

#### **4.8.2 Cooking Energy Source**

A mixed form of cooking energy source in the form of gas, electricity and coal reduces the dependence on wood fuel for meeting the cooking and other energy source and hence indicates a less vulnerability. Whereas exclusive dependence on wood fuel shows a maximum vulnerability as these resources are damaged by the floods and other natural disasters.

<b>Energy Sources</b>	<b>Frequency</b>	<b>Percent</b>
wood fuel + gas/electric	111	55.5
Exclusively wood	89	44.5
<b>Total</b>	<b>200</b>	<b>100</b>

From the figures dependency on a mix form of energy is 55.5% that is a sign of less dependency on wood and shows less vulnerability. At the same time exclusively wood is 44.5% which is indicative of a more vulnerable section of the society who



solely depend of resource like forest for making up their energy source for cooking and other heating requirements and this contributes -3 to the sub index and also indicates the vulnerability. The dependence on wood fuel along with gas and electric sources of energy dominate the area and shows a less vulnerable situation while those who could not afford these sources depend on wood for their energy requirements which in most cases is collected from common property resource like forest wherever available or from personal lands. This exclusive dependence on wood source is a major vulnerability. The contribution of the wood fuel along with gas/electric source gives a value of -1 for the calculation of sub index while -3 is the assigned value for exclusive wood with the maximum vulnerability index.

#### **4.8.3 Source of Water**

Source of water that is open and can be effected by climatic conditions affect the health conditions and thus increases the vulnerability to diseases and health issues. While a properly arranged taped water facility will increase the adaptive capacity of the human body from water born and other water related diseases.

<b>Table 4.12: Source of Water</b>		
<b>Source</b>	<b>Frequency</b>	<b>Percent</b>
Tap Water	200	100

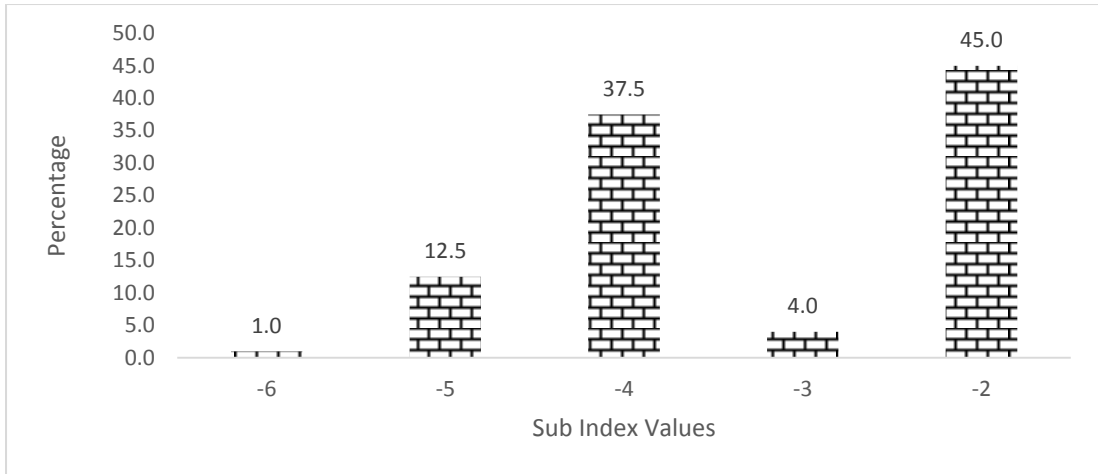
This is unique and might be surprising to know that all the households in the area are linked with properly managed tap water for drinking, cooking and other requirements. This improves the adaptive capacity and contributes 0 to the calculation of sub index showing a minimum vulnerability. There is a 100% distribution of water through tap and this is possible due to the huge contribution of different NGOs working in the area special BASIP, AKRSP, SRSP, and other NGOs working in the area.

#### 4.8.4 Sub Index of Susceptibility to Environmental Changes

The values from each factor are combined to calculate the sub index value for susceptibility to environmental changes as shown in table below:

<b>Table 4.13: Sub Index of Susceptibility to Environmental Changes</b>		
<b>Sub Index</b>	<b>Frequency</b>	<b>Percent</b>
-6	2	1.0
-5	25	12.5
-4	75	37.5
-3	8	4.0
-2	90	45.0
<b>Total</b>	<b>200</b>	<b>100</b>

From the constructed values from Table 3.1, the sub index values were -7 showing the maximum vulnerability and -2 showing the minimum vulnerability due to environmental changes. Whereas the calculated values vary from -2 showing minimum vulnerability to -6, showing the most vulnerable situation given the prevailing conditions. Based on the calculated value of sub index, 49% of the population show less vulnerability and more adaptive capacity while 51% of the population is adversely effected by the changes in environmental factors that affects the economic conditions and make them vulnerable. This is presented graphically as:



**Figure 4.6: Susceptibility to Environmental Changes**

#### 4.8.5 Awareness Level and Action Taken

There is a very famous saying that, “*A stitch in time saves nine*” so is the ability and awareness about changes in the climatic conditions of the area. The ability to ascribe the change in climatic variations and planning accordingly is very important.

<b>Awareness level</b>	<b>Frequency</b>	<b>Percent</b>
No	3	1.5
Yes	197	98.5
<b>Total</b>	<b>200</b>	<b>100</b>

Living in the valley for the past many years, the people of the area have their own science of reading the change in climatic conditions. The color and the movement of cloud, blowing of wind, etc. all have meanings and can be used to forecast weather. The figure shows that 99% of the inhabitants of the area feel the change in climate and are aware of changing season, rain pattern and extreme weathers both in winter and in summers. The clear majority of the inhabitants showing 99% awareness about

change in weather pattern give a value of 1 to the sub index while only 1% is unaware giving a value of 0 to the calculation.

#### 4.8.6 Calculation of HACI without External Sub Index

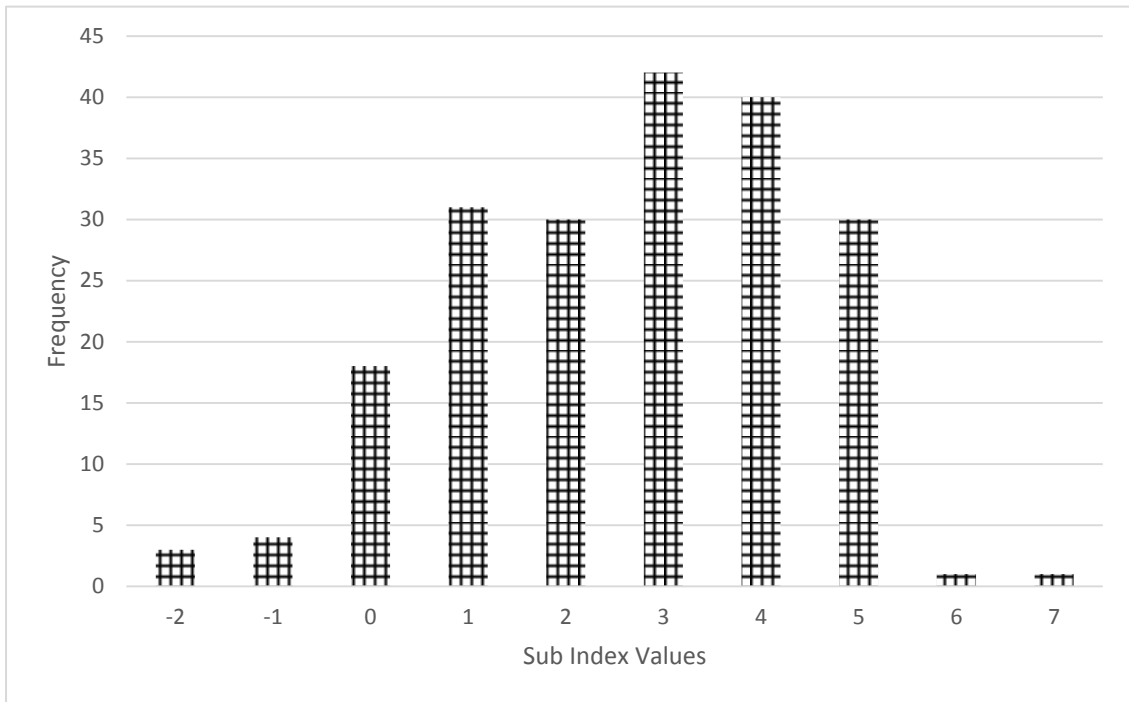
Summing up all the sub-indices we come up with the HACI for the households without external sub index. The assigned values were -11 showing maximum vulnerability and 8 showing maximum adaptive capacity and minimum vulnerability (*as discussed in Table 3.1 sub-index I to V*).

. However, the values calculated from the sample data are given below:

<b>Table 4.15: HACI Without External Sub Index</b>			
HACI Values	Frequency	Percent	Cumulative Frequency
-2	3	1.5	1.5
-1	4	2	3.5
0	18	9	12.5
1	31	15.5	28
2	30	15	43
3	42	21	64
4	40	20	84
5	30	15	99
6	1	0.5	99.5
7	1	0.5	100
<b>Total</b>	<b>200</b>	<b>100</b>	

From the frequency distribution the calculated values of the HACI ranges from -2 to 7 showing most vulnerable to maximum adaptive capacity. Majority of the values are falling in the positive region showing a more robust environment. Taking 2 as the least acceptable value for adaptability we can see that 43% of the population are

vulnerable because they are having HACI value less than or equal to 2 while the remaining 57% are more adaptive as compared to the previous ones.



**Figure 4.7: HACI without External Sub Index**

The graph clearly indicates that majority of the values falling between the range of 1 to 4 showing more adaptive capacity and less vulnerability. Whereas aggregate value of HACI from 4 to 7 values shows higher adaptive capacity to deal with the calamities and changing environmental patterns.

#### **4.9 Calculation of HACI from External Sub Index**

##### **4.9.1 Institutional and Infrastructural Environment**

The factors that are not in the control of the household but affects the vulnerability of the same are calculated in the external sub index. The contribution of common property access, the availability of public sector services in the affected area and the location of the household, all contribute to the calculation of Institutional and Infrastructural environment which intern determines the external sub index. The

minimum value that it can take is -4 showing maximum vulnerability and maximum value 5 showing minimum vulnerability for the external factors on the household (*as discussed in Table 3.1, sub index VI*). The details of data for external factors are given as below.

#### **4.9.2 Common Property Access**

Access to common properties like grazing lands and forests has always been the source for improving the quality of life of rural people. The access to these resources have a positive effect on the lives of rural people in the form of resource available for wood, animal rearing etc.

<b>Table 4.16: Access to Common Property Resources</b>		
<b>Common Property Access</b>	<b>Frequency</b>	<b>Percent</b>
No	10	5
Yes	190	95
<b>Total</b>	<b>200</b>	<b>100</b>

The accessibility to resources will give a value of 1 while the non-availability of such access renders 0 to the sub index. Given above condition 95% of the population have access to the resource while only 10% said that they do not have access to such resources. This shows that 190 of the individuals out of 200 individuals do have common property access which is 95% of the people sampled and contribute value 1 while only 5% have no access and are vulnerable and contributes 0 to the value of external sub index calculation.

### 4.9.3 Public Service Accessibility in the Affected Areas

The availability of services like access road and government help in evacuation and rehabilitation helps in coping with the situation and improves the adaptability level of the households

### 4.9.4 Type of Access Road

Roads play an important role in timely delivery of help to the affected areas and reduces the level of vulnerability of the affected individuals.

<b>Table 4.17: Type of Access Road</b>		
<b>Road Type</b>	<b>Frequency</b>	<b>Percent</b>
Earth/kacha roads	139	69.5
Metal/pakka raods	61	30.5
<b>Total</b>	<b>200</b>	<b>100</b>

The vast percent of the population almost 70% do not have access of metal roads and this makes them more vulnerable and contributes a unit -1 to the sub index while 30% have proper road access and can be reached in short span of time during floods. This contributes point 1 for the calculation of the sub index. The frequency of individual connected by earth road is large as compared to metal roads and this shows a more vulnerable situation to much of the population. The reason is that delivery of help and other necessities will take time to be delivered in nonmetal road and heavy vehicles cannot go to areas where there are no proper roads.

### 4.9.5 Role of Government

The simple question regarding the role of governments was any facility provided to and if the effected people are satisfied with that support.

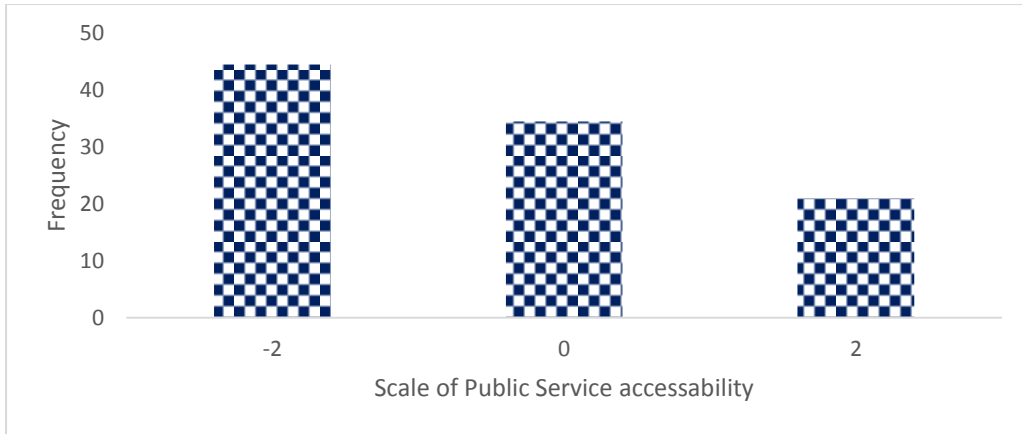
<b>Table 4.18: Role of Government</b>		
<b>Role of Government</b>	<b>Frequency</b>	<b>Percent</b>
No Effect	108	54
Positive Effect	92	46
<b>Total</b>	<b>200</b>	<b>100</b>

Most the people affected from the recent floods were of the view that government did very little to help them to cope with the floods in the form of food, material and cash grants for rehabilitation. 54% of the sampled HH were dissatisfied and said that there was no effect of government help on their life after floods while 46% were of the view that it has a positive effect. The responses with no effect yields a value of -1 to the sub index while positive effects give 1 point in the calculation. Combining the factors of access road type and role of the government we come up with the values for the calculation of Public Service accessibility in the affected region.

<b>Table 4.19: Public Services Accessibility in the Area</b>		
<b>Public Service Accessibility</b>	<b>Frequency</b>	<b>Percent</b>
-2	89	44.5
0	69	34.5
2	42	21
<b>Total</b>	<b>200</b>	<b>100</b>

The frequency of 89 with severe vulnerability level of -2 along with 69 households with 0 gives total of 79% for the most vulnerable and shows a maximum vulnerability from 0 to -2.





**Figure 4.8: Index for Public Service Accessibility**

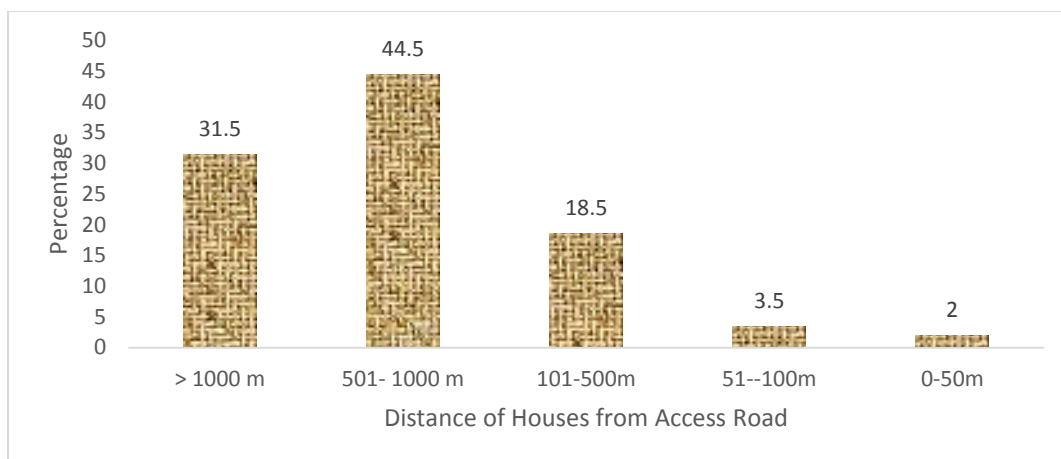
The range of Accessibility to public services comprised of access road type and role of government in the time of calamity for provision of basic lifesaving services. The scale is -2 to 2, which gives a scale of most vulnerable situation with value of -2 and least vulnerable situation with a positive 2 value. From the graph, the frequency of least vulnerability is the lowest with only 42 out of 200 with a percentage of merely 21% while remaining 79% fall in the most vulnerable portion.

#### **4.9.6 Household Location**

<b>Distance</b>	<b>Frequency</b>	<b>Percent</b>
> 1000 m	63	31.5
501- 1000 m	89	44.5
101-500m	37	18.5
51--100m	7	3.5
0-50m	4	2
<b>Total</b>	<b>200</b>	<b>100</b>

Natural calamities affect the infrastructures in the area and thus causes hindrance in the timely delivery of help and rescue facilities. The location of house plays an important role in this case. Houses located in the vicinity of most easily reachable access roads, can be reached easily. These houses are in a better position to cope with the situations whereas houses located in far off areas cannot be reached within due course of time to provide the rescue and evacuation. Even after the flood events, houses located near road facilities can be easily reached and provided with food, water and other utility services. The distance of the affected from the access road is given here from the four affected areas of Chitral.

The table above shows that 152 out of 200 or 76% of the households are living at 500m to 1000 m or above distance from the nearest access roads. This makes them more vulnerable as compared to the other 24% who have access to road from a distance of 500 m or less. 31.5% of the population have a vulnerability level of -2 due to a distance of more than a kilometer from the connecting road while 44.5% have value of -1. The remaining three categories contribute 0, 1 and 2 to the calculation of sub index respectively.



**Figure 4.9: Distance of Households from Nearest Access Roads**

Those living beyond 500 m are more vulnerable as compared to those living within a distance of less than 500 m from access road. It is important to note here that in mountainous areas, even a small distance can be very important hurdle

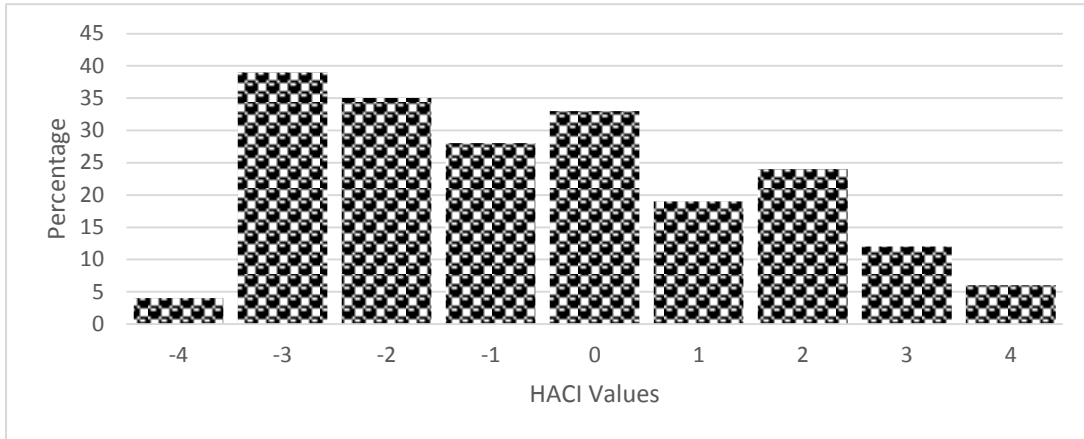
#### **4.10 Measurement of HACI for the Institutional and Infrastructural Environment**

By calculating values from the above given values using frequency distribution we have developed the Sub index for the institutional and infrastructural environment of the area given as:

<b>HACI</b>	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percentage</b>
-4	4	2	2
-3	39	19.5	21.5
-2	35	17.5	39
-1	28	14	53
0	33	16.5	69.5
1	19	9.5	79
2	24	12	91
3	12	6	97
4	6	3	100
<b>Total</b>	<b>200</b>	<b>100</b>	

The external sub index for the institutional and infrastructural environment can have a maximum value of 5 and minimum value of -4, however according to data, the range

is between 4 to -4. 69.5% of the calculated values of the sub index given above show that 140 out of 200 households are in vulnerable status with sub index value from 0 to -4 while remaining 30% are less vulnerable.



**Figure 4.10: HACI for Institutional and Infrastructural Environment**

From the graph above, the HACI scale shows the level of vulnerability. The level of vulnerability increases to the left side and increases to the right side. From left, the graph shows maximum frequency with sub index value -3 and -2 showing a high vulnerability as compared to the frequency of those who are more stable and are on the right-hand side of the graph with sub index value above 0. Hence, on the front of external factors, the area under research is facing vulnerability.

#### **4.11 HACI with Both Internal and External Sub Index.**

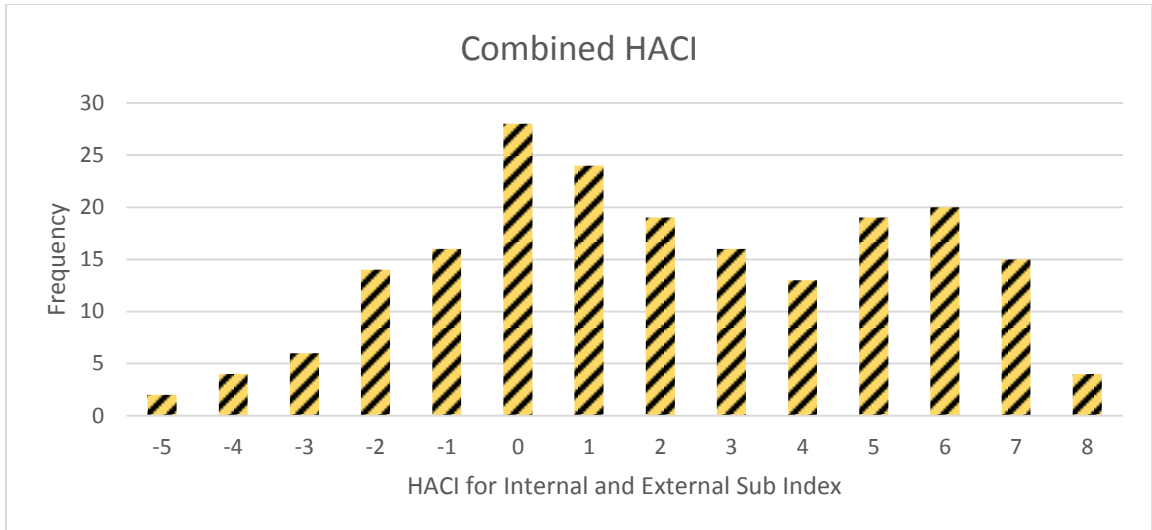
From the Internal and External Sub Indexes, we come up with the total HACI for the household of Chiral. The assumed scale of measurement was -11 and 8 for the internal sub index and -4 and 5 for the external sub index. By combining these two, the final scale of HACI could take the value of -15 (-11 from internal sub index and -4 from external sub index), and 13 (8 from internal sub index and 5 from external sub index). Both the extreme values of -15 and 13 were supposed to indicate the

maximum and minimum vulnerabilities (*as discussed in Table 3.1 & 3.2 sub-index I-VI*).

The Calculated values are:

<b>Table 4.22: HACI for Internal and External Sub Index</b>			
<b>HACI Values</b>	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percentage</b>
-5	2	1	1
-4	4	2	3
-3	6	3	6
-2	14	7	13
-1	16	8	21
0	28	14	35
1	24	12	47
2	19	9.5	56.5
3	16	8	64.5
4	13	6.5	71
5	19	9.5	80.5
6	20	10	90.5
7	15	7.5	98
8	4	2	100
<b>Total</b>	<b>200</b>	<b>100</b>	

However, from the results and figures given here we can see that majority have HACI value from +2 to +8, showing low vulnerability and maximum capacity to adapt to the changing pattern of weather. This indicates that although the unique setting regarding the living style of people in district Chital given than better adaptation capacity due to internal factors, nevertheless, the external factors still leaves them vulnerable.



**Figure 4.11: HACI for Internal and External Sub Index Combined**

The horizontal axis of the graph given above shows the HACI values and run from 0 to -5 on left and from 0 to 8 on right side showing the level of vulnerability. The vertical axis shows the frequency of the HH falling into each category along with the percentages. Households acquiring HACI values 3 and above are considered as less vulnerable and more adaptive to the prevailing conditions. The given picture shows symmetrical distribution with majority of the population in the middle area having HACI value 0 to 6. It is a sign of strong adaptive capacity of HHs with the attributes of strong social contacts, less dependence on environmental goods, availability of knowledge and information regarding climate change issues are able to see that changes and plan accordingly. Only 6% of the sampled population fall in the very high vulnerable zone with low HACI values of -3 to -5. At the same a reasonable number show high adaptive capacity with HACI values from 6-8 showing maximum ability to deal the climatic vulnerabilities and disturbance of GLOF and FF.

## **4.12 Empirical Results for Regressions**

Binomial Regression Method was used to study the adaptation techniques used during floods in the given study area. Once an area is hit by FF and/or GLOF, people feel vulnerable in the future as well. Hence as per the sample data, two main coping strategies were identified as the major coping strategies in the affected areas. Firstly, ‘permanent migration’ is reported to be an important strategy adopted by the HHs in the affected areas while the second option was ‘to flee/vacate’ the area in the time expected disaster but to reoccupy once the danger is over. Sample data exhibited the people in Chitral resorted to Safe Shelters<sup>2</sup> at the time of flood but returned to area of permanent residence once the danger was over. Therefore, migration from the flood affected zone and safe shelter homes (to be used during floods) were used as dependent variables in two different regressions as discussed below.

### **4.12.1 Empirical Results for ‘Permanent Migration’: Dependent Variable 1**

The change in global environment and climate is affecting the ecosystems and communities relying on these ecosystems. Migration as response to environmental change, depends on the stress on environment and the pace of change in the environment that influences the mode of expulsion and migration decisions (Renaud et al., 2011). In this study, we tried to find out how the decision of migration to a new location is effected (after being hit by the FF and/or GLOFs) is affected by factors like age of household head, education level, distance to water, access

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<sup>2</sup> These were allotted to the HHs during the previous occasions of floods but they still retain these and use in case of calamities

<b>Table 4.23: Empirical Results for Binomial Logistic Regression (Dependent Variable: Permanent Migration)</b>
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to rangeland, access to forests, income level, dependency ratio, times of hit by floods, agriculture contribution in income, and role of government in the flood affected area. The regression analysis is given in Table 4.23 And results are discussed below.

As explained earlier permanent migration was used as an adaptation strategy to prevent from recurring GLOF and FF events in the area. This strategy regressed against the independent variables to analyze factors that determine the decision whether to migrate or to stay in the same locality. First, the age of the HH head, reflects the experience of the person responsible for taking HH decisions. According to results with the increase in the age of the HH head, the probability to migrate declines. Although apparently, the results appear against the expectation as he is taking risk to face floods in the future as well but on the contrary, the age might also be reflecting his affiliation to the vicinity. Hence, as age increase, the extend of love and affiliation with the area also reaches the higher levels which restricts migration. The second important variable that can influence migration was education level of the HH head. The education level of graduation or above is statistically significant ( $p < 0.05$ ) but with a negative relation. The negative sign could be due to the non-availability of employment in the new area and job commitment in earlier/permanent place of residence. Majority of the employment in the area is private job, mostly in education sector and other middle level jobs in government offices. Similarly, distance to available water is significant ( $p < 0.01$ ), has a negative relation with migration to the new area.



	<b>List of Independent Variables</b>	<b>Odd ratios</b>	<b>P&gt;z</b>
General Variables	Age of HH Head	0.9611**	0.041
	Illiterate	0.4178	0.306
	Bachelor or above	0.0721***	0.000
Variables depicting situation after floods	Distance to water source	0.3728***	0.000
	Access to Forests	0.4773	0.135
	Access to Rangeland	21.4023***	0.008
	Role of government in affected area	0.1299***	0.000
	Times hit by floods	2.6121***	0.009
	Earning members in family	0.7959	0.432
	Constant	6.1988	0.286
		Number of Obs = 195	
	LR chi2(9) = 68.73		
	Prob > chi2 = 0.0000		

The level of significance is given as: \*\*\* = 1 Percent, \*\* = 5 Percent

In addition to the basic HH characteristics, the situation faced by the HH in the new place after (following the hit by floods) migration also influences their decision to stay or reoccupy their permanent place of residence. Therefore, the other variables explain the effects of factors experienced after being hit by the floods and how these influences HH's decision of migration. Distance to available water is an important variable in the given list and is significant (at 1 percent level of significance). As per expectation, as the distance to drinkable water increases in the new place, it discourages migration to the new area. Water is necessity and readily availability of this source is very essential for survival. This is shown in results as negative relationship with migration as nobody will willingly migrate to an area where the availability of water is not in easy access.

Similarly, the availability of rangelands in the new location has a significantly encouraging effect on migration as availability of rangeland will provide the opportunity to keep livestock for the living. Livestock provides milk and meat, along with the usage in marriage and other traditional ceremonies. This facility also reduces

the dependence on fodder for the animals as animals can rear in the rangelands for most part of the year. Hence, this variable has a positive effect on the decision towards migration.

Normally government help the affected people by providing them the resettlement opportunities in the same locality and provide them with resettlement funds, loans, construction of safety walls etc. These efforts encourage the people to resettle in the permanent place of residence and thus the role of government has a significantly negative effect on migration from the area affected.

Lastly living in a vulnerable, flood prone area weakens the ability to reconstruct and normalization of life after every event. The more one gets hit, the more he/she will be willing to migrate to a new and safer place to start a new life. This effect is depicted in the regression result which show positive relationship between migration and frequency of floods in the area.

Two factors that we were expecting to have a significant effect on migration were total number of earning members in the family and access to forest. Contribution of income to wellbeing and access to forest were supposed to have a positive effect on migration but according to the sample data these two variables remain statistically insignificant.

#### **4.12.2 Empirical Results for ‘Use of Safe Shelter Home During Floods’:**

##### **Dependent Variable II**

The second coping strategy used as dependent variable was the use of temporary shelter homes during floods season. HH occupy these shelter homes during the vulnerable times but return to their permanent place of residence once the flooding is over, while keeping the possession of the said shelter homes for any future use. The

factors that affect the decision for safe shelter are age of household head, distance to water, access to forest, role of government, frequency of floods, income sources, income level 2, income level 3.

The regression results are shown below:

<b>Table 4.24: Empirical Results for Binomial Logistic Regression (Dependent Variable: Use of Safe Shelter During Floods)</b>			
<b>List of Variables</b>	<b>Independent</b>	<b>Odd Ratios</b>	<b>P&gt;z</b>
Age of HH Head		1.017	0.307
Distance to water		0.872*	0.050
Access to Forests		3.735**	0.031
Role of government		3.641**	0.024
Times of hit of floods		3.702***	0.007
Income source		0.997	0.994
Income_2		1.370	0.550
Income_3		3.292*	0.074
Constant		.001***	0.000
Number of Obs = 200			
LR chi2(8) = 64.24			
Prob > chi2 = 0.0000			
Pseudo R2 = 0.3353			

The level of significance is given as: \*\*\* = 1 Percent, \*\* = 5 Percent, \* = 10 Percent

The odd ratios indicate the factor that influence the decision regarding the acceptance or rejection of opting safe shelter as adaptation strategy against floods and GLOFs. Values greater than 1 show a positive influence to adopt the option while values less than one show negative impact on the dependent variable i.e. the rejection of the proposed adaptation strategy.

Results indicate that different factors have varying effects to report to safe shelter homes and keep and keep it in managed form so as to be able to occupy these in the times of calamity. The factor that negatively affect this decision is the distance to drinking water in the new place where safe shelter was initially set up by Government

and NGO respectively. Distance to water is significant and has Odd ration value less than one which show that the availability of water at a long distance will discourage the use of shelter homes as an adaptation strategy.

The factors that positively influence HH's decision to report to Safe Shelter homes are proximity to forests, role of government and frequency of getting affected by floods. The availability of forest will encourage shifting to safe shelters temporarily as forest provide the easy access to fuel wood source without any cost. This is shown with an Odd ration figure having value greater than 1. similarly, the role of government in construction of safe shelters in the form cash grants and other facilities will have a positive effect on the decision. This is also evident from the above result with significant level at 5 percent and Odd ratio being greater than 1. The frequency of the occurrence of floods and the times a family is hit by the floods event is also significant ( $p < 0.01$ ) and with value of Odd ratio greater than 1. The greater the frequency of flood events, more will be the willingness to use (and keep/maintain) safe shelters.

Keeping these shelter homes and bearing the maintenance cost has economic burden. Therefore, income source of the family is very important. As per the experience, the HH's with lower level of income though remained insignificant but HHs with higher income has a greater chance to use safe shelter as adaptation strategy during the time of calamities. This is because with higher income, families can afford the cost of keeping safe shelters to protect their families. This variable achieves high level of statistical significance at 5 percent with a value of Odd ratio higher than 1.

From the regression analysis given above most of the factor showing significant impact towards safe shelter as adaptation strategy. The factors like access to forests,

role of government in construction of safe shelters, frequency of hit by floods and future vulnerability and higher incomes (income level 3) have statistically significant and positive effect on the probability to use shelter home during floods seasons to avoid any losses and to reduce the vulnerability and suffering from flood events.

#### **4.13 Information from the Different Offices in Chitral**

##### **Expert Opinions on the Issues of Global warming, (GLOF) and Flash Floods in Chitral**

Chitral is the largest district of Khyber Pakhtunkhwa. This district was badly affected by the GLOF and Flash floods in 2015 and 2016. According to the information gathered from the Government office of the Assistant Commissioner Booni a total of 26 villages were affected in the upper Chitral region by the GLOF and Flash Flood events during 2015-16. There were 458 incidences of fully damaged infrastructure and 563 partially damaged infrastructure incidences reported from these 26 villages.

To find out the reasons about the GLOF and Flash Floods of 2015 and 2016, some of the organizations were visited during the field study. The given organizations operate in Chitral and were responsible for providing the rescue and rehabilitation service in the affected areas. The office visited included Focus Humanitarian Assistance Program office Balach Chitral, Red Crescent Pakistan Zang bazar Office Chitral, Sarhad Rural Support Programme (SRSP) Junali Dok office Chitral, Aga Khan Planning and Building Service (AKPBS) Balach office Chitral, and Biyar Local Support Organization (BLSO) office located in Booni.

During these visits information (via informal interviews) was gathered from responsible office holders including the ranks of Manager Disaster Risk Reduction Unit FOCUS, Disaster management officer Red Crescent Pakistan, District Program

Manager SRSP, Manager (AKPBS) and Tehsil Nazim and members of BLSO. These organizations were engaged in providing different services during and after the incident of devastated GLOF and Flash Floods of 2015 and 2016.

#### **4.13.1 Main Reasons of GLOFs**

According to the study and practical observations of organization like FOCUS and Red Crescent following were the reason of GLOF and Flash Floods of 2015 and 2016:

1. Over grazing and Grazing of Goats (that uproot the grass and destroy its growth prospects)
2. Too much deforestation in the past that made the areas lying below ice caped mountain barren and grazing of animals near glaciated areas in search of green shrubs and vegetation.
3. Climate change and sharp increase in temperature was also one of the reason of such floods according to Red Crescent Office Chital in 2015 the maximum temperature recorded in Chitral was 43° which was very unusual for the area.
4. The Mountains of Upper Chitral are either Glaciated or rocky with no forest cover. With the increase in temperature the glacier of the mountains melts at very high rate. At the same time Chitral has experienced heavy rain of very short to long durations which increased the melting on one hand and flooded the low-lying areas on the other hand.
5. Mineral exploration and extraction in the area was also one of the possible reason of these events as explorations near glaciers effect these glaciers and with the passage of time becomes factor of disasters.

#### **4.13.2 Services Provided:**

The services provided by the organizations differed as per their working requirements and expertise. SRSP and AKPBS work only on the rescue and relief work in the area.

SRSP provided the following services in the area:

- Rehabilitations of water channels
- Building of safety walls before and after the incidents
- Construction of link roads
- Utility services provision like tap water, electricity etc
- Construction of new and old bridges.
- Distribution of foods and other necessities of life during floods.

Whereas Aga Khan Planning and Building has the specialty in the field of construction. During the said events of Floods and Earthquake the organization has served 43 villages across Chitral and provided 683 shelters to the local people of the area. Majority of the services were provided to Muzgol, Reshun and Brep area which were very severely affected. Only in Muzgol 58 shelters were constructed after the flash flood events and the locals are still using these shelters as their homes.

FOCUS and Red Crescent are the organizations that provided training to local people and have huge number of trained volunteers for rescue and evacuation. Both organization have experts to study the causes and effects of the natural calamities.

Services provided are:

- Emergency relief
- Information regarding resilient structures in the flood effected areas
- Community based early warning systems – watch and ward.
- Awareness regarding building

- Weather alerts regarding possible rains, floods and GLOFs.
- Early evacuation alerts specially regarding avalanches in winter and GLOF and Flash floods in summer.
- Provide trainings and have formed different units like Disaster Assessment Response Team (DART), Search and Rescue Team (SART), Community Emergency Response team (CERT), weather monitoring Units etc.

FOCUS Pakistan has done mapping of 371 villages of the area and out of these 171 villages have been categorized as most vulnerable according to FOCUS Regional office Chitral. FOCUS has 51 Clusters with 19,000 trained volunteers on community levels, 51 stock piles with basic lifesaving materials. The organization has also set up 35 weather monitoring posts from where they receive updates about weather using mobile phone services and from areas with no telecommunication facility like Boroghul in Upper Yarkhoon area, Thuraya Satellite phones have been placed to gather information.

Where BLSO is a village organization that work in collaboration with organizations like Aga Khan Rural Support Program (AKRSP) United Nation Organization (UNO) and its sub organization, Hands International (HI), Malteser International (MI), World Wild Life (WWF) etc. for the protection of grazing areas, afforestation, protection of range lands with awareness session at community level and formation of Khidmatgar Groups in village levels.

#### **4.13.3 Way Forward**

The interviews revealed that to deal with such calamities timely alerts are very useful and for that proper monitoring system needs to be in placed in the area. To minimize



the risk of loss of live, evacuation of people from the most prone and vulnerable area is necessary. The area of Attalegandeh of Brep was totally affected by the 2015 and 2016 floods and according to FOCUS records about 50 houses were fully damaged along with 21 partial damages in this area. Government and organizations like FOCUS have declared it as prone zone and categorized the area insecure for living because of the chances of occurrence of the events in future. Therefore, government has asked the people of the area to leave this area and had provided plots in Khotan Lasht to migrate but the locals are reluctant to move as there are no basic facilities like water, wood for heating and cooking, access to nearby markets and other facilities. Same is the case of Muzgol where people are still living in shelter homes even after two years of the incident. People who have some piece of land have shifted their houses to comparatively safer locations but those who have no lands are forced

<b>Table 4.25: Contacted persons and their Organizational designations</b>				
<b>S. No</b>	<b>Name</b>	<b>Designation</b>		<b>Organization</b>
1	Mr. Amir Mohammad	Emergency Head	Management	AKAH (FOCUS)
2	Mr. Ghafoor Ahmed	Disaster	Management	Red Crescent

to reconstruct

their houses at the same locations and thus could be affected again if the incidence of flash floods happen again in the future.

		Officer	Pakistan
3	Mr. Tariq Ahmed	District Programme Manager	SRSP
4	Mr. Karam	Manager	AKPBS
5	Nazim and Members	Village Nazims and members	BLSO

## CHAPTER 5

### CONCLUSIONS AND POLICY RECOMMENDATIONS

#### 5.1 Major Findings of HACI

The main objective of the study was to examine the vulnerabilities of the affected people of the sample area and to find out the adaptation strategies being adopted by the people after being hit by GLODs and FF. The findings about vulnerabilities are clear from the Calculated HACI. Apart from that, regression analysis was done to find out migration and safe shelter homes as adaptation strategy used by the locals after GLOF and FF. Following are the main conclusions derived from the HACI.

- ❖ The economic stability and wellbeing of the area is low with 84% of the sampled population having only one to two source of incomes. Deriving income from a limited source for a household indicate a high vulnerability as incase the only source of income is destroyed, the HH has no other way to meet ends of life.
- ❖ 51% of the sampled population has shown a higher dependency ratio that is mainly due to non-working members of the family. As the onset of marriage is at

early age and fertility rate is also high so there are more dependents upon single earning members of families.

❖ Almost every family is dependent on agriculture sector and this sector provides up to 35% of wellbeing to 82.5% of the total sampled population. At the same time agro sector provides 35-70% wellbeing to 16% of the total sampled population.

❖ The 44.5% exclusive dependency on fuel wood is also a sign of huge dependence on natural resource and is an indication of vulnerability for the population of the area.

❖ The area is well furnished with water facilities, thanks to the NGOs working in the area. Almost 99% of the facilities provided are NGO based, few governments installed facilities are also there but they are not in good conditions.

❖ Climate change impacts and the changing pattern of rain falls has increased the events of floods and other weather related challenges like loss of crops. On account of susceptibility to environmental changes, the area is facing a huge challenge with 64% of the sampled population falling under vulnerable.

❖ The people of the area are well aware about the changes in the weather pattern and it could be one of the reason that there were very rare cases of death during the GLOF and FF event of 2015 and 2016.

❖ The HACI without the external sub index indicates a combined effect of all the factor effecting HH vulnerability and gives a high vulnerability rate of 64% for the sampled population with minimum HACI values from 3 to -2.

❖ The Public service accessibility for the area has also shown a vulnerability of 79% where 69% are without metal road connection, 54% are of the view that the role

of government has no effect on the rehabilitation and 76% of the population are far away from direct access roads.

❖ 56.5% of the population fall under vulnerable portion on the combined HACI value calculated from both Internal and External sub-indexes. But at the same time we conclude that there are no extreme vulnerability and if supported by the government, majority of the population can improve their HAC.

## **5.2 Conclusion of the study**

From the study we conclude that even after passing two years, the people of the area are living under notable vulnerable conditions. 64.5% of the sampled population have shown high vulnerability in the form of few income source, high dependency ratio, heavy reliance on natural resource for heating and cooking requirements. In addition, lack of proper roads and other infrastructure, negligence of government institutions for the rehabilitations of the area, the possibility of future events of floods and lack of protective measures on individual and on governmental level, lack of electricity, loss of income etc. also plays its role in classifying HHs as vulnerable.

The contribution of agriculture to the wellbeing, the dependency on wood fuel for energy requirements, and the water sources of the area are adversely affected whenever there is a flood and this aggravates the vulnerability of the locals. Moreover, the lack of properly carpeted access roads along with the absence of connecting roads to far off areas after the floods has increased the vulnerability. Due to recent devastating floods, a new problem of land ownership issue has emerged and this has created the natural resource disputes in some of the affected areas.

### **5.3 Policy Recommendations**

1. There is no early warning system installed against GLOF and FF, the government should install early warning system on all vulnerable locations. Though NGOs like FOCUS and Red Crescent Pakistan have trained many volunteers for the rescue and evacuation during emergency situations, but still more is needed with the collaboration of the local government of Chitral.
2. Climate change and resulting seasonal variation are a great threat for the future of Chitral. The government with the help of local community and NGOs should make proper valuation and protection measures. Tree plantation is a good initiative in this regard which needs to be strengthened and it should continue for the coming years so that all barren land and hills can be planted and this will have a great effect on future climatic conditions.
3. Alternate energy source and protecting mountains from goat grazing is a requirement of the area to prevent floods specially flash floods. For that government should come up with a proper mechanism to convince the locals to formalize the cattle size. The provision of alternate energy will reduce deforestation and better grazing pattern will help in the regeneration of vegetation in the mountains that will reduce flash floods in the long run.
4. Government should construct protection walls where it is possible to protect the agricultural land of the locals. Water way extension is also one solution to reduce the effect of floods.
5. Some villages are at great risk of future GLOF and FF disaster, Government should take it seriously and make proper arrangements to protect the lives of the people of those areas. Temporary migration to safe locations is a solution in the short

run but for the long run permanent migration of the locals to a safe location is the only option. Government should take up this matter with the local leaders, religious scholars and community heads to convince them to migrate to new locations before any human loss. For that government should allocation lands for shelter along with some agriculture land so that the local agree to move to new location.

#### **5.4 Limitation of the Study**

The study is conducted for the selected villages; however, future studies can have an in-depth analysis of the area by taking greater sample.

#### **References:**

- Adger, W. N., Arnell, N. W., & Tompkins, E. L. (2005). Successful adaptation to climate change across scales. *Global environmental change, 15*(2), 77-86.
- AKRSP. (2008). An Assessment of socio-economic trends in the Northern Areas and Chitral, Pakistan.
- Chatterjee, D. P., Somayaji, S., & Somayaji, G. (2011). Environmental concerns and sustainable development: Some perspectives from India: JSTOR.
- Din, K., Tariq, S., Mahmood, A., & Rasul, G. (2014). Temperature and Precipitation: GLOF Triggering Indicators in Gilgit-Baltistan, Pakistan. *Pakistan Journal of Meteorology Vol, 10*(20).
- Handicap international, h. a. i., Islamic relief Pakistan and Malteser international. (2015). Joint Accessment Report.

- Hussain, A., Agrawal, N. K., & Leikanger, I. (2016). Action for Adaptation: Bringing climate change science to policy makers-a synthesis report of a conference held in Islamabad on 23–25 July 2015. *Food Security*, 8(1), 285-289.
- Ibrahim, A. (2014). *Gendered analysis of the determinants of adaptive capacity to climate change among smallholder farmers in Meatu and Iramba districts, Tanzania*. Sokoine University of Agriculture.
- Khan, A. N. (2011). Analysis of flood causes and associated socio-economic damages in the Hindukush region. *Natural hazards*, 59(3), 1239-1260.
- Khan, M. A., Haneef, M., Khan, A. S., & Tahirkheli, T. (2013). Debris-flow hazards on tributary junction fans, Chitral, Hindu Kush Range, northern Pakistan. *Journal of Asian Earth Sciences*, 62, 720-733.
- Khan, W. M., & Uddin, S. (2015). Flash flood risk assessment, capacity building, and awareness raising: Focus Humanitarian Assistance (FOCUS) Pakistan.
- Khanal, N. R., Hu, J.-M., & Mool, P. (2015). Glacial Lake Outburst Flood Risk in the Poiqu/Bhote Koshi/Sun Koshi River Basin in the Central Himalayas. *Mountain Research and Development*, 35(4), 351-364.
- Mwamba, L. O. (2012). *Vulnerability and Adaptability: Modelling the Adaptive Capacity of Rural Households to Environmental Changes*.
- Notenbaert, A., Karanja, S. N., Herrero, M., Felisberto, M., & Moyo, S. (2013). Derivation of a household-level vulnerability index for empirically testing measures of adaptive capacity and vulnerability. *Regional Environmental Change*, 13(2), 459-470.

- Opiyo, F. E., Wasonga, O. V., & Nyangito, M. M. (2014). Measuring household vulnerability to climate-induced stresses in pastoral rangelands of Kenya: Implications for resilience programming. *Pastoralism*, 4(1), 1-15.
- Piya, L., Maharjan, K. L., & Joshi, N. P. (2013). Determinants of adaptation practices to climate change by Chepang households in the rural Mid-Hills of Nepal. *Regional Environmental Change*, 13(2), 437-447.
- Rasheed, E. A. a. T. (2015). Empowering indigenous community conserved areas for worldlife conservation in Chiral. *Lead Pakistan*.
- Rasul, G., Chaudhry, Q., Mahmood, A., Hyder, K., & Dahe, Q. (2011). Glaciers and glacial lakes under changing climate in Pakistan. *Pakistan Journal of Meteorology*, 8(15), 1-8.
- Renaud, F. G., Dun, O., Warner, K., & Bogardi, J. (2011). A decision framework for environmentally induced migration. *International Migration*, 49(s1), e5-e29.
- Shakir, A. S., Rehman, H., & Ehsan, S. (2010). Climate change impact on river flows in Chitral watershed. *Pak J Engg & Appl Sci*, 7, 12-23.
- Shongwe, P., Masuku, M. B., & Manyatsi, A. M. (2014). Factors Influencing the choice of climate change adaptation strategies by households: a case of Mpolonjeni Area Development Programme (ADP) in Swaziland. *Journal of Agricultural Studies*, 2(1), 86-98.
- Shrestha, A. B., & Bajracharya, S. R. (2013). *Case studies on flash flood risk management in the Himalayas: in support of specific flash flood policies*: International Centre for Integrated Mountain Development (ICIMOD).
- Smit, B., & Pilifosova, O. (2003). Adaptation to climate change in the context of sustainable development and equity. *Sustainable Development*, 8(9), 9.

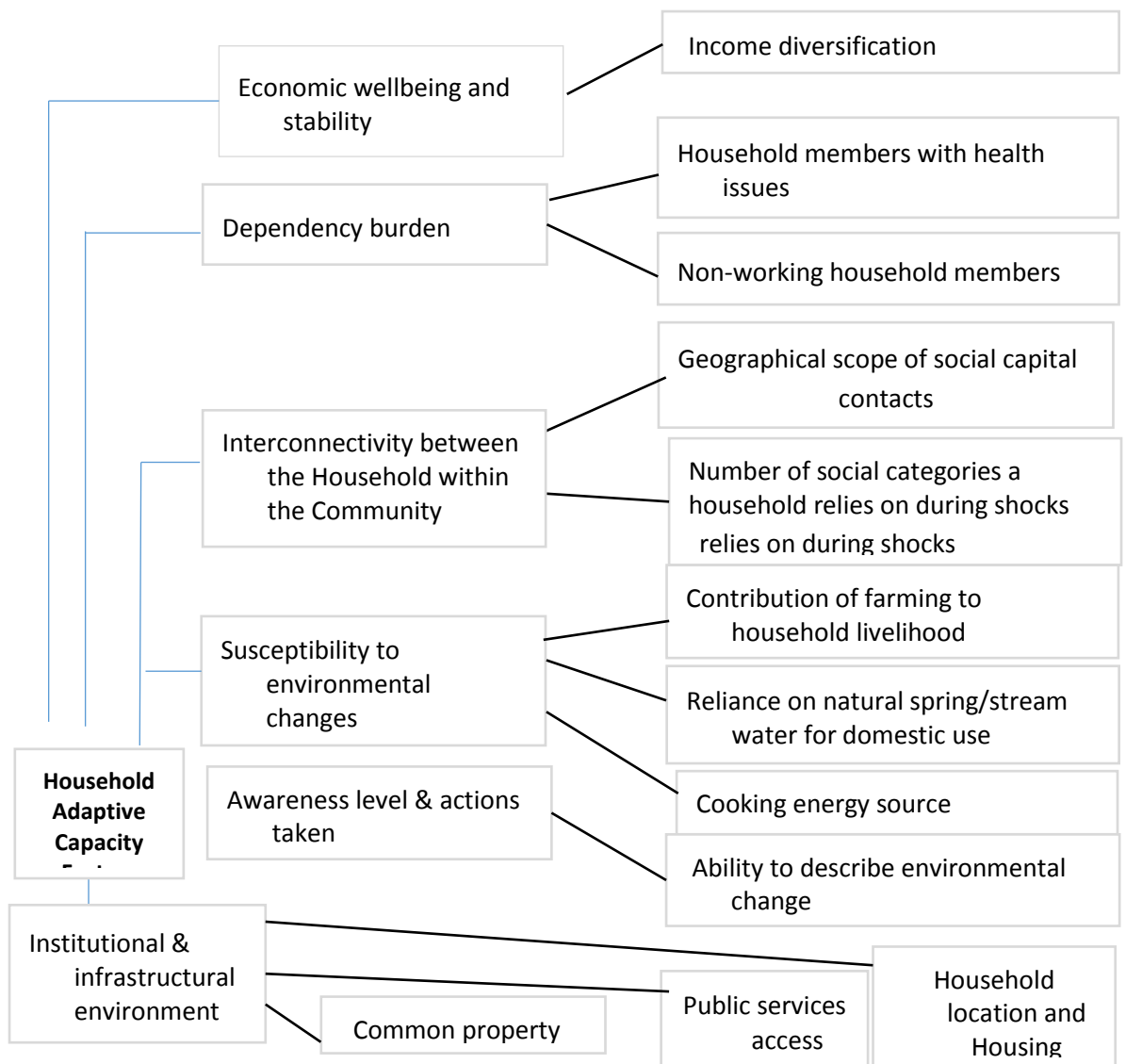


- Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global environmental change, 16*(3), 282-292.
- Syed Sajidin, M. H. (2013). Climate Change Scenarios and Possible Adaptation Measures, Chitral and DIK Districts, KPK: Researchgate.
- Tran, P., Tuan, T. H., & Tinh, B. D. (2010). Adaptation Behaviors of Communities and Households to Extreme Climate Events in Quang Nam Province, Viet Nam: Towards a Set of Possible Adaptation Measures: Economy and Environment Program for Southeast Asia (EEPSEA).
- Willroth, P., Diez, J. R., & Arunotai, N. (2011). Modelling the economic vulnerability of households in the Phang-Nga Province (Thailand) to natural disasters. *Natural hazards, 58*(2), 753-769.
- Xu, J., Grumbine, R. E., Shrestha, A., Eriksson, M., Yang, X., Wang, Y., & Wilkes, A. (2009). The melting Himalayas: cascading effects of climate change on water, biodiversity, and livelihoods. *Conservation Biology, 23*(3), 520-530.

## Appendix I: Assessing Adaptation

Household adaptive capacity is used for assessment of Households adaptation. Indicators are then defined for the synthesized sub-indices of the household adaptive capacity index. Household adaptive capacity depends upon a number of factors and can be presented as below in figure A1 Source: (Mwamba, 2012)

*Figure A1: Structure of HAC*



## **Operational definition of Variables**

The variables in the diagram can be explained as under:

### **A. Economic wellbeing and stability:**

Economic wellbeing and stability are the key components of adaptive capacity of any household. Physical, financial, social and human capital assets can help people to cope with their vulnerabilities. Livestock ownership, land ownership, and skilled households are the factors that help in the case of natural calamities and help in coping with the recovery with the passage of time. Economic wellbeing and stability is approximated with the help of Income Diversification i.e.

#### **i) Income diversification:**

Income diversification plays an important role in adaptability as household with more than one income sources will have greater adaptive capacity as compared to those who have only one source of living.

A value of 1 will be assigned in cases with only one significant source of income, 2 for two significant sources of income, 3 for three significant income sources and 4 in cases with four or more sources of income while 0 will serve as no income source.

### **B. Dependency Ratio:**

The more the dependency ratio, the less is the adaptive capacity of any household. Children under the age of maturity and higher age individuals are considered as dependents. The number of terminally ill household members and that of non-working household members therefore serve as indicators for the dependency ratio within a household. This indicator is categorized with;

**i) Household with a member suffering from a long-term/recurrent disease:** A high incidence of long term/recurrent diseases or illnesses such as cancer, tuberculosis, diabetes, epilepsy and high blood pressure weakens household adaptive capacity.

The values are assigned as: 0 none of the household members had a terminal illness, -1 one member had a terminal illness and -2 cases where the number of terminally ill members was two or more.

**ii) Non-working household members:** This is the number of nonworking persons (males and females) who rely on the support of the working household members.

Value are assigned as: 0 - no dependents, -1 dependency represents less than 3 non-working adults in the H.H, while -2 reflects between 3 – 6 non-working adult.

**C. Interconnectivity between the House Hold within the Community:**

Network within village and out of villages are important in time of natural calamities. The extension of network to over a greater geographical range and connections with a wider variety of institutions makes the adaptive capacity stronger as compared to those households whose contacts and knowledge are based around the village. The variable is approximated with the help of following:

**i) Geographical Scope of Social Capital:** Household relies on social capital contacts like friends, coworkers, and class fellows in cases of shock. Contacts within the same geographical region are affected with the same frequency as prevalent to the area under natural calamity. Reliable contacts in

far geographical areas which are less affected by the threats in question may offer more reliable assistance in emergency situations.

A value of 0 was assigned in case of a household with no contact outside its locality, 1 was assigned in case of 1 – 2 contacts while 2 was assigned in cases of three or more contacts.

**ii) Membership of Social categories a household relies upon:**

Household also rely on family members residing outside the affected zone. Hence family having no family member outside the hit zone have poor copying capacity as compared to those who have more family linkages outside. The more reliable family source the higher the adaptability.

A value of 1 will be assigned for 1 reliable family member source, 2 for 2 or more sources, while 0 for no family members outside affected area.

**D. Susceptibility to environmental changes:** The more a household depends on environmental/ climate change sensitive resources, the lower its adaptive capacity is likely to be. According to the IPCC (2007), poor communities can be especially vulnerable - particularly those concentrated in high-risk areas since they tend to have more limited adaptive capacities, and are more dependent on climate sensitive resources such as local water and food supplies (it is expected that climate change will affect farming, for instance, livestock production both directly and indirectly). Susceptibility of the Household is captured with;

**i) Contribution of Farming to Household Wellbeing:** For some households, farming constitutes the main base of their livelihoods yet for

others, it is an equal or lesser contributor alongside other economic activities. Moreover, there are households that do not participate in farming at all.

For this variable, a value of -1 will be assigned in cases where a household obtained not more than 35 per cent of its income from farming, -2 will be assigned in cases where income from farming accounted for between 35 – 70 per cent while -3 was assigned where the share of income from farming activities was more than 70 per cent. In case no income is derived from farming, a value 0 will be assigned.

**ii) Source of cooking fuel:** Wood fuel forms a major part of household energy supplies. Heavy reliance on the natural resource for fuel requirement shows a low level of adaptability.

The values attached to this variable are: -1 in cases where households used wood fuel besides cooking gas or electricity, -2 in cases of wood fuel and kerosene, while -3 are assigned where households used wood fuel exclusively.<sup>3</sup>

**iii) Source of water:** Multiple source of water availability in the form of local channels and government constructed pipeline from rivers give a more adaptability. A heavy reliance on local spring/stream water may imply a higher susceptibility to environmental stress and therefore a lower level of adaptability.

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<sup>3</sup> The value -3 is assigned because wood fuel is normally collected in summer and dumped for the whole year use. Hence such HHs are more vulnerable, if their stored wood is flushed away by floods.

A value of -1 will be assigned to this variable in cases of households fetching water from local springs or river lakes while 0 has been assigned in cases of households with access to piped water.

**E. Awareness level and actions taken:** Awareness to environmental changes are crucial for the adaptation and meeting the challenges of calamities. A household having information on strategies for adaptation have a higher adaptive capacity compared to another which is unaware or one which is doing nothing against the environmental changes.

i) **Ability to describe environmental changes:** To be aware about the negative and positive environmental changes a household has better chances of survival. Hence the household who are aware of the environmental change phenomenon are better to adapt to such changes as compared to those who are ignorant to it.

The scale applied to this variable will have the values 0 for inability to describe prevalent environmental changes and 1 for ability to describe prevalent environmental changes.

#### **Variables of the External Sub-Index**

Factors that are beyond the influence of many ordinary households but which have effects on their ability to adapt have been grouped under institutional and infrastructural environment under which the households operate. In order to bring out the effects of the external factors, a presentation of the HAC without external factors will be made and then the external factors will be included later on.

## **Institutional & infrastructural environment**

Three main variables have been used to capture the institutional and infrastructural environment. These are:

### **a) Common Property Access**

Common property access to resource poor households make them capable of adapting as compared to those who do not have such access. So the access to public resources like grazing lands and fuel wood influences their adaptive capacities. In developing economies there is high difference of resource access, in such situation access to common property serves to partially cover certain needs of less capable sections of the populations.

For this variable, cases with access to common property have been assigned a value of 1 and those without any access to common property have been assigned a value of 0 (zero).

### **b) Access to public services**

Access to public services are need of the time for fast recovery and limiting the adverse effects of natural disasters. Factors delaying access to markets or useful public services are therefore likely to lower household adaptive capacity.

The variable - access to public services - was measured with the help of the following indicators

#### **i) Type of access road to the affected area**

The better the access road, the quicker the commodities will reach as desired. The better metaled road serves to increase the adaptability as compared to nonmetal and rugged roads.



Values assigned to this variable are: -1 in cases of earth roads, 0 in cases of murrum/Gravel roads and 1 in cases of tarmac (macadamized)/metal roads.

**ii) Supporting role of the Government**

The important role of the government cannot be overlooked while looking at the adaptive capabilities of households. For this variable, cases of delayed government actions have been assigned the value -1 (negative one) while reported cases of quick and rapid contribution from the government have been assigned the value of 1

**c) Household location and Housing Quality**

The location of household and its vicinity to markets and access roads contribute to their adaptive capacity. Transport and communication are issues that can be greatly affected by the location of the households and at the same time these issues are important for adaptation.

The following indicators (lower level variables) were used for this variable (household location) which is a component of the sub-index of institutional and infrastructural environment:

**i) Distance of a household from the nearest access road**

The Households away from road access have lower adaptive capacity as those having easy access to roads.

In cases where households are located more than 200m away from nearest access road, a value of -2 was assigned, a location of 150 – 200m away from the nearest access road had a value of -1 assigned to this variable, a distance of 100 – 150m attracted a value of 0 (zero), 50 – < 100m attracted a value of 1 while a distance of

below 50m from the nearest access road attracted a value of 2 for this lower level variable

## Appendix II: Questionnaire

Questionnaire No. ....

Enumerator: .....

Date: .....

### General Information

S.No.	Question	Responses
1	Position in the household (if respondent is not HH head)	
2	Age of Household head (HHH)	..... Years
3	Gender of HH head	<input type="checkbox"/> Female <input type="checkbox"/> Male
4	Education level of the HH head:	..... Years
5	Highest education within Family	M (Years)____, F(Years)____
6	Sources of family income	<input type="checkbox"/> Government Jobs  <input type="checkbox"/> Private Job <input type="checkbox"/> Livestock <input type="checkbox"/> Rent <input type="checkbox"/> Agriculture <input type="checkbox"/> any other

### Demographic Information

S.No.	Question	Responses
1	Household family size	1. M____, F____, 2. children (less than age 5)____
2	How many non-working members in the family	<input type="checkbox"/> 0 (none) <input type="checkbox"/> -1( 1-3 NWM) <input type="checkbox"/> -2 (3-6 NWM)
3	Is there any terminal illness in your family	<input type="checkbox"/> none <input type="checkbox"/> one <input type="checkbox"/> two or more (If No, go to question 4)
4	What is the cost (in Rs per month)	

5	For how long you have been living here (in years)	
6	How many times have you faced Flooding and GLOF over the past two years.	
7	How many of your relatives (dependable) live in the same locality (villages)?	
8	Number of social categories that the family relies on during shocks	<input type="checkbox"/> 0 (no family members) <input type="checkbox"/> 1 (1 family) <input type="checkbox"/> 2 (2 or more family members)
9	Do they help you in time of need or in case of any emergency situations?	<input type="checkbox"/> Yes <input type="checkbox"/> No
10	How they help in such situations	<input type="checkbox"/> with monetary support <input type="checkbox"/> shelter <input type="checkbox"/> food <input type="checkbox"/> any other
11	Is there any social group that you are member of	<input type="checkbox"/> Yes <input type="checkbox"/> No
12	Geographical scope of social capital contacts (tribes, friends, general community)	<input type="checkbox"/> 0 (none) <input type="checkbox"/> 1 (1-2 contacts) <input type="checkbox"/> 2 (3 & above contacts)
13	Do they help you in emergency situations like floods	<input type="checkbox"/> Yes <input type="checkbox"/> No (If No, go to next section)
14	How they help in such situations	<input type="checkbox"/> with monetary support <input type="checkbox"/> shelter <input type="checkbox"/> food <input type="checkbox"/> any other

### **Socio Economic situation**

S.No.	Question	Responses
1	What is your cooking energy source	<input type="checkbox"/> -1 (Wood fuel + gas/electric) <input type="checkbox"/> -2 (Charcoal + Kerosene) <input type="checkbox"/> -3 (Exclusively wood fuel)
2	What do you use in time of floods for cooking and other heating	<input type="checkbox"/> Fuel <input type="checkbox"/> wood <input type="checkbox"/> Gas cylinder <input type="checkbox"/> any other
3	What is the source of water in your area	<input type="checkbox"/> tap water <input type="checkbox"/> natural spring <input type="checkbox"/> water from

		river/stream etc
4	How do you fulfil water requirements in time of floods?	<input type="checkbox"/> same source <input type="checkbox"/> Fetch from outside
5	Has the water resource depleted/ non usable during floods?	<input type="checkbox"/> Yes <input type="checkbox"/> No
6	What is the access road type	<input type="checkbox"/> -1 (earth) <input type="checkbox"/> 0 (Gravel) <input type="checkbox"/> 1(Metal)
7	Distance covered to fetch water during floods/GLOFs	.....km
8	Distance covered to fetch water from your current house location	.....km
9	Distance to Paved Roads from your current house location	<input type="checkbox"/> -2 > 1000m <input type="checkbox"/> -1 (501-1000 m) <input type="checkbox"/> 0 (101-500 m) <input type="checkbox"/> 1 (51-100 m) <input type="checkbox"/> 2 (0-50 m)
10	Do you have access to Forests for domestic use (like fuel wood etc.)	<input type="checkbox"/> Yes <input type="checkbox"/> No
11	Do you have access to rangelands/grazing land	<input type="checkbox"/> Yes <input type="checkbox"/> No
12	What is the effect of government role in public services accessibility in the effect areas	<input type="checkbox"/> -1 (negative effect) <input type="checkbox"/> 1 (positive effect)

### Event information

S.No.	Question	Responses
1	Do you feel any change in environmental pattern (	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know
2	Do you consider the weather pattern (frequency of rain, floods, temperature) different from historical patterns	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know
3	Are you aware of the reasons of such change	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know
4	Have you ever heard about the climate change	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know
5	Have you noticed any change in rainfall over the years	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't Know
6	If yes what changes do you observed	<input type="checkbox"/> very intense <input type="checkbox"/> intense <input type="checkbox"/> don't know
7	Which month does it rain the heaviest for the last 10 years	
8	How frequent do you experience floods	<input type="checkbox"/> always after rains

		<input type="checkbox"/> often after rain <input type="checkbox"/> Rarely after rain <input type="checkbox"/> Never
9	Which month does it gets flooded	
10	What kind of impact do you experience as a result of flood	<input type="checkbox"/> loss to lives <input type="checkbox"/> loss to agriculture <input type="checkbox"/> loss to livestock <input type="checkbox"/> loss to utilities <input type="checkbox"/> other
11	Cost of impacts of floods	
12	What do you think is primary cause of flood in your area	<input type="checkbox"/> Heavy rain <input type="checkbox"/> climate change <input type="checkbox"/> encroachment <input type="checkbox"/> any other
13	What do you think are the underlying causes of GLOFs in your area	<input type="checkbox"/> climate change <input type="checkbox"/> overpopulation <input type="checkbox"/> deforestation <input type="checkbox"/> overgrazing

### Coping Strategies

S.No.	Question	Responses
1	What do you think can be done for the prevention of flooding or GLOFs in chitral	<input type="checkbox"/> Tree plantation <input type="checkbox"/> alternate energy source <input type="checkbox"/> Reduction in live stock <input type="checkbox"/> reduction in grazing <input type="checkbox"/> other
2	Which house type you consider is more safe against GLOF and Floods	<input type="checkbox"/> Mud Housing <input type="checkbox"/> Concrete housing
3	What was the type of your house structure before GLOF/FF	<input type="checkbox"/> Mud Housing <input type="checkbox"/> Concrete housing <input type="checkbox"/> Other
4	Have you managed a better housing facility after floods	<input type="checkbox"/> Yes <input type="checkbox"/> No (If No, go to question 6)
5	What is the cost of better housing after floods	
6	What is the type of your house structure after GLOF/FF	<input type="checkbox"/> Mud Housing <input type="checkbox"/> Concrete housing <input type="checkbox"/> Other
	Did you migrate from this area after floods?	<input type="checkbox"/> Yes <input type="checkbox"/> No

7	If Yes, what was the type of migration from this area after floods?	<input type="checkbox"/> Temporary (reoccupied own houses) <input type="checkbox"/> Temporary (reconstructed own house) <input type="checkbox"/> Permanent within the same area/village (Why.....) <input type="checkbox"/> Permanent to other area (Why.....)
8	What problem/losses do your household experience as a result of flood	<input type="checkbox"/> loss of income <input type="checkbox"/> property <input type="checkbox"/> damage to house, <input type="checkbox"/> out of school children <input type="checkbox"/> death of working household member <input type="checkbox"/> death of head of household <input type="checkbox"/> terminal illness of household member/head <input type="checkbox"/> injury to household members <input type="checkbox"/> reduced employment <input type="checkbox"/> Loss of livestock
9	How the household pull out of the weather related shock (FF, GLOF)	<input type="checkbox"/> reduce consumption/expenditure <input type="checkbox"/> Assisted by family or friends <input type="checkbox"/> Borrowed from social contacts or institutions <input type="checkbox"/> Sold some assets <input type="checkbox"/> other
10	Do you think the area you live is making you prone to flood impacts	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't Know
11	What specific thing did you do to manage the most recent flood you experienced	<input type="checkbox"/> Relocate <input type="checkbox"/> call on family or friend for help <input type="checkbox"/> call on government for assistance <input type="checkbox"/> call on NGO for assistance..... <input type="checkbox"/> nothing
12	If nothing? Why so	
13	Do you have any option for relocation to other area	<input type="checkbox"/> Yes <input type="checkbox"/> No (If No, go to question 19)
14	What is the type of adaptation	<input type="checkbox"/> relocation

	you are doing	<input type="checkbox"/> building more secure houses <input type="checkbox"/> safety walls <input type="checkbox"/> migration to new and safe locality <input type="checkbox"/> Better/increased savings <input type="checkbox"/> Better connection with friends and family members <input type="checkbox"/> Income diversification <input type="checkbox"/> other
15	Do you receive any early warning information about floods	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't Know (If No, go to question 24)
16	Who give you the warning system	<input type="checkbox"/> family <input type="checkbox"/> community leader <input type="checkbox"/> media <input type="checkbox"/> local government <input type="checkbox"/> NGOs <input type="checkbox"/> don't know
17	Which medium was used for warning	<input type="checkbox"/> Radio <input type="checkbox"/> tv <input type="checkbox"/> cell phone <input type="checkbox"/> newspaper <input type="checkbox"/> internet <input type="checkbox"/> Word of mouth
18	Do you receive any help from government on Flood problems	<input type="checkbox"/> Yes <input type="checkbox"/> No
19	Do you receive any emergency loan during floods	<input type="checkbox"/> Yes <input type="checkbox"/> No
20	What type of help do you receive from government?	<input type="checkbox"/> Food, <input type="checkbox"/> Materials, <input type="checkbox"/> Cash Grants <input type="checkbox"/> other _____
21	Do you receive any help from NGOs on Flood problems	<input type="checkbox"/> Yes <input type="checkbox"/> No (If No, go to question 28)
22	What type of help do you receive from NGOs?	<input type="checkbox"/> Food, <input type="checkbox"/> Materials, <input type="checkbox"/> Cash Grant <input type="checkbox"/> other _____

## Income

S.No.	Question	Responses
1	How many persons in the family are in earning position (income diversification)	<input type="checkbox"/> 0 (no source of inc) <input type="checkbox"/> 1 (one source) <input type="checkbox"/> 2 (two sources) <input type="checkbox"/> 3 (three sources) <input type="checkbox"/> 4 (four sources)
2	What are the income sources for family members	<input type="checkbox"/> Government job, <input type="checkbox"/> Private job, <input type="checkbox"/> Agriculture <input type="checkbox"/> Business
3	Income earned from Livestock during last year	Rs.
4	Income earned from Agriculture (crop/fruits) during last year	Rs.
	Contribution of farming into wellbeing of the family	<input type="checkbox"/> 0 (No contribution) <input type="checkbox"/> -1 (less than 35%) <input type="checkbox"/> -2 (35-70%) <input type="checkbox"/> -3 over 70%
5	Income earned from assets (Rent/dividends) during last year	Rs.
6	Household head monthly income	<input type="checkbox"/> 0 - 14,000 <input type="checkbox"/> 14, 001 – 30,000 <input type="checkbox"/> 30,001 – 50,000 <input type="checkbox"/> 50,001 – 100,000 <input type="checkbox"/> above
7	Household total monthly Income	<input type="checkbox"/> 0 - 14,000 <input type="checkbox"/> 14, 001 – 30,000 <input type="checkbox"/> 30,001 – 50,000 <input type="checkbox"/> 50,001 – 100,000 <input type="checkbox"/> above