

# **ON MEASURING HOUSEHOLDS' ADAPTIVE CAPACITY TO CHANGING CLIMATE: A CASE STUDY OF SWAT DISTRICT**



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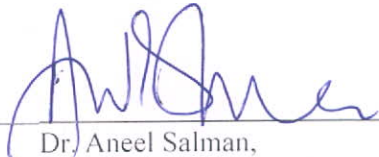


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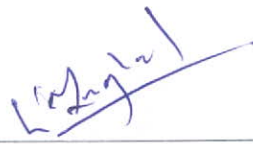
## CERTIFICATE

This is to certify that this thesis entitled: **“On Measuring Households’ Adaptive Capacity to Changing Climate: A Case study of Swat District”**, submitted by Sundas Ishfaq 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**.

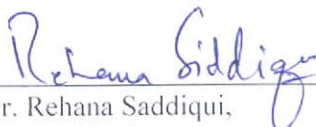
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## **LIST OF ABBREVIATIONS**

HACI	HOUSEHOLD ADAPTIVE CAPACITY INDEX
IPCC	INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
NRSP	NATIONAL RURAL SUPPORT PROGRAM
PDMA	PAKISTAN DISASTER MANAGEMENT AUTHORITY
UNFCC	UNITED NATIONS FRAMEWORK FOR CLIMATE CHANGE

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## **ABSTRACT**

Risk free life can have a positive impact on human development. Climate change impacts are clearly visible in the district Swat and are expected to increase. The ability of individuals to adjust and recover from the hazards of climate change is known as adaptive capacity. Adaptive capacity of household can minimize the risk of climate change vulnerability on human development. To measure the adaptive capacity of local household advance assessment tool is highly needed. This study highlights the factors driving and limiting the capacity of household to adapt environmental change. Household adaptive capacity index (HACI) for Swat district has been constructed for this purpose. We found that household adaptive capacity of rural household of district Swat is very low, 78% households are living in the condition of high vulnerability. Reasons of this high vulnerability according to results are high dependency burden, lack of social contacts, low income level, lack of land rights and low market value of assets owned by household. Besides this other barriers of adaptive capacity are lack of house ownership, level of education of household members and lack of safety nets. It is recommended that high dependency burden on environmental sensitive resources should be reduced, and authorities should take responsibility from making policies to its implications until results come.

# CHAPTER 1

## INTRODUCTION

### 1.1 Background and introduction of the study

Climate change is defined as “change in regional or global climate pattern largely to the increase level of carbon dioxide in atmosphere by the use of fossil fuels or a long term change in the statistical distribution of weather over period of time that range from decade to million years, it can be change in average weather for example, extreme weather events” (Report of the IPCC, 2007).

Adaptive capacity is basically the ability of households to amend or recover from the effects of climate change. Here adjustment means modification in characteristics and behavior of society to expand its coping arrangement under existing climatic conditions. Adaptability depends on the adaptive capacity exhibited or inherited by a household, households with high adaptive capacity will be less vulnerable and their chances of recovery from hazards will be more than those who have low adaptive capacity.

According to the report of Intergovernmental panel on climate change (IPCC), developing countries are at high risk of climate change vulnerability because they have weak socio economic structure and have lack of institutions that can work properly. Besides this adaptive capacity of a system also depend on household’s social network and their access to resources, because climate change has direct effect on livelihood assets, health and economic conditions, water and food security of countries.

Low Adaptive capacity and low level of development are systematically linked with each other because climate change adaptation doesn’t only depend on economic condition. Adaptive capacity

depends on economic stability, susceptibility to environmental changes, awareness level, Institutional & infrastructural environment and geographical scope of social capital etc. (Magnan, 2010).

To implement the strategies of adaptation, financial as well as economic, social, human and natural resources are important. Financial and social capital include strong institutions, collective efforts from formal and informal institutes. Human capital comprises their skills, expertise, knowledge. Similarly, natural resources consist of land, raw materials, and biodiversity all these resources are really important for implementing adaptation strategies. (Brooks & Adger, 2005)

Adaptive capacity also depends on how much willingness to adapt, a society has. So as long as society acts collectively their adaptive capacity will continue to rise. There are two scales of adaptation, planned and reactive adaptation. In these scales lesson learned from previous hazards used to make future adaptation strategies (Brooks & Adger, 2005).

After flood, vulnerability can be reduced by relocating affected groups to less exposed areas. Adaptive capacity depends on the level of awareness about floods, willingness to move to safe place, houses availability and affordability. In under developed countries availability of material that can build flood resistant houses is an important indicator that shows their adaptive capacity. There are two types of barriers to adaptive capacity one are external barriers others are internal barriers. External barriers to adaptive capacity are unavailability of land at safe place to reconstruct house, or limited place provided by government or any agency etc. internal barriers are unwillingness of people to move away from flood prone areas, high prices of land etc. (Brooks & Adger, 2005)

Adaptive capacity is very important for climate change adaptation as if household has strong ability to adapt the effects of climate change then negative effects of hazards will be weak on them,

on the other hand if household has weak adaptive capacity then chance of damage will be more on them. Similarly, household with good adaptive capacity will manage its vulnerability better than those who have lower adaptive capacity. This ability to adapt can be enhanced through appropriate technology and approaches. (Mwamba, 2012)

The goal of this study is to construct a household adaptive capacity index for the rural population of district Swat, and to find out the adaptive capacity of local residents against floods. It also highlights that how adaptive capacity can improve the condition of household to manage the hazards of floods. This research addresses following research questions: 1) understand the adaptive capacity of rural household in district swat in response to climate change, 2) highlighting the factors driving and limiting household capacity to adapt to changes in climate, and 3) measures to improve the adaptive capacity of rural household.

Adaptive capacity of a region depends on its state of development. Sustainable development can lead developing countries to get prepared for and coping with the impacts of climate change. By promoting sustainable development social and ecological aspects of vulnerability can be reduced through improving its adaptive capacity to climate change. Lack of sustainable development leads to environmental degradation, poverty, socio-economic losses, and lack of health care facilities, which ultimately results in lowering the adaptive capacity.(Khan, 2002)

Two types of adaptation strategies have been discussed in the literature. One is micro scale adaptive strategy other one is macro scale adaptive capacity. Micro strategy promotes sector base improvement, like growing drought resistant crops, enhancing the ability to cope in case of any unfortunate event like floods by providing information and training etc. and this strategy will improve sector level adaptive capacity. Macro scale strategy improves macro level adaptive capacity by increasing wealth, income distribution, improving literacy rate and institutions. This

strategy will improve country's adaptive capacity to climate change by enhancing social capacity and lowering vulnerability. (Khan, 2002)

Uncertainty in floods is a result of combination of different climatic factors like rise in temperature, and glacier melting. These melting glaciers increase the risk to floods. In Pakistan temperature rises, precipitation increases, and increased water stress is observed. Floods are most uncertain in Pakistan (Khan, 2002)

Climate change, whether it is because of anthropogenic activities or other factors combine to have an effect on people to make them vulnerable. In developing countries people have to depend on their abilities in case of reduction in natural resource base, because household in rural areas of developing countries mostly depends on natural resources for their livelihood. So in case any unfortunate event occurs their mean of living will be disturbed, only choice they are left with in this situation is to depend on their skills and abilities. Management of natural resources are very important because loss of biodiversity and land degradation has a link with erratic rainfall pattern, rise in temperature, and floods so poor natural resource management will increase land degradation, crops failure and will destroy the means of livelihood of people. (Mwamba, 2012)

Adaptive capacity varies within regions, communities or even sectors. Building adaptive capacity according to the situation helps to minimize the effects of climate change. Making adaptation policies are important but more important is to implement those policies and strategies, and this implementation depends on the capacity of organizations and institutions. To understand the household adaptive capacity, the stand of government on adaptive capacity and effect of adaptive capacity on implementing strategies on household scale is important. Risk perceptions of communities are important to influence the adaptive capacity of that region, because it will identify their adaptation choices. A household decision about political support, education, food type, and

mean of transportation is very important because household decision scales influence vulnerabilities. Household adaptive capacity also depends on the outcomes of implementing certain policies the cost and benefits of such strategy implementation for humans and natural resource base is very important. (Elrick-Barr, Preston, Thomsen, & Smith, 2014)

In this context this study addresses following objectives: identifying the drivers of and barriers to adaptive capacity of rural households, constructing a household adaptive capacity index (HACI) for household of Swat, policy implications to help designing effective interventions for enhanced adaptive capacity of households. To fight changing climate adaptation is a pre-requirement, it doesn't only depend on hypothetical situations or perception actual adaptive capacity has to be built for managing the risk.

Household adaptive capacity index (HACI) is used in this study for assessing adaptive capacity of rural household of district Swat. Variable of economic wellbeing and stability, dependency burden, interconnectivity of social contacts, Susceptibility to environmental changes, housing quality, and awareness level are used as variables of sub-indices. Poisson regression is used to estimate the model. For this regression the variables included are house ownership, safety nets, age of household head, education of household members, foreign remittances, money sent by members working in another city, basic health units, market value of assets and subsidy from government. Poisson regression is used to model count variables.

## **1.2 PROBLEM STATEMENT**

According to World Bank reports Pakistan is among top 10 countries that are highly vulnerable due to climate change, position of Pakistan is upgraded in that list with the passage of time. (Kreft, Eckstein, Junghans, Kerestan, & Hagen, 2014). Among flood affected countries Pakistan is at 7.

In 2010 arrival of flood over flowed swat river up to 5 feet and cause damages to buildings, land,

standing crops, and infrastructure especially roads, (National Rural Support Program 2011) Again in April 2016 different districts of Swat were also affected by flood. According to PDMA report nearly 60 houses has been damaged and 46 people killed due to flood in Swat River in April 2016.

This area is always at risk due to climate change, and high adaptive capacity can improve the condition of the household. So there is a need to assess the adaptive capacity of rural households against climate variability, environmental stress. An assessment tool which is applicable for rural areas like Swat has been lacking in literature conducted in Pakistan. Strategies of adaptive capacity that are effective in one rural area not necessarily give clear cut results for different rural areas. There is no effective policies that has been implemented so far to enhance the adaptive capacity of rural household.

### **1.3 LOCATION OF SWAT AND ITS CLIMATE**

Swat valley is located in Trans Hindu Kush-Himalaya mountain range, because of climate change phenomena floods of 2010 and later in 2016 affected agricultural land, livestock, infrastructure and lives of people. Not only this, the road from Madyan to Kalam also got badly affected in 2010. The winter season is long and extends from November to March, rain and snowfall occurs during this season. The hottest month is June with mean maximum and minimum temperature of 33°C and 16°C, respectively. Besides this, erratic rainfall pattern along with sessional changes also been observed over last decade. Flood and these seasonal changes resulted in loss of income, agriculture land, loss of forest cover etc. Floods cause problems of food security, shortage of clean drinking water, non-food items availability, lack of access to health services and house damages etc. (save the children 2010).



## **1.4 SIGNIFICANCE OF THE STUDY**

Constructing a household adaptive capacity index (HACI), this study will be a contribution in existing literature and will provide awareness among rural household of district Swat about environmental vulnerability and will provide information to policy makers about enhancing the adaptive capacity of local residents to live a risk free life, which will also improve the human development at that area. Study can be used to create a standard for long-term observation of natural resources in the area. Thus the study can be used as prospective tool for research, policy construction and policy execution for Sustainable use of the natural resources.

This study particularly focuses on factors driving and limiting the capacity of household to adapt environmental change. Household adaptive capacity index (HACI) for Swat district has been constructed for this purpose.

## **1.5 OBJECTIVES**

Objectives of the study are

- To identify the drivers of and barriers to adaptive capacity of rural households.
- To construct a household adaptive capacity index (HACI) for household of Swat.
- To draw policy implications to help designing effective interventions for enhanced adaptive capacity of households.

## **1.6 RESEARCH QUESTIONS**

- What is the adaptive capacity of rural household in district swat in response to climate change?

- What are the factors driving and limiting household capacity to adapt to changes in climate?
- What can be done to improve the adaptive capacity of rural household?

## **1.7 ORGANIZATION OF THE STUDY**

The complete discussion of this dissertation is structured in 5 chapters. Introduction, statement of problem, location Swat and its climate, significance of the study, significance of the study, and research questions are included in chapter 1. In chapter 2 literature reviews has been discussed and in chapter 3 theoretical framework, study area, sampling design and methodology are included. Results and discussions are included in chapter 4, in chapter 5 conclusion and policy recommendations have been discussed.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter contains relevant literature to better understand the adaptive capacity of household in response to climate change. Number of studies have been reviewed in this part of dissertation.

#### **2.2 Adaptive capacity and its drivers**

Adaptive capacity has emerged as major part in shaping the adaptation to climate change. Root causes of increase in vulnerability and lowering adaptive capacity are that people have limited access to resources and power. They are not involved in the political systems and they have a poor economic system. Lack of institutes, skills, training, investment and lack of access to market are dynamic pressures for progression of vulnerability. Similarly unsafe physical environment like dangerous locations of houses, unsafe building materials can also increase vulnerability and reduce adaptive capacity (Downing et al., 2003). Cost of adaptation to climate change is increasing rapidly each year but effects of climate change are not certain around the globe, so investment in right technology is really a big challenge. Better choice is to invest in the field of building resilience and adaptive capacity (Agrawal & Perrin, 2009).

People who have resources like wealth, insurance, credit will be able to protect their property and themselves from destruction. They can recover from any disaster in a better way but there is a possibility of great economic loss. (Wamsler, 2011)

Adaptive capacity development is not cost free. It has benefits and cost. But while developing a strategy or policy it should be noticed that whether the addressed policy development is economically justified or not. If the policy is economically justified then it is good to adapt such policy (Scheraga & Grambsch, 1998; Watson, Zinyowera, & Moss, 1998) .

For protecting human health, livestock and ecosystem using correct adaptive strategies and investment in right area is important. In case any adaptive strategy fails it will leave the society poorer against climatic risk. Adaptive capacity is used either to reduce the effect of hazard or to minimize the sensitivity of the system. Adaptation actions are taken under two situations, 1<sup>st</sup> is after the occurrence of an event due to climate change, this is also known as *reactive adaptation*. 2<sup>nd</sup> strategy is preparation in defense of climate change hazards in future; it is also known as *anticipatory adaptation*. IPCC report stated that climate is changing day by day and this change will continue to rise with the passage of time, any mitigation or adaptation activity cannot stop it, but it can reduce the vulnerability of the hazards. This change occurs due to anthropogenic activities, and these activities had altered the environment already , whatever the reasons of these changes are but its effect is obvious around the globe regardless who are responsible for this change (Herrick & Beh, 2015; Scheraga & Grambsch, 1998).

Willingness to pay for climate change adaptation depends on the information they receive about climate change and their persuasion about climate change if the information provided to people clearly indicating high level risk then willingness to pay will be high besides this level of income of the household and their wealth will also influence to adaptive capacity and willingness to pay for climate change. Household with high income source and owning good wealth will pay more as compared to the person whose income is less. Other than income, social stability also effects adaptive capacity. Population which is dependent on natural resources, needs livelihood security,

but because of increase in population growth rate, land degradation and crop failures (due to climate change related events i.e. floods) burden on natural resource base is increasing day by day. So preservation of natural resource base by investing in increasing adaptive capacity is badly needed. Risk of vulnerability to climate change can be minimized by adopting strategies like crop rotation change in technology etc. while investing in adaptation must consider the frequency of the events occur in that particular area for example floods or droughts. (Bennett, Dearden, Murray, & Kadfak, 2014; O'Garra & Mourato, 2013) (Herrick & Beh, 2015).

Education is one of the important social and economic factor to reduce vulnerability to climate change. Education provides relevant information in a better way like early warnings about the hazard. Education helps to improve behaviors towards risky situations. Literate society can better deal and manage the effects of climate change (Sharma, Patwardhan, & Patt, 2013; Striessnig, Lutz, & Patt, 2013).

Both formal education in the form of school-based education as well as informal education in form of inherited knowledge will help in managing risks because both type of education enhance ability to adapt, understand, and cope with the situation and makes society to survive in a better way. Education and adaptive capacity have positive relationship. Education and information itself cannot solve the problem it also needs resources but it is a better start to be informed and look for appropriate resources. (Sharma et al., 2013)

Knowledge and skill helps household to adjust their life styles according to changes in climate to make them less vulnerable. Years of education often used as an indicator of knowledge and skills this is not good, because only years of education without practicing and experience to make that education a positive outcome is useless. As described earlier, access to infrastructure plays a key role in building adaptive capacity. Variables which are very important to measure access to

institutional resources are distance of house to nearest market, distance from nearest road, availability of high school, college or university, and safe drinking water. (Byrne, 2014; Hsiang & Burke, 2014)

### **2.3 Relationship of adaptive capacity and climate change**

The relationship of climate change adaptation with risks, conflicts, security issues, bad governance, and social political and economic instability is very important. Due to a rise in conflicts and security issues adaptive capacity of region will go down. They will not be able to invest more in adaptation and their first priority will not be climate change adaptation (Hsiang & Burke, 2014).

Principles that should be kept in mind while designing an adaptation policy are that every region has different effects of climate change which need to be addressed, so while designing an adaptation policy the problem of that particular area should be considered. 2<sup>nd</sup> principle is that risk varies across demographic location and social condition, for example people living in same location may not be equally vulnerable due to good financial resources and social categories they belong. Adaptive capacity and vulnerability has negative relationship, higher adaptive capacity is an indication of low vulnerability and vice versa. Other principle is that while making an adaptation policy must have kept in mind that when climate change poses a negative impact on one region it must have some positive impact of that change on other region. It's a tradeoff relationship between two regions where one is benefiting from a change other region is suffering loss from that change. Systems that are sensitive to climate change i.e. population growth, poverty, pollution etc. are not only degraded because of climate change, there must be other factors responsible for this stress. While developing a strategy this side must be considered that what are the other stressors

responsible for affecting these sectors and how climate change is boosting that hazard. (Scheraga & Grambsch, 1998)

One of the major after effects of floods is the decline in environmental quality. This loss could generate problems like increase in water borne diseases, demolition of houses and other physical and social assets due to flood water, sewage problem and crop damage along with demolition of crop land. Safety nets provided by the society are very helpful in reducing vulnerability and building the adaptive capacity. Diversification of income is also an important variable to minimize the damage, besides this less reliance on natural resource base can also reduce vulnerability due to climate change. Literature expose that diversifying the sources of income is only a short term solution (Armah, Yawson, Yengoh, Odoi, & Afrifa, 2010).

Adaptive capacity of any region, or any area could be different. Same climate hazard can affect different regions in different ways. So not only regionally but also the effect of climate could be different in rural and urban divisions of same district by shifting the process of planning and policies to local level that can helpful for collecting right type of results and data(Rahman & Salman, 2013).

Household adaptive capacity is just one part of the complex system that can impact the vulnerability arise due to climate change. For assessing household adaptive as a tool to reduce vulnerability due to climate change factors which should be kept in mind are that how governance can influence the adaptive capacity and how adaptive capacity influence the planning and implementation strategies at household level. (Elrick-Barr et al., 2014)

Climate change vulnerability is a complex phenomenon if a community is at risk due to climate change but is not getting affected by the hazard, they will not be vulnerable. Comparative to this if a society is getting significant effects of even a small change in climate, they will be considered

as vulnerable. Household adaptive capacity depends on the amount of assets a household own, assets include; physical assets, human assets, institutional assets and economic resources.

Knowledge base of a household is very important to understand the adaptive capacity.

The dependency of household income on agriculture sector only can make them more vulnerable.

Agriculture sector's income as a major contribution in total income can also expose them to risks.

Besides this, access to advance technology in every field can help to maximize adaptive capacity for household. For example, in agriculture sector access to advanced technology will help to improve crop productivity and its sensitivity. (Byrne, 2014; Smith, Huq, & Klein, 2003).

Household adaptive capacity index helps to measure the adaptive capacity of household. A composite household adaptive capacity index has been developed for Kenya. Different factors that can affect HACI is used this study. {Mwamba, 2012 #19}

#### **2.4 Dimensions of adaptive capacity**

There are many dimensions of adaptive capacity; most important dimensions especially for landholders are their financial status, support from communities and local networks for management practices. Different types of techniques used in literature for assessment are inductive theory driven approaches, secondary data assessment technique, future modeling, and process of self-assessment. Literature showed that for analyzing the adaptive capacity of rural community to climate change appropriate technique used is rural livelihood framework, the benefit of this technique is that it makes the development process of a country consistent but biggest criticism on these types of techniques is that it provides less opportunity for stakeholders to get involved (Adger & Vincent, 2005; Ellis, 2000; Lockwood, Raymond, Oczkowski, & Morrison, 2015; Pelling, High, Dearing, & Smith, 2008).



Social capital is a dimension of adaptive capacity, it includes social norms and social groups' household belongs to and trust they have on society to improve the efficiency specially to cope environmental hazard. Social circle helps native and nonlocal people in case of emergency to deliver management resources. Most important features of social capital are trust, mutuality and links. Native and non-native groups play essential role in managing risk and transferring knowledge, these groups are divided into horizontal and vertical network. Former networks are that in which people of same social and economic status belong, and later is that network which include people of different backgrounds and status. To measure social capital indicators like number of social groups household members belong to and number of government organization household participates are important.(Byrne, 2014; Lockwood et al., 2015; Pelling et al., 2008; Pretty & Ward, 2001)

Adaptation is a multistage process in which first of all identification of the problem is important. Like if climate is changing there must be detection signals of increase in rainfall pattern, precipitation, rise in temperature, floods, droughts. 2<sup>nd</sup> step is to identify the impact of those happenings on humans' environment, there is a possibility that such event can harm only one sector or it may be able to destroy what comes in its way. 3<sup>rd</sup> and most important step is modifying personal and overall behavior to resist and minimize the effect of such events. (Baez, Kronick, & Mason, 2012)

Generally, there is a misconception that adaptive capacity of a region depends on its state of development but it's not the only factor. Only economic development and latest technology cannot maximize adaptive capacity other characteristics of the society also influence the adaptive capacity like social contacts, insurance etc. Institutions need to be equally advanced and proactive as environmental stress. As climate is changing rapidly, institutes and social networks needs to get

improved with same speed so that vulnerability could be minimized. So if a society will already be in a position to adapt the changes of climate that could have occurred, chances of their vulnerability will decrease. Adaptive capacity is inherited features of institutions that make society able enough to cope with any unfortunate event. Institutions of adaptive capacity develop a sense of awareness among society, these institutes make them think about and question about norms and traditions that are not helpful in solving problems. Adaptation learning could be of two types. One is the kind of learning that make society to improve their current status of knowledge, other type is that which challenges current norms and cultural traditions to improve them and terminating the myths. Institutions those are good at generating resources and distributing them well are good institutes. Resources could be in form of skills and trainings provided to individuals, latest technology or any authority that can make them powerful. Besides this any good institute couldn't work well without government support. So fair governments will encourage social institutes to maximize the ability of society to adapt the changes that are unpredictable, as well as uneven. All these dimensions are interlinked. One cannot be helpful without other, like good governance, resources availability, knowledge, skills cannot stand without each other, each dimension is equally important (Brown et al., 2010; Gupta et al., 2010; Mendelsohn, Nordhaus, & Shaw, 1999).

## **2.5 Contribution of my study**

Identification of household with low adaptive capacity at regional level can facilitate authorities to improve the adaptive capacity of local households. On this issue no study has been conducted so far in Pakistan that uses household adaptive capacity index to measure the adaptive capacity of rural households, so this research will be a contribution in existing literature by measuring the HACI as a function of house ownership, safety nets, age of household head, education of household

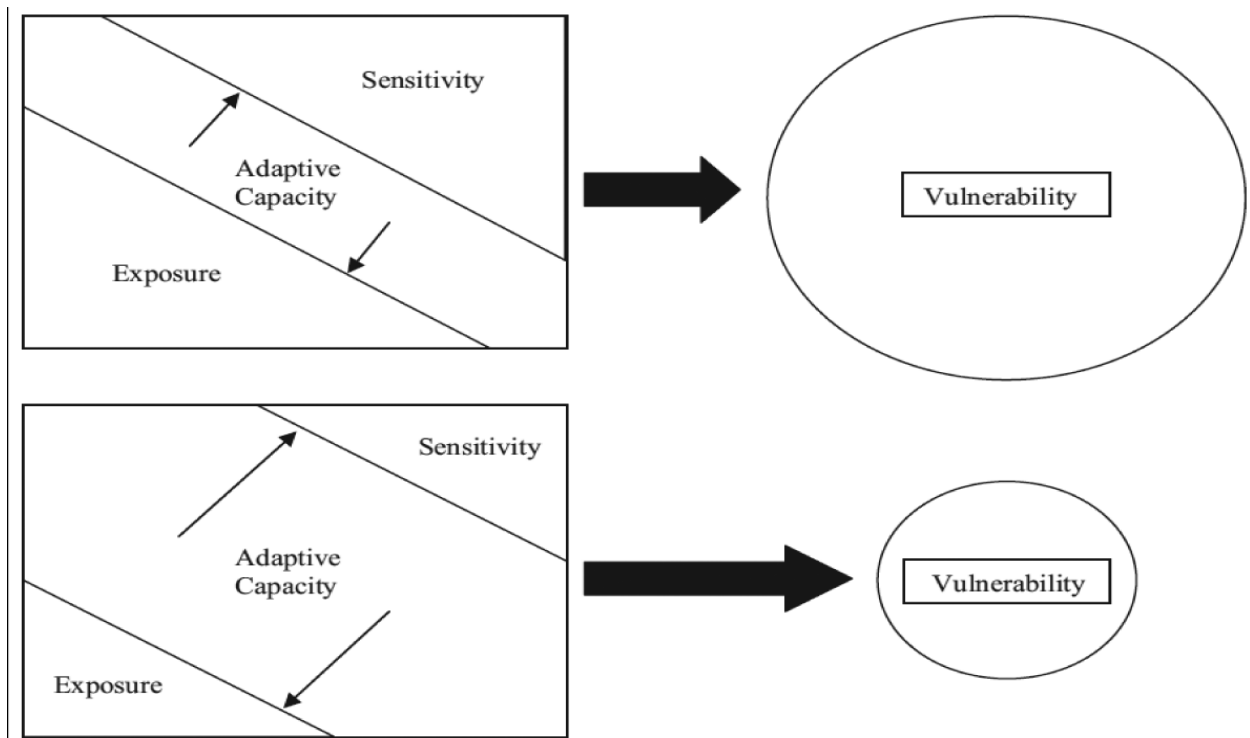
members, foreign remittances, money sent by members working in another city, basic health units, market value of assets and subsidy from government.

## CHAPTER 3

### 3.1 RESEARCH METHODOLOGY

This section provides details of conceptual framework, theoretical framework, data, area of selection, sampling design, structure of HACI, definitions of variables, and methodology.

### 3.2 CONCEPTUAL FRAMEWORK



**Figure 3.1 The basic role of adaptive capacity in influencing vulnerability (Fellmann, 2012).**

The above figure shows that adaptive capacity and vulnerability has negative relationship, higher adaptive capacity is an indication of low vulnerability and vice versa. Increase in exposure and sensitivity will lower the adaptive capacity which will directly affect community by increasing vulnerability. By improving the adaptive capacity, sensitivity of a system to climate change and its exposure towards the hazards will automatically decrease.

### 3.3 THEORITICAL FRAMEWORK

Enough literature is available that proves that environmental stress is an actual issue, literature also highlights that global warming is increasing and world has seen the adverse effects of climate change. Against these unfortunate events societies are forced to adapt or mitigate. For the first time adaptation to climate change was addressed in IPCC 1996 report. It states that adaptation either could be impulsive or pre planned, it also states that developing countries mostly use impulsive adaptation.

IPCC 2007 report states that climate change mostly has negative effect on mankind and especially poor are more exposed to the negative effects of climate change because this change limit the economic activities of people. Especially those households are highly economically vulnerable who are directly depend on natural resource base for their livelihood.

Rural households who are highly dependent on natural resources for their livelihood got highly effected to climate change. It often leads to loss in income which is directly related to increase in poverty and household adaptive capacity to climate change will decrease. Improving the adaptive capacity of rural household will not only improve the economic condition but also decrease poverty. (Mwamba, 2012) (Kelly & Adger, 2000)

In 2002, 2003, 2005 first few studies have been conducted on important issue of adaptation, these studies used adaptation first time in impact assessment, constructing regional level indices for estimating the socio-economic factors of adaptation

First of all, the theory related to adaptation need more attention than social development. It is important to focus the discussion on stressors of climate change. This study also talked about fundamentals and means that are controlled or uncontrolled (Füssel, 2007).

Adaptation to climate change is not a new phenomenon; there is no doubt about this that humans have shifted their settlements, cropping patterns and other activities according to the changing climate, because according to biologists and psychologists' humans are the most adjustable species on earth. Human development depends on individual's exposure to the risk and the ability to adapt(Smit, Burton, Klein, & Wandel, 2000).

### **3.4 DATA**

Data of all variables included in sub index is obtain from primary source. Questionnaire method is used to collect the information.

### **3.5 Introduction of Methodology**

This study is based on primary data, which is collected through questionnaire, and survey method is used to analyze the adaptive capacity of local people in response to climate change.

### **3.6 Assessing Adaptation – Through HACI**

Household adaptive capacity index is used for valuation of adaptation of rural household of district Swat. Sub-indices that are used to measure household adaptive capacity index are economic wellbeing and stability, dependency burden, interconnectivity in higher level processes, susceptibility to environmental changes, housing quality, awareness level and action taken and institutional and infrastructural environment.

### 3.7 Area of selection

District Swat has 6 Tehsils. Each tehsil is comprising of certain number of union councils. There are 65 union councils in district swat, 56 rural and 09 urban. Union councils Madyan, Asharay, Durshkila, Kalam, Bahrain are randomly selected for study. From each selected district 2 villages have been chosen for data collection.

### 3.8 Sampling Design

The primary data has been collected from 383 respondents. The sample size has been calculated through sample calculator with 95% confidence level, 5% confidence interval and projected rural population of swat for 2015 is 1,497,382 at growth rate of 1.92 (Pakistan Bureau of Statistics, 2015).

**Table 3.1 Sampling design and its allocation**

S. No	Union councils	Population	Sample size
1	Madyan	32482	83
2	Asharay	23550	60
3	Durshkila	28281	72
4	Kalam	34394	88
5	Bahrain	30794	78
	Total	149501	383

Data is collected from 5 union councils of district Swat and sample size is based on the population of each area. Systematic random target sampling technique has been used to collect the information. Systematic sampling is a type of probability sampling method in which sample members from a larger population are selected according to a random starting point and a fixed

periodic interval. This interval, called the sampling interval, is calculated by dividing the population size by the desired sample size. Union councils which are affected from floods are targeted to collect the information and within these union council's respondents of questionnaire are randomly selected.





Figure 3.1 Structure of HACI

### **3.9 Definition of sub-indices and variables**

#### **3.9.1 Economic wellbeing and stability:**

For measuring the household adaptive capacity against any unfortunate event related to climate change, one of the most important variables is economic wellbeing and stability. Assets that can provide a support to poor by enhancing their ability are human, financial, social capital. Lack of access to the resources especially economic and social resources make them even poorer and in developing countries generally deprived communities don't have access to politics as well, this make them more unprotected and sensitive to the risk. Ownership of houses, lands, livestock and skills etc. make them less sensitive because they seem to be permanent sources of income.

##### **i) Market value of assets:**

Assets like land, house, and livestock are the variables to measure economic wellbeing. Livestock includes goats, buffalos, cows, chicken, house, donkey etc. by estimating the market value of such indicators economic well-being could be drawn out.

If the total value of assets own by the household is below Rs 150,000, then it would make a contribution of point 1 to sub index, similarly values lies between Rs 150,000 – Rs 249,999 would indicate 2 points, value of assets if lies between Rs 250,000 – Rs 349,999 would yield point 3, and value among Rs 350,000 – Rs 449,999 yield 4 points, and if total assets value would be beyond Rs 450,000 contributes 5 points to sub index.

##### **ii) Income diversification:**

Another important indicator that can measure economic wellbeing is income diversification. A household who has more than one income sources will have high adaptive capacity than those who

only rely on one source for living. If the household's main income source belongs to natural resources, then chances of vulnerability will be high.

Value of 1 will be allocated in cases if household has 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.

**Table 3.2 Measurement Scales Applied to The Variables:**

<b>Sub-indices</b> (min., max. values)	<b>Variables</b> (min., max. values)	<b>Values. Labels</b>
Economic wellbeing & stability  (2,11)	Market value of assets	1. < 150, 000
		2. 150, 000 – < 250, 000
		3. 250, 000 - < 350, 000
		4. 350, 000 - < 450, 000
		5. 450, 000 and above
	Land rights	0. No or well-wishers' land
		1. Communal land
		2. Title deed
	Income diversification	1. One income source
		2. Two income sources
		3. Three income sources
		4. Four or more income sources

### **iii) Land rights**

Ownership of land is important for seeking loans to invest in business, or to fight against negative shocks.

To quantify this variable a value of 0 is assigned in case of no land ownership, 1 for commercial land and 2 for title deed.

By combining all points contribution of variables of economic wellbeing and stability, separate value of this sub index is attained.

### **3.10 Dependency Burden:**

Adaptive capacity of the household will be low who have more dependent members than those who have less relying members because dependent members will put extra burden on earning members of family. Members below 18 years and over 65 will be considered as dependents. Besides this terminal ill members and non-working members are also indicators of dependency.

#### **i) Household with a member suffering from a long-term/recurrent disease:**

A high rate of long term illnesses such as cancer, HIV/AIDS, tuberculosis, diabetes, epilepsy and high blood pressure minimize household adaptive capacity.

The scale applied has the values: 0 in cases where no member is suffering from any disease, -1 in case where one member had a terminal illness and -2 in cases where the number of terminally ill members was two or more.

**Table 3.3 Measurement Scales Applied To The Variables:**

<b>Sub-indices</b> (min., max. values)	<b>Variables</b> (min., max. values)	<b>Values.</b>	<b>Labels</b>
(-4,0)	Members with terminal illnesses (-2,0)	0.	None
		-1.	One
		-2.	Two or more
	Non-working members (-2,0)	0.	None
		-1.	1 - < 3
		-2.	3 – 6

**ii) Non-working household members:**

In this variable those members of household include who are not earning even they are in condition to earn, but still they rely on others for support.

For this variable, 0 is the value in case of no dependents, -1 is assigned in cases where the number of dependents are positive but less than 3 adult equivalents while -2 is assigned in cases of numbers of dependents between 3 – 6 adult equivalents.

**3.10.1 Interconnectivity within higher level processes:**

Households who only rely on the contacts within the village in case of emergency will have less adaptive capacity than those whose contacts are extend to other geographical regions and they also have access to such institutions that can provide them support in hour of need.

**Table 3.4 Measurement Scales Applied to The Variables:**

<b>Sub-indices</b> (min., max. values)	<b>Variables</b> (min., max. values)	<b>Values. Labels</b>
Interconnectivity in higher level processes  (1,7)	Geographical scope of social capital contacts  (0,2)	0. None
		1. 1 - 2
	Number of social categories a household relies on during shocks  (1,5)	2. 3 and above
		1. Family
		2. Family & neighbors
		3. Three social groups
		4. Four social groups
		5. Five or more social groups

**i) Geographical Scope of Social Capital:**

More diversified the level of social contacts a household relies in emergency more adaptive capacity they will have. Probability is that people living in same area face same level of risk and hazard, so a group of people with same geographical area can offer less reliable support.

A value of 0 was assigned in case of a household with no contact outside its area, 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:**

Household who only rely on close family but don't have such friends or any other contacts to which they can take help in case of negative shock will to be more vulnerable because family cannot always assist at a certain point in time. So to be a part of more social groups will be better off, the more social contacts one has the higher it's adaptive capacity will be.

A value of 1 is assigned for family, 2 for Family & neighbors, and 3 for three social groups, 4 for four social groups, 5 for five or more social groups.

**3.10.2 Susceptibility to environmental changes:**

Adaptive capacity of a household also depends on the dependence on environmental sensitive resources. The more dependence on climate sensitive resources the less will be adaptive capacity. Communities living at high risk areas will have less adaptive capacity.

**Table 3.5 Measurement Scales Applied To The Variables:**

<b>Sub-indices</b> (min., max. values)	<b>Variables</b> (min., max. values)	<b>Values. Labels</b>
Susceptibility to environmental changes	Farming contribution to wellbeing	-1. Less than 35 %
		-2. 35 – 70 %
	(-3,-1)	-3. Over 70 %
(-7,-2)	Cooking energy source	-1. Wood fuel + gas/electric
		-2. Charcoal + Kerosene
		-3. Exclusively wood fuel
(-1,0)	Water source for domestic use	0. Piped water
		-1. Spring/stream water

**i) Contribution of Farming to Household income:**

Contribution of farming in total household income is very important. Some households has minimum contribution of farming in their livelihood others has maximum part of farming as a source of income.

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.

**ii) Source of cooking fuel:**

In rural areas household relies on dry wood or charcoal as a source of energy. Heavy reliance on wood fuel makes them more susceptible to climate stress by increasing their vulnerability.

The values assigned 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.

**iii) Source of water:**

Large rivers/lakes from which governments pipe water normally have their sources. Because of this, a heavy reliance on local spring/stream water may be construed to imply a higher susceptibility to environmental stress and therefore a lower level of adaptability.

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



### 3.10.3 Housing Quality:

Quality of household house is an important variable to decide its adaptive capacity especially in case of high risks like floods. People living in mud houses will be more exposed and sensitive to the weather shocks and will have less adaptive capacity than those who are living in permanent houses.

**Table 3.6 Measurement Scales Applied To The Variables:**

<b>Sub-indices</b> (min., max. values)	<b>Variables</b> (min., max. values)	<b>Values. Labels</b>
Housing quality	Quality of HH head's house	1. Mud-wall & grass thatch
(1,4)	(1,4)	2. Mud/iron sheet wall & iron sheet roof
		3. Semi-permanent
		4. Permanent

A value of 1 for mud-walled houses, 2 for mud- or iron sheet-walled and iron sheet roofed houses, 3 for semi-permanent units (cemented floor, mud+ cement walled, and iron sheet-roofed) and 4 for permanent ones .

### 3.10.4 Awareness level and actions taken:

Awareness level about climate deviation and environmental changes to make them able to respond according to the situation. Informed households are expected to have higher adaptive capacity than those who are doing nothing to minimize the risk.

**Table 3.7 Measurement Scales Applied to The Variables:**

<b>Sub-indices (min., max. values)</b>	<b>Variables (min., max. values)</b>	<b>Values. Labels</b>
Awareness level & actions taken (0,1)	Ability to describe environmental change (0,1)	0. No 1. Yes

**i) Ability to describe environmental changes:**

To enhance the ability to adapt households must be aware of the events occurring around them. Those who can distinguish environmental change could also cope there negative effects effectively.

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

**Table 3.8 Measurement Scale Applied to Variables of the Sub-indices**

<b>Index</b> (min., max. values)	<b>Sub-indices</b> (min., max. values)	<b>Variables</b> (min., max. values)	<b>Values. Labels</b>	
HACI (-7,21)	Economic wellbeing & stability (2,11)	Market value of assets (1,5)	1. < 150, 000 2. 150, 000 – < 250, 000 3. 250, 000 - < 350, 000 4. 350, 000 - < 450, 000 5. 450, 000 and above	
		Land rights (0,2)	0. No or well-wishers' land 1. Communal land 2. Title deed	
		Income diversification (1,4)	1. One income source 2. Two income sources 3. Three income sources 4. Four or more income sources	
		Dependency burden (-4,0)	Members with terminal illnesses (-2,0)	0. None -1. One -2. Two or more
			Non-working members (-2,0)	0. None -1. 1 - < 3 -2. 3 – 6
		Interconnectivity in higher level processes (1,7)	Geographical scope of social capital contacts (0,2)	0. None 1. 1 - 2 2. 3 and above

	Number of social categories a household relies on during shocks (1,5)	1. Family 2. Family & neighbors 3. Three social groups 4. Four social groups 5. Five or more social groups
Susceptibility to environmental changes (-7,-2)	Farming contribution to Wellbeing (-3,-1)	-1. Less than 35 % -2. 35 – 70 % -3. Over 70 %
	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
Housing quality (1,4)	Quality of HH head's house (1,4)	1. Mud-wall & grass thatch 2. Mud/iron sheet wall & iron sheet roof 3. Semi-permanent 4. Permanent
Awareness level & actions taken (0,1)	Ability to describe environmental change (0,1)	0. No 1. Yes

---

Aggregating the responses of the variables mentioned above, yield values of the respective intermediate variable which in turn if aggregated, yield the points for the sub-indexes. The minimum value of HACI is -7, which shows maximum vulnerability and minimum adaptive

capacity, while the maximum is 21 showing maximum adaptive capacity and minimum vulnerability.

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

Adaptive capacity is influenced by many internal and external factors. Internal factors are those which are under the control of household in rural areas but there are many such factors as well that are not influenced by households but they affect their adaptive capacity against environmental stress, such factors are known as external factors.

#### **Institutional & infrastructural environment**

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

##### **i) Common Property Access**

Access to public property is another factor than can influence adaptive capacity. Developing countries are facing the problems like income inequality, poverty, unstable political system, so if they got an access to public property like grazing lands, forests etc. they can have better capacity to adapt than those who doesn't have access.

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).

##### **ii) Access to public services**

In case of harsh environmental stress situation switching the enterprises is an important step can be taken by household. Factors that are included in this sub-index are following.

**i) Number of visits by agricultural extension officer within the last 5 years**

Number of visits by an agriculture extension officer is an indication of information provided to local people about better crops, improved seeds and latest technology use etc. so as number of visits increase adaptive capacity is supposed to be increase as well.

Values of 0 (zero) has been assigned in cases of no visits at all, 1 in cases of one or two visits in five years, 2 in cases of one visit a year, 3 in case of once a month, and 4 in case of weekly visits.

**Table 3.9 Measurement scale applied to variables of external sub-index**

HACI	Institutional & infrastructural environment (-5,10)	Common property access (0,1)	Common property access (0,1)	0. No 1. Yes
		Public services access (-2, 6)	Agric. officer visits (0,4)	0. Not at all 1. 1 or 2 times in 5 years 2. Once a year 3. Once every month 4. Weekly
			Access road type (-1,1)	-1. Earth 0. Murram 1. Tarmac
			Government role (-1,1)	-1. Negative effect 1. Positive effect
		Household location (-3,3)	Distance to nearest market (-1,1)	- 1. >10 km 0. 5 - 10 km 1. <5 km
			Distance from access road (-2,2)	-2. > 200 m -1. 150 - < 200 m 0. 100 - 150 m 1. 50 - < 100 m 2. 0 - < 50 m

**i) Type of access to road**

Access to road is very important to deliver the commodities produced by the household to the market on time. Other than this taking patient to hospital on time required road in good condition. So household who have access to road has high adaptive capacity than those who doesn't have.

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

**ii) Government role in supporting**

The important role of the government in enhancing the adaptive capacity is through preservation efforts and environmental protection policies. For this variable cases of negative government actions have been assigned the value -1 (negative one) while reported cases of positive contribution or actions from the government have been assigned the value of 1

**iii) Household location**

If house is located near road and near to headquarters or any other government offices then household have better adaptive capacity, then those houses that are located at far fledged areas or near rivers or in downstream.

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 to nearest market**



Nearest markets to houses will provide the benefit of selling goods produced by household at fair prices, that prices will improve the economic condition of household and at the end will improve adaptive capacity.

The values assigned are: -1 in cases where the distance to the nearest market is greater than 10 km, 5 – 10 km has been considered average and therefore assigned a value of 0 while a distance of less than 5 km has been considered to be significantly advantageous to adaptation hence assigned a value of 1.

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

The far the access road, the lower the chances that commodities will reach the market fast enough and in good quality, that sudden illnesses will be attended to in time, and that products required by the households will reach them at affordable prices. For this reason, location too far away from access roads is likely to be accompanied by lower adaptive capacity.

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.

Aggregating the responses of the variables mentioned above, we yield values of the respective intermediate variable which in turn if aggregated, yield the points for the sub-index (institutional and infrastructural environment).

The HACI is a function of house ownership, safety nets, age of household head, education of household members, foreign remittances, money sent by members working in another city, basic health units, market value of assets and subsidy from government.

### **3.12 Methodology**

Descriptive statistics and Poisson regression analysis are used to analyze the data that is collected from five union councils of district Swat. Different graphs and tables are used to analyze the statistics of household adaptive capacity of rural household. Tables are made to sight the percentage of points that each household contribute in household adaptive capacity index. Poisson regression is used to model count variables.

## CHAPTER 4

### RESULTS AND DISCUSSION

#### 4.1 Introduction

Household adaptive capacity is being estimated in this chapter. Primary data is collected from rural households of district Swat. Poisson regression analysis and descriptive statistics are used for estimation.

##### The Poisson Distribution

A random variable  $Y$  is said to have a Poisson distribution with parameter

$\mu$  if it takes integer values  $y = 0, 1, 2, \dots$  with probability

$$\Pr\{Y = y\} = e^{-\mu} \mu^y / y!$$

for  $\mu > 0$ . The mean and variance of this distribution can be shown to be

$$E(Y) = \text{var}(Y) = \mu.$$

Since the mean is equal to the variance, any factor that affects one will also

affect the other. Thus, the usual assumption of homoscedasticity would not

be appropriate for Poisson data. (Hilbe, 2014)

## 4.2 Model of the study:

$$HACI = \beta_1 MVA + \beta_2 BHU + \beta_3 FR + \beta_4 NR + \beta_5 HO + \beta_6 SN + \beta_7 SFG + \beta_8 EDU + \varepsilon_i$$

- MVA is the numerical values of assets including livestock, Radio, Television, Bicycle, Motorbike, Mobile phone, Rental shops/houses, Cars Tractor etc.
- BHU is the variable of access to basic health unit center. It will provide the information about the availability of basic health unit in the village or in union council.
- FR is foreign remittances which a household receives from the family member working abroad.
- NR shows national remittances which a household receives from the family member working within the country in another city.
- HO is house ownership which will get the information whether house is rented or they are living in personal house.
- SN is the safety net which could be a wall around their houses or any other net they use to protect themselves from the hazards of floods.
- SFG is the subsidy from government they receive to cope the effects of floods.
- EDU is education level of household. They will be asked about the maximum education acquired by the members of house.

The above factors has been observed in the study area, and we hypothesized that these factors effecting the household adaptive capacity.

### 4.3 Empirical Results of Poisson Regression Equations

**Table 4.1 Estimated result of poisson regression.**

Variable	HACI
Dependent Variable	Coefficients (t-stats)
HO	1.404(.5371)*
SN	.522(.32295)***
AGE_HH	-.00099(.01442)
M_EDU	.1254(.05751)*
FR	.00002(.00001)*
NR	.000024(.00003)
BHU	-.2701(.3107)
MVA	3.88e-06(.0000)*
SFG	2.664(.3471)*

\*, \*\*, \*\*\* indicates significant at 10, 5 and 1% respectively.

The estimated results of Poisson regression analysis shows that how house ownership, safety nets, age of household head, education of household members, foreign remittances, money sent by members working in another city, basic health units, market value of assets and subsidy from government can affect the household adaptive capacity. Results are showing that HACI has positive and significant relationship with house ownership, safety nets, education level of household members, foreign remittances, market value of assets and subsidy from government. Reason of positively significant relationship of house ownership with HACI is that household living in own house will be considered more safe then those living in rented houses, because while constructing own house person will try his best to use perfect material, safe land and will choose

best person to construct it while in rented house all these details are neglected and this difference highly influence the adaptive capacity. other than this safety nets in front of houses will minimize the intensity of flood and will protect the property from damage. Reason of positively significant relationship of household member's education level will help them to diversify their income sources, it can also enhance the quality of decisions they take to improve the adaptive capacity. Foreign remittances have positive and significant relationship with HACI, as household members working abroad will send money back home which will improve their financial condition and will enhance the adaptive capacity as well. However, there exists positive and insignificant relationship between HACI and the money sent by the members of household working in other city. Reason for this insignificant relationship is that most of the people of district Swat are either working abroad or they are engaged in farming or non-forming activities in Swat. So very few of them are working in other cities, and those who are working there have positive relationship with HACI. Two variables have negative and insignificant relationship with HACI. First one is age of household head and second is availability of basic health unit centers. Reason for the negatively insignificant relationship among HACI and age of household head is that most of the families are headed by the members aged more than 60's. The more a person will be old the maximum would be its vulnerability. So the families headed by 60 or more than 60 aged person will possess negative and insignificant relationship with HACI. Reason for negatively insignificant relationship between HACI and basic health unit is that the condition of BHU's are very bad in the area, people used to visit these places and are not getting any proper treatments. They are not visiting big hospitals and these wrong treatments possess negative impact on their health.

**Table 4.2 CORELATION MATRIX**

	HACI	HO	SN	AGE_HH	M_EDU	FR	NR	BHU	MVA	SFG
HACI	1									
HO	0.2105	1								
SN	0.0229	0.0122	1							
AGE_HH	0.0475	0.0618	-0.1339	1						
M_EDU	0.2722	0.1502	-0.1482	0.1085	1					
FR	0.3647	0.1033	-0.1992	0.3146	0.2805	1				
NR	0.0652	-0.0006	-0.0743	-0.0080	0.0318	-0.119	1			
BHU	-0.138	-0.070	0.1993	-0.0429	-0.0514	-0.131	0.039	1		
MVA	0.4582	0.0714	-0.1591	0.1998	0.2143	0.411	-0.0085	-0.0027	1	
SFG	0.5016	0.1060	0.1211	-0.1952	0.1074	0.1063	0.1164	-0.1720	0.0794	1

Above correlation matrix shows that independent variables have no multicollinearity problem.

#### **4.4 DESCRIPTIVE STATISTICS OF HOUSEHOLD ADAPTIVE CAPACITY INDEX**

From framework of household adaptive capacity index discussed in above chapter, values of HACI have been calculated from 383 rural households of district Swat. Descriptive statistics of the variables included in the sub-indices are presented in this section.

##### **4.4.1 HOUSEHOLD'S ECONOMIC WELLBEING AND STABILITY**

Market value of assets, income diversification and land rights are the variables that combines to make up the sub-index of economic wellbeing and stability. Descriptive statistics of these variables are given below.

#### 4.5 MARKET VALUE OF ASSETS

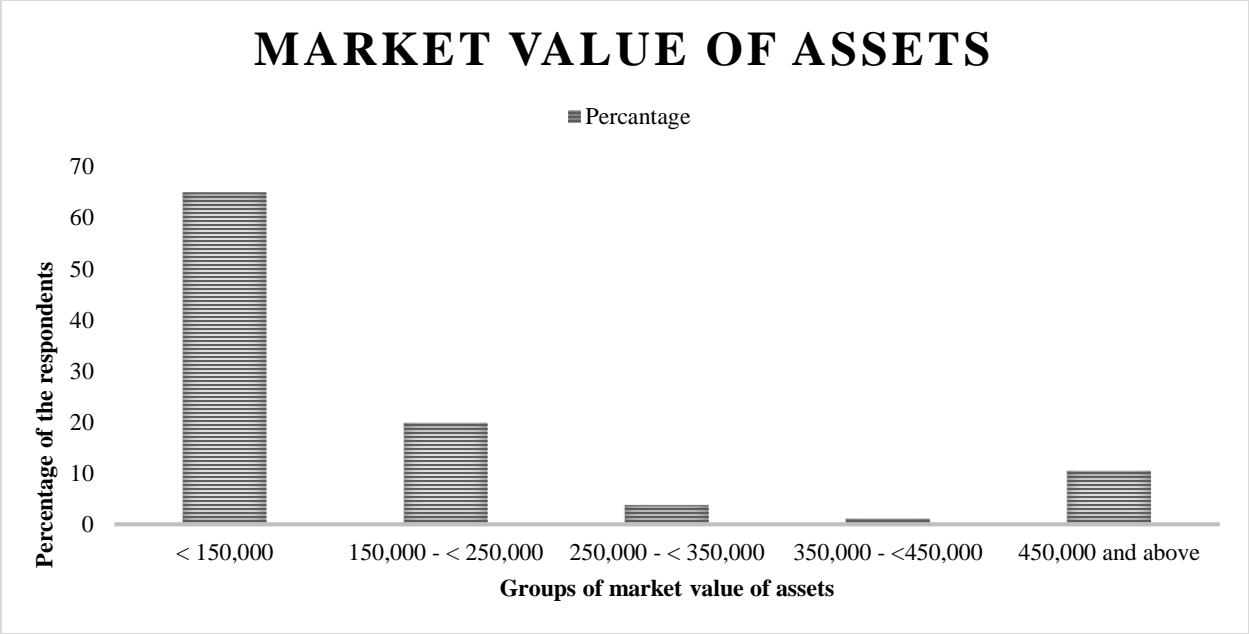
Assets included in construction of this variable are cows, buffalos, chicken and other poultry, goats, radio, televisions, bicycles, motorbikes, mobile phones, rental houses and shops, generators, cars, tractors, gold and others

**Table 4.2 Statistics of market value of livestock assets**

	Frequency	Percent	Valid Percent	Cumulative Percent
< 150,000	249	65.0	65.0	65.0
150,000 - < 250,000	76	19.8	19.8	84.9
250,000 - < 350,000	14	3.7	3.7	88.5
350,000 - <450,000	4	1.0	1.0	89.6
450,000 and above	40	10.4	10.4	100.0
Total	383		100.0	100.0

More stable economic condition of household will be an indication of high adaptive capacity. In case of any emergency households can dispose of these assets and can use that money for rehabilitation and reducing vulnerability. Household with high economic value of assets will poses high adaptive capacity than those who doesn't have enough value of assets.





**Figure 4.1 Market value of assets**

Table of statistics for economic value of assets shows that 65% of total households owned the assets with market value of less than 150,000 so these 65% households are making a contribution of 1 point only in the sub-index of economic wellbeing and stability, these are the people having minimum adaptive capacity because the assets they own have very low economic value.

Remaining 19% households are contributing 2 points in sub-index by holding assets values lies between 150,000 and 250,000. These households are in a better condition than those discussed earlier because their adaptive capacity is better as economic value of their assets are improved. 3% and 1% households had a contribution of 3 and 4 points in sub-index respectively. Remaining 10% are those who make a contribution of 5 points in sub-index by owning the assets of 450,000 and above, and these are the people who have high adaptive capacity against any unfortunate event because their assets have high economic value. First 65% of households have very low values of assets and low adaptive capacity as well.

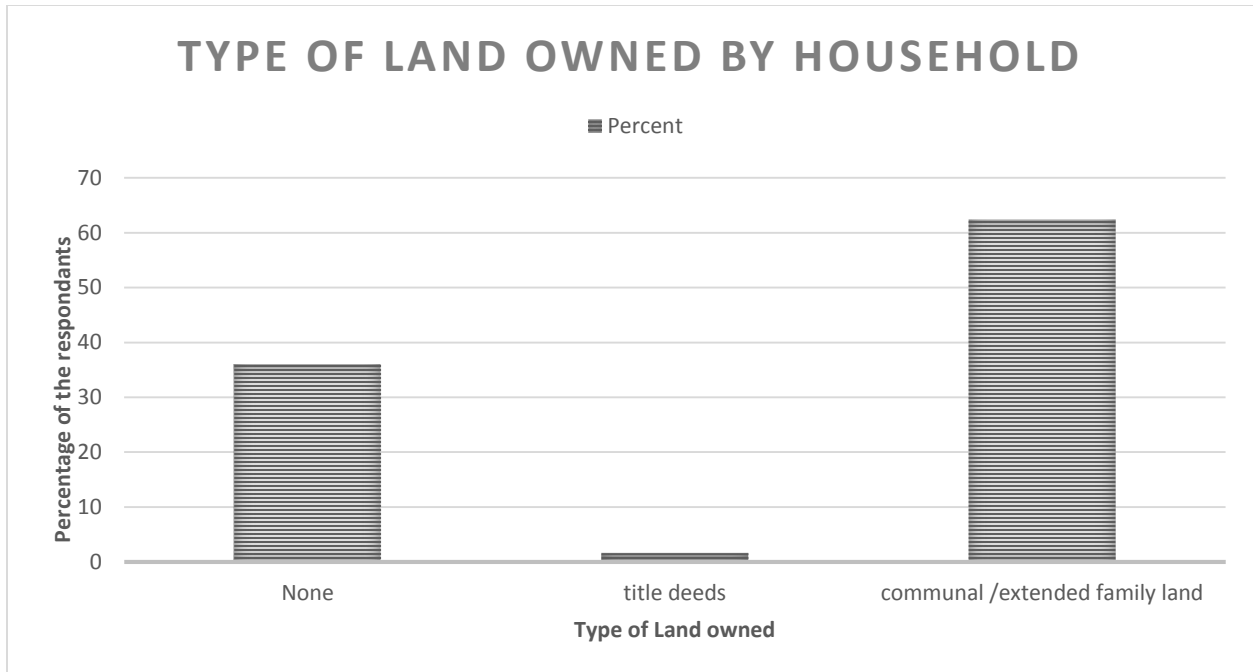
## 4.6 LAND RIGHT

Title deed is the type of land that is highly acceptable as a security while providing loans, these loans can be used in multiple fields like investing in new business and could also be used to minimize the risk of climate change.

**Table 4.3 Type of land owned by household**

	<b>Frequency</b>	<b>Percent</b>	<b>Valid Percent</b>	<b>Cumulative Percent</b>
<b>None</b>	138	36.0	36.0	36.0
<b>title deeds</b>	6	1.6	1.6	37.6
<b>communal /extended family land</b>	239	62.4	62.4	100.0
<b>Total</b>	383	100.0	100.0	

Statistics table for type of land owned by household shows that 36% of the household do not own any piece of land and slightly more than 62% are sharing the inherited family land. While only 1.6% of total household owns title deeds which is the most important security considered while seeking loans.



**Figure 4.2 Ownership of land**

So households do not own any land will make a contribution of 0 points in sub-index and they are highly vulnerable because they have no security in form of personal credit for investment or some other purpose. while 62% of households who are sharing inherited or family land will make a contribution of 1 point, these household will not easily be able to use land or dispose it off in hour of need because it's a mutual property. Remaining 1.6% will had a contribution of 2 points in the sub-index, these are the household having most important form of land known as title deed. This land is a form of personal credit which can be used easily for investment or some other purpose.

#### **4.7 INCOME DIVERSIFICATION**

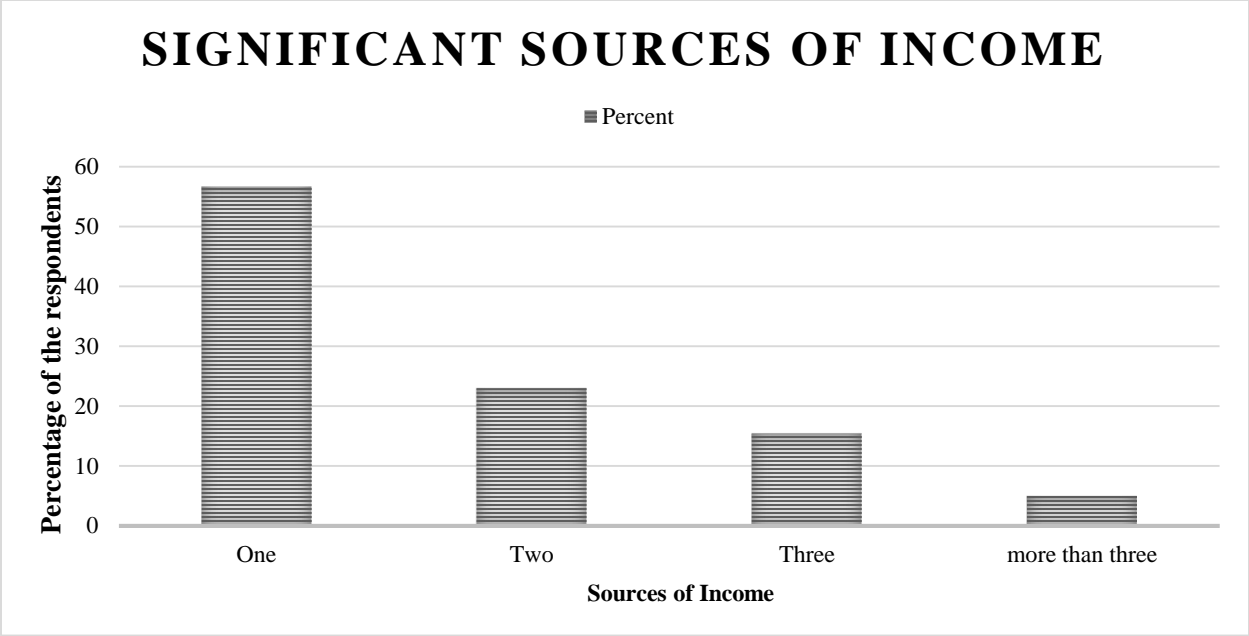
More diversified sources of income the more stable will be the economic state of the household. More than one source of income will make household better off. If household relies on only one

income source and it got destroyed during any unfortunate event then they will be highly vulnerable compared to those who have 2 or more sources to rely for earning livelihood.

**Table 4.4 Significance sources of income**

	Frequency	Percent	Valid Percent	Cumulative Percent
One	217	56.7	56.7	56.7
Two	88	23.0	23.0	79.6
Three	59	15.4	15.4	95.0
more than three	19	5.0	5.0	100.0
Total	383	100.0	100.0	

In the above table of statistics for income diversification, it can be seen clearly that nearly 57% of household are relying on only one source of income. They haven't diversified their income sources to share the burden.



**Figure 4.3 Income diversification**

This figure shows that 57% households are highly vulnerable with minimum adaptive capacity as they are depending on single income source. Having single source of income is very risky, because in any emergency situation when the household will not be able to continue with that only source of earning he will be at high risk. There will no other choice for him to earn his living and he will be highly vulnerable. One income source will make a contribution of 1 point in sub- index. 23% households are having two income sources they are not very high vulnerable and they have better adaptive capacity than those who are depending on single income source and it will make a contribution of 2 points in sub-index.

15% and 5% households are having three and more than three sources of income respectively. They are the households having maximum adaptive capacity and low vulnerability. It will make a contribution of 3 and 4 points in the point table of sub-index.

#### 4.8 Sub-index of Economic wellbeing and stability:

By aggregating the contributed points of the variables of sub-index, single value of sub-index is calculated.

**Table 4.5 Economic wellbeing and stability**

	<b>Frequency</b>	<b>Percent</b>	<b>Valid Percent</b>	<b>Cumulative Percent</b>
2	70	18.3	18.3	18.3
3	32	8.4	8.4	26.6
4	108	28.2	28.2	54.8
5	67	17.5	17.5	72.3
6	43	11.2	11.2	83.6
7	24	6.3	6.3	89.8
8	15	3.9	3.9	93.7
9	9	2.3	2.3	96.1
10	9	2.3	2.3	98.4
11	6	1.6	1.6	100.0
Total	383	100.0	100.0	

From above table it can be seen that about 83.6% households are making a contribution of 6 points and below in HADI for each household, while minimum value of HADI is -11 which shows high vulnerability and zero adaptive capacity. While maximum value of HADI is 30 which show high level of adaptive capacity and zero vulnerability. So these 83.6% households have minimum adaptive capacity and vulnerability of these households is high.

## 4.9 Dependency Burden

Terminal ill members of household and non-working household members are the variables combine for the sub-index of dependency burden.

**Table 4.6 Number of members suffering from long term illness**

	Frequency	Percent	Valid Percent	Cumulative Percent
0	342	89.3	89.3	89.3
1	26	6.8	6.8	96.1
2	13	3.4	3.4	99.5
3	1	.3	.3	99.7
4	1	.3	.3	100.0
Total	383	100.0	100.0	

Sufficient amount spent on medication will maintain the health of people. Above statistics of households terminal illness shows that 89% of households are not suffering from any long term disease and almost 7% households where 2 persons are suffering from long term illness and 3% households are those where 3 and more than 3 persons are suffering from long term illness. No member suffering from terminal illness will make a contribution of 0 points in sub-index and they are the household who have high adaptive capacity. One suffered member will contribute -1 points in sub-index. While two or more terminal ill household members will have a contribution of -2 points in sub-index. Two or more than two members suffering from illness is a sign of high vulnerability.

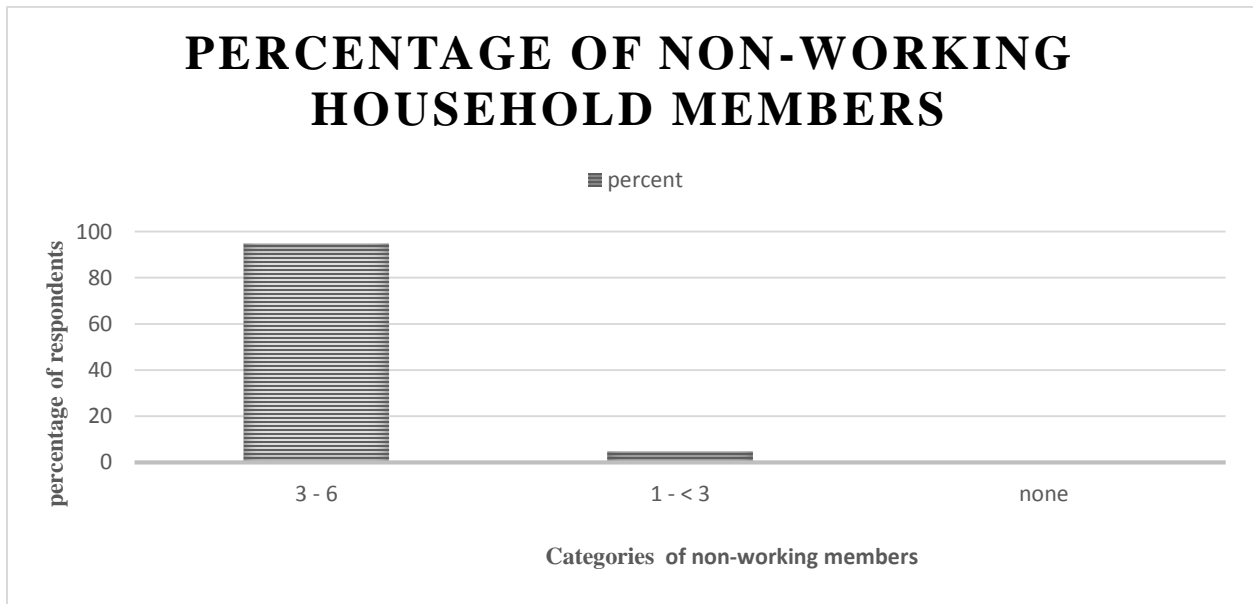
#### 4.10 Non-working household members

Household with more dependent members will have less adaptive capacity because non-working household members will economically be dependent on working member of household. This dependence will put extra burden on the shoulders of working members.

**Table 4.7 Non-working household members**

		Frequency	Percent	Valid Percent	Cumulative Percent
	3 - 6	365	95.1	95.1	95.1
	1 - < 3	19	4.9	4.9	100.0
	Total	384	100.0	100.0	

Above statistics shows that up to 95% of households in the study area are those who have 3 or more than 3 dependent members.



**Figure 4.4 Non-working household members**



95% households are those who are bearing the extra burden of 3 to 6 additional members. These 95% households are having minimum adaptive capacity and extra burden will enhance their vulnerability, because dependent members are economically dependent on them and fulfilling each member's need in one source of income make the household vulnerable. Other than this 5% are the households with 1 to 3 dependent members. Their adaptive capacity is also low. Remaining .3% households are having maximum adaptive capacity and minimum vulnerability.

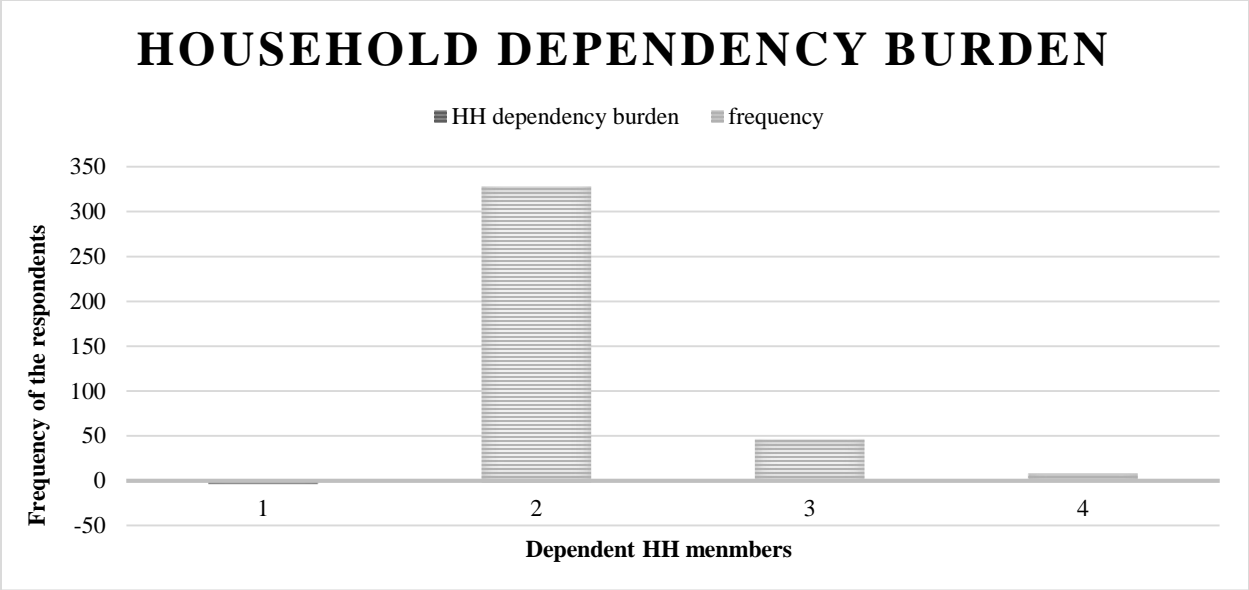
#### 4.11 SUB-INDEX OF DEPENDENCY BURDEN

Aggregating the contributed points of each variable, single value of sub-index dependency burden will be achieved.

**Table 4.8 Dependency burden sub-index**

	<b>Frequency</b>	<b>Percent</b>	<b>Valid Percent</b>	<b>Cumulative Percent</b>
-4	1	.3	.3	.3
-2	328	85.4	85.6	85.9
-1	46	12.0	12.0	97.9
0	8	2.1	2.1	100.0
	0		100.0	
<b>Total</b>	<b>384</b>	<b>100.0</b>		

Minimum and maximum values of the sub-index dependency burden are -4, 0. Where -4 is showing extreme vulnerability and 0 is showing highest adaptive capacity.



**Figure 4.5 Household dependency burden**

Calculated statistics of dependency burden of the sub-index is showing that about 86% of household had a contribution of -2 to -4 points in HADI. This shows that 86% of households are facing high dependency burden in form of non-working members and terminal ill members, which reduces the adaptive capacity of rural household and maximizes the vulnerability in case of an unfortunate event. Remaining 14% of household had a contribution of -1 to 0 points in the

Sub-index which shows that 14% of the household are those with minimum dependency burden and it is an indication of high adaptive capacity and low level of vulnerability.

Graph also shows that 328 households out of 383 are those whose dependency burden is extremely high which also shows their extreme vulnerable situation.

#### 4.12 Interconnectivity in higher level processes

Sub-index of interconnectivity in higher level processes consists of two variables. One is geographical scope of contacts on which households rely in case of emergency, and second is the number of social categories a household rely on during a shock.

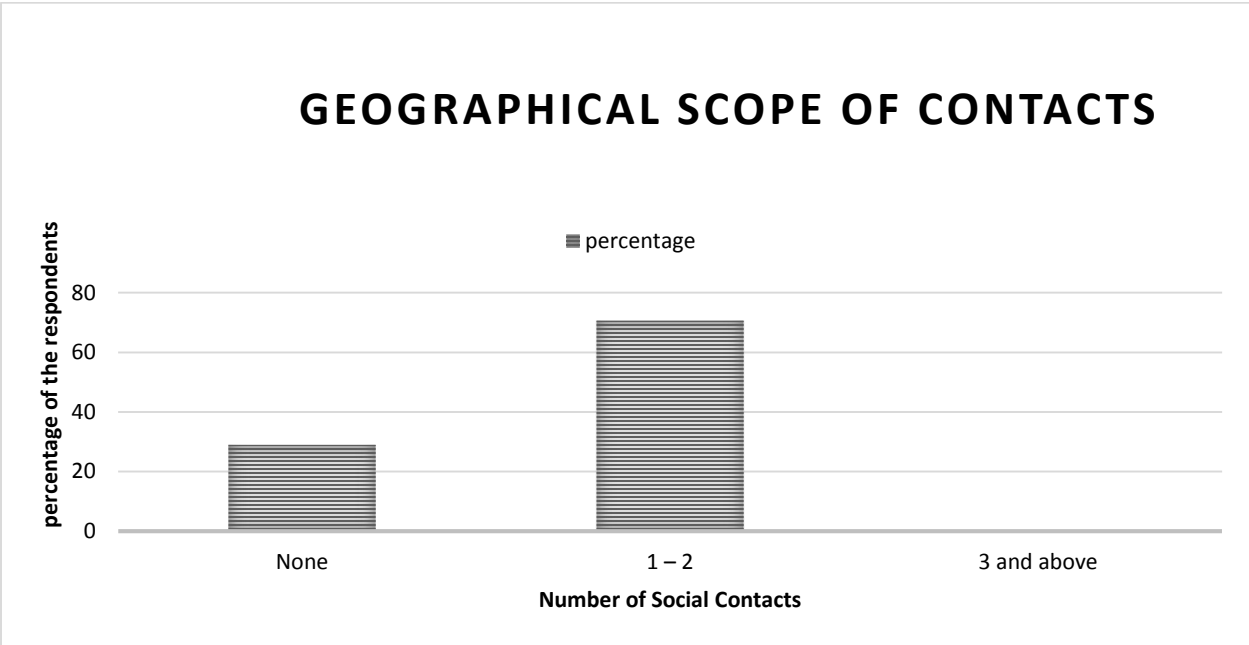
##### i. GEOGRAPHICAL SCOPE OF CAPITAL

Households relying on contacts living in same area or village cannot enhance the adaptive capacity. As people living in same geographical region will face same type of risk and they will not be able to help each other.

**Table 4.9 Geographical scope of contacts**

	<b>Frequency</b>	<b>Percent</b>	<b>Valid Percent</b>	<b>Cumulative Percent</b>
<b>None</b>	111	28.9	29.0	29.0
<b>1 – 2</b>	271	70.6	70.8	99.7
<b>3 and above</b>	1	.3	.3	100.0
<b>Total</b>	384	99.7	100.0	
<b>Total</b>	<b>384</b>	<b>100.0</b>		

According to the above calculated statistics 28% people are those who don't have any contact to rely on in case of emergency, around 71% household are those who rely on 1 or 2 contacts outside their villages in any emergency situation and remaining .3% are those who depend on 3 and more social and capital contacts.



**Figure 4.6 Geographical scope of contacts**

First 28% are making a contribution of 0 point on Sub-index, these are extremely vulnerable households because they do not have any social contact to rely if anything bad happens to them remaining 71% and .3% are making a contribution of 1 and two points respectively in points table of sub-index. In this way that household having maximum number of social contacts outside the village will have high adaptive capacity then those who does have anyone to rely on.

**ii. Number of social categories household rely**

Number of social categories a household rely in emergency is really important variable of this sub-index. If a household only rely on family for assistance he will be more vulnerable than those who relies on friend, neighbors and other social groups.

**Table 4.10 Number of social categories a household relies on during shocks**

	<b>Frequency</b>	<b>Percent</b>	<b>Valid Percent</b>	<b>Cumulative Percent</b>
<b>Family</b>	1	.3	.3	.3
<b>family &amp; friends/ neighbors</b>	378	98.4	98.7	99.0
<b>three social groups</b>	5	1.0	1.0	100.0
<b>Total</b>	<b>384</b>	<b>100.0</b>		

Above statistics shows clearly that at study area only .3% households are those who only relies on family, and other 98% households depends on family, friends and neighbors for help. .3% households make a contribution of 1 point in total sub-index, while remaining 98.4% households are making a contribution of 2 points in sub-index. Those who are only dependent on family in emergency situation will be more vulnerable than those who have friends and family both for assistance.

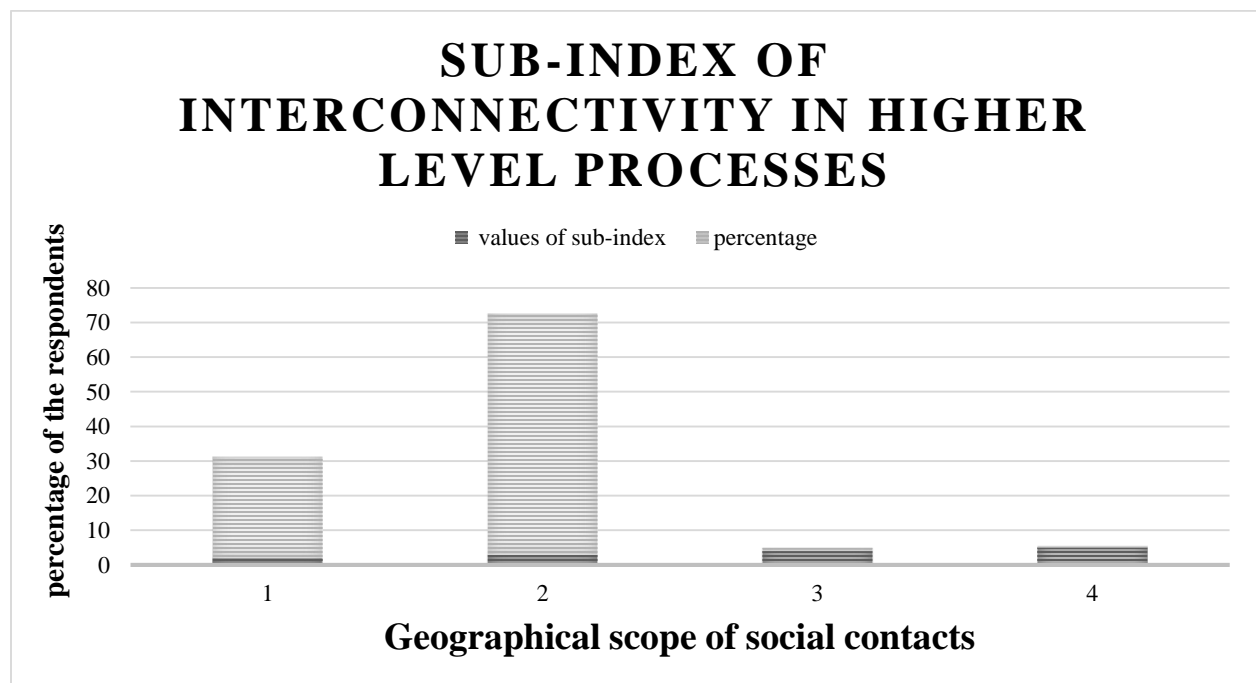
#### **4.13 SUB-INDEX OF HIGHER LEVEL PROCESSES**

By aggregating the points calculated from above discussed variables, value of higher level processes sub-index is calculated for each household, which can further make contribution in calculating a single value of HACI for each household.

**Table 4.11 sub-index of Interconnectivity in higher level processes**

	Frequency	Percent	Valid Percent	Cumulative Percent
2	112	29.2	29.2	29.2
3	267	69.5	69.7	99.0
4	3	.8	.8	99.7
5	1	.3	.3	100.0
<b>Total</b>	<b>384</b>	<b>100.0</b>		

Minimum and Maximum values of this sub-index are 1 and 7 respectively.



**Figure 4.7 Interconnectivity in higher level processes**

1 is showing high level of vulnerability and 7 showing maximum adaptive capacity. Above statistics of this sub-index shows that more than 99% of households had a contribution of 2 to 3 points in the sub-index this means that they are highly vulnerable because they are not the members

of social help groups or other organizations that can help them in case of emergency, besides this they don't have such friend or family circle on which they can rely during a shock. and remaining .5% households are doing better in this sub-index.

These 99% households don't have strong back to rely on in case of emergency. The geographical scope of social as well as capital contacts, and the number of contacts they rely on in case of emergency are not strong enough to depend in case of any shock.

#### **4.14 SUSCEPTIBILITY TO ENVIRONMENTAL CHANGES**

This sub-index is calculating the extent of household dependency to natural resources. The more they will be exposed to or depend on such natural resources that are susceptible to environmental changes, the more they will be at risk. Variables of this sub-index are farming contribution in total income, cooking energy source, and water source for domestic use.

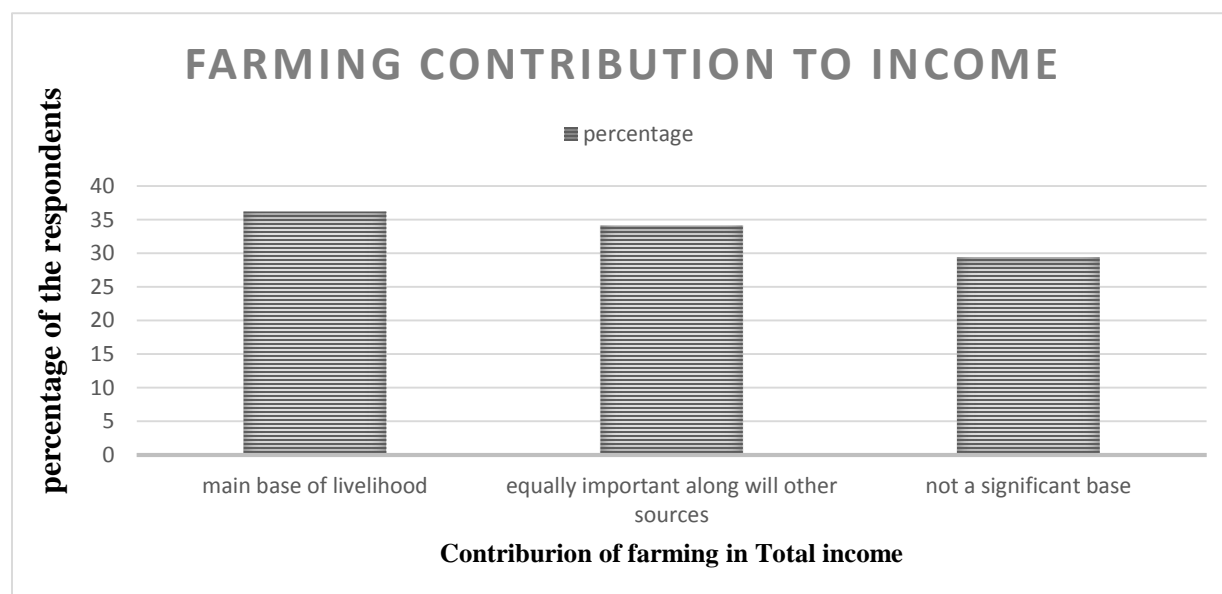
##### **i. Farming contribution to income**

Statistics shows that about 36% households are directly involved in forming activities, some of them are producing crops, others have land for planting fruit trees, and rented land from where they get rent and produce of land for domestic use. So any environmental change can destroy their fruit trees, and can cause land erosion etc.

**Table 4.12 Contribution of farming in household income**

	Frequency	Percent	Valid Percent	Cumulative Percent
<b>main base of livelihood</b>	139	36.2	36.3	36.3
<b>equally important along with other sources</b>	131	34.1	34.2	70.5
<b>not a significant base</b>	113	29.4	29.5	100.0
<b>Total</b>	<b>384</b>	<b>100</b>	<b>100.0</b>	

Farming is equally important base of livelihood for 34% households along with some other sources of income. They are in a better condition to cope against any unfortunate event, and their adaptive capacity is better than those who solely depend on agriculture. Farming is not a significant base of livelihood for 29% households.



**Figure 4.8 Importance of farming contribution to income**



In the sub-index farming contribution is making a contribution of -3 points where farming is a main base of livelihood for households, -2 in case where farming is equally important source of livelihood along with other source. Contribution of -1 points in case where farming is not a significant base of livelihood.

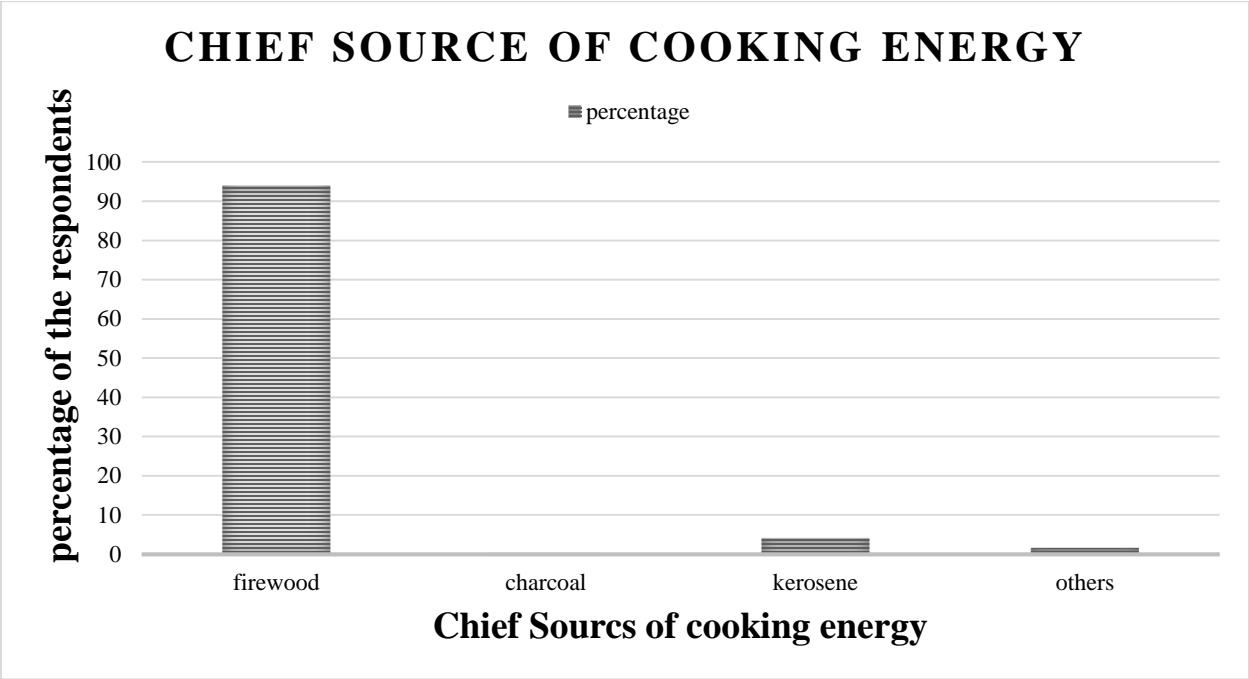
**ii. Cooking energy source**

Use of such energy sources that are less sensitive to environmental change will enhance the adaptive capacity of household, but heavy dependency on climate sensitive resources will not just only increase the vulnerability of household but also will be a cause of environmental degradation.

**Table 4.13 Chef Source of cooking power**

		<b>Frequency</b>	<b>Percent</b>	<b>Valid Percent</b>	<b>Cumulative Percent</b>
	<b>firewood</b>	360	93.8	94.0	94.0
	<b>charcoal</b>	1	.3	.3	94.3
	<b>kerosene</b>	16	4.2	4.2	98.4
	<b>others</b>	6	1.6	1.6	100.0
	<b>Total</b>	<b>384</b>	<b>100</b>	<b>100.0</b>	

Descriptive statistics shows that about 94% of households are using firewood as a chef source of cooking power. Heavy reliance on firewood is making people extremely susceptible to environmental good and also being a cause of environmental degradation. As people are obtaining this wood from forest without bearing any cost. This heavy reliance on forest is also the reason of forest degradation.



**Figure 4.9 Chief source of cooking**

Other 6% households are using charcoal, kerosene oil and others. Another reason of this heavy dependency on firewood is free access to forest. Prohibited access to forest or heavy fine on wood cutting can improve the situation.

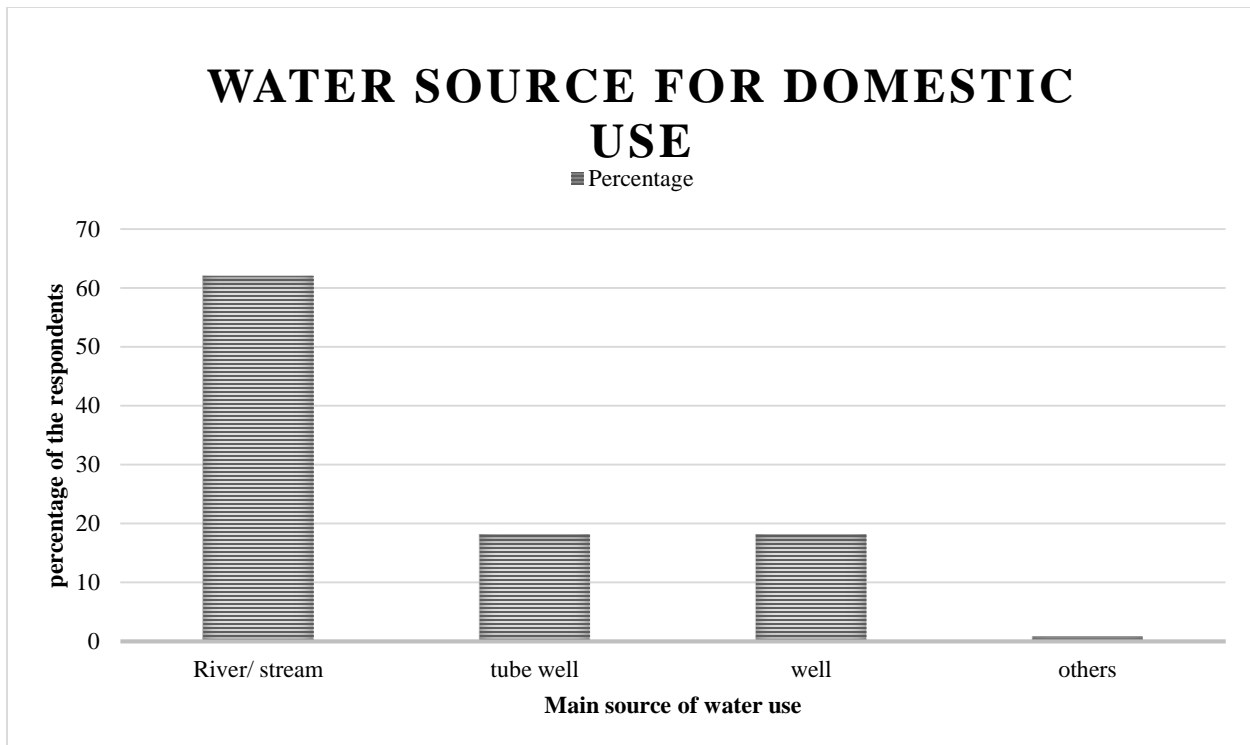
**4.15 Domestic water source**

Heavy reliance on water sources that are sensitive to environmental change will decrease the adaptive capacity of the household.

**Table 4.14 Main source of domestic water**

		<b>Frequency</b>	<b>Percent</b>	<b>Valid Percent</b>	<b>Cumulative Percent</b>
	<b>0</b>	2	.5	.5	.5
	<b>River/ stream</b>	238	62.0	62.1	62.7
	<b>tube well</b>	70	18.2	18.3	80.9
	<b>Well</b>	70	18.2	18.3	99.2
	<b>Others</b>	3	.8	.8	100.0
	<b>Total</b>	<b>384</b>	<b>100</b>	<b>100.0</b>	

Statistics shows that about 62% of households depend on river water for domestic use. This heavy reliance on water sources that are sensitive to environmental change will make household more vulnerable and reducing its adaptive capacity. Another aspect is that this water can cause water borne diseases.



**Figure 4.10 Main source of domestic water**

Other sources of water are well, tube well and others. 18% households rely on well water and similarly 18% households rely on tube well water for water.

#### **4.16 Sub-index of susceptibility to environmental changes**

By aggregating the points of all three variables discussed above, single value of susceptibility to environmental change for each household has been obtained.

**Table 4.15 Susceptibility to environmental change**

		<b>Frequency</b>	<b>Percent</b>	<b>Valid Percent</b>	<b>Cumulative Percent</b>
	<b>-6</b>	2	.5	.5	.5
	<b>-5</b>	102	26.6	26.6	27.2
	<b>-4</b>	109	28.4	28.5	55.6
	<b>-3</b>	139	36.2	36.3	91.9
	<b>-2</b>	31	8.1	8.1	100.0
	<b>Total</b>	<b>384</b>	<b>100</b>	<b>100.0</b>	

Descriptive statistics shows that about 54% households are making contribution of -4 to 6 points it means that they are highly vulnerable and are having less adaptive capacity because they are susceptible to environmental change like they don't have access to safe drinking water, safe cooking energy source or farming has a major contribution in their income.

#### **4.17 Housing quality**

House is the first protection that a household can get in any emergency situation. If the quality of household is good then the household had high adaptive capacity than those who are living in mud-walled houses, or semi-permanent houses.

**Table 4.16 Quality of house**

		<b>Frequency</b>	<b>Percent</b>	<b>Valid Percent</b>	<b>Cumulative Percent</b>
	<b>mud-walled</b>	33	8.6	8.6	8.6
	<b>iron sheet</b>	93	24.2	24.3	32.9
	<b>semi-permanent</b>	68	17.7	17.8	50.7
	<b>permanent</b>	189	49.2	49.3	100.0
	<b>Total</b>	<b>384</b>	<b>100</b>	<b>100.0</b>	

Descriptive Statistics shows that about 49% household are living in mud-walled, iron sheet and semi-permanent houses, these 49% people are considered as highly vulnerable than those who are living in permanent houses and are having high adaptive capacity. Mud-walled houses will make a contribution of 1 point in this sub-index, iron-sheet houses will make a contribution of 2 points, semi-permanent houses will make a contribution of 3 points and permanent houses will make a contribution of 4 points. Though number of household living in a vulnerable situation are less than those living in permanent or semi-permanent houses still they are enough in number and they are on extreme threat.

#### **4.18 Awareness level to describe environmental change**

This sub-index will calculate the level of awareness about environmental change. If a household will be aware of the changing environment frequency and extent, he can cope with the risk in a better way than those who doesn't have information about it.

**Table 4.17 Can respondent describe any signs of environmental stress**

	Frequency	Percent	Valid Percent	Cumulative Percent
No	23	6.0	6.0	6.0
Yes	360	93.8	94.0	100.0
Total	384	100	100.0	

About 94% household respond that they are well aware to describe the environmental change. This awareness is based on past experience and observation, and it can help household to respond correctly against any risk. Here the problem is that the source of information is conventional so it can also mislead households. Value of 1 was assigned to respondents having ability to describe environmental change and 0 was assigned in case of inability to describe such changes.

#### **4.19 HACI WITHOUT EXTERNAL FACTORS**

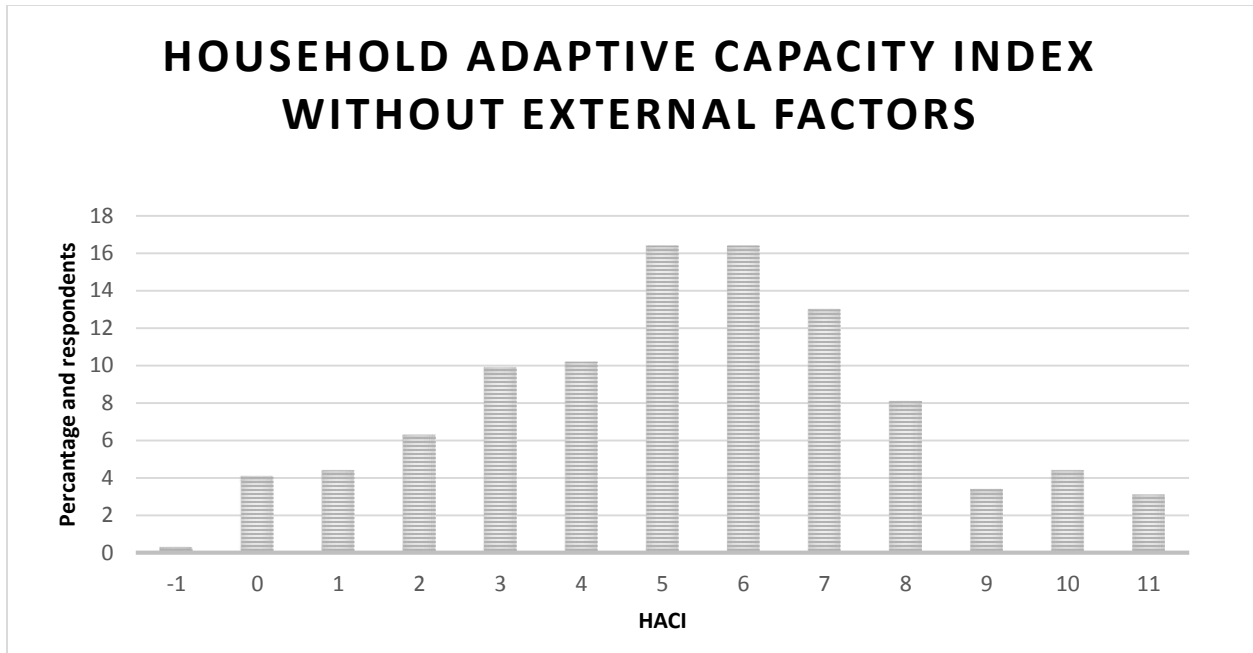
By aggregating the points obtained from each sub-index, household adaptive capacity without external factors can be obtained. After excluding external factors from HACI the minimum and maximum value of HACI is -7 to 11. -7 shows extreme vulnerability and 11 shows high adaptive capacity.

**Table 4.18 Household adaptive capacity index without external factors**

	Frequency	Percent
-1	1	.3
0	16	4.1
1	17	4.4
2	24	6.3
3	38	9.9
4	39	10.2
5	63	16.4
6	63	16.4
7	50	13.0
8	31	8.1
9	13	3.4
10	17	4.4
11	11	2.9
Total	384	100

Above descriptive statistics shows that about 77.1% household having minimum adaptive capacity and maximum vulnerability because there HACI values are less than 7.





**Figure 4.11 Household adaptive capacity index without external factors**

Household with 10 or more value of HACI is possess high adaptive capacity and is relying less on environmental sensitive resources. Total dependency on environmental sensitive resources can make household extremely vulnerable in case of any fluctuation in climate pattern. Graph shows that HACI value of 77.1% household without external factors is less than 10 and they are more close to the point of high vulnerability while remaining 22.9% households have high adaptive capacity and low vulnerability.

**4.20 EXTERNAL FACTORS AFFECTING HOSEHOLD ADAPTIVE CAPACITY**

Along with internal factors there are some external factors that affect household adaptive capacity. These factors are beyond the control of household but it had effect on determining the adaptive capacity of each household. Institutional and infrastructural environment is the sub-index of

external factors. Variables include in this sub-index are common property access, public service access and household location.

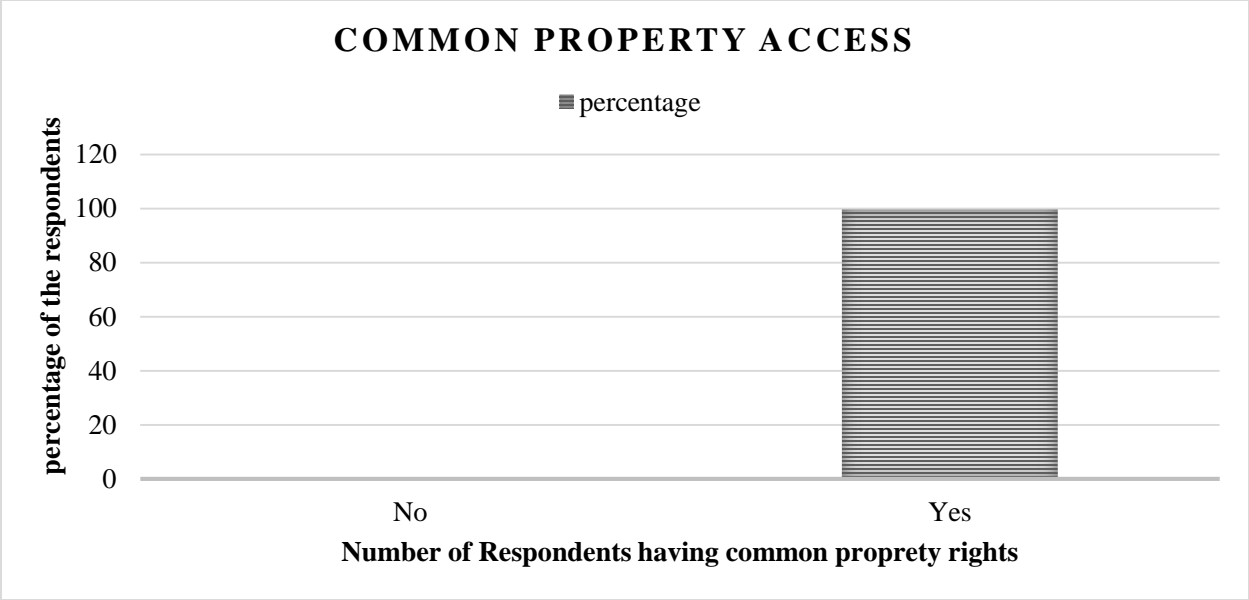
**i. Common property access**

In this variable respondents are asked about the access of common property. Households with access to common properties like grazing land will be considered as less vulnerable compare to those who doesn't have such resources.

**Table 4.19 Common property access**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	2	.4	.4	.4
	Yes	382	99.5	99.7	100.0
	Total	384	100	100.0	
Total		384	100.0		

Descriptive statistics shows that only 2% of household doesn't have access other 99.5% households have access to common property. It shows that almost all individuals have access to common property. A situation where people have huge inequalities in resource or income distribution, access to common property will provide a positive contribution to their lives by fulfilling their small requirements easily. This access will improve their adaptive capacity as well.



**Figure 4.12 Common property access**

Response of yes will make a contribution of 1 point in sub-index. And no will make a contribution of 0 points.

**ii. Public service access**

Variables of public service access are agriculture officer visits and government role. Agricultural officer visits will provide latest information to people about new technology, and better seeds.

**Table 4.20 Public service access**

		<b>Frequency</b>	<b>Percent</b>	<b>Valid Percent</b>	<b>Cumulative Percent</b>
	-1	248	64.6	64.8	64.8
	0	1	.3	.3	65.0
	1	134	34.9	35.0	100.0
	Total	383	99.7	100.0	

Minimum and maximum value of this sub-index is -1 to 5, 65% household have high vulnerability and low adaptive capacity, because they don't have access to public service like agricultural officer visits, and government is not playing any role to provide them latest information about agriculture products, better seeds, and fertilizers etc. while remaining 35% are facing better situation.

**iii. Household location**

This variable is constructed on the basis of distance of house to nearest market, and its distance from nearest road.

**Table 4.21 Housing location**

		<b>Frequency</b>	<b>Percent</b>	<b>Valid Percent</b>	<b>Cumulative Percent</b>
	-3	1	.3	.3	.3
	-2	2	.5	.5	.8
	-1	5	1.3	1.3	2.1
	0	50	13.0	13.1	15.1
	1	172	44.8	44.9	60.1
	2	61	15.9	15.9	76.0
	3	92	24.0	24.0	100.0
	Total	383	99.7	100.0	

Minimum and maximum value of housing quality lies between -3 and 3. -3 show that household's house is far away from road and market. Products produced by the household can't reach to markets on proper time and this is a clear indication that household will suffer with economic loss and its adaptive capacity will definitely be low. While 3 is the point where household will be having maximum adaptive capacity. Statistics show that more than 57% of household lies between the value of -3 to 1. And remaining lies between 2 and 3 points.

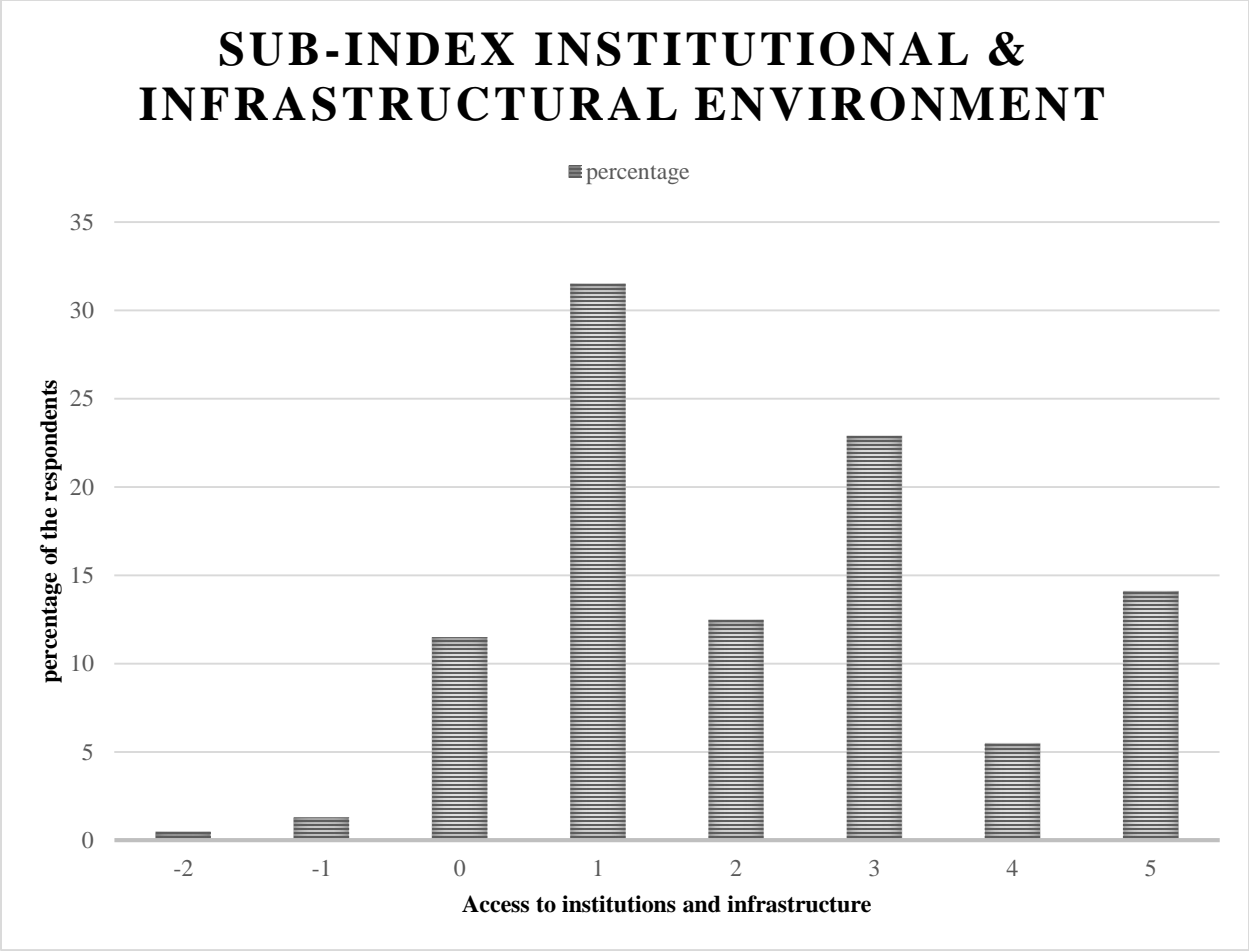
#### 4.21 Sub-index Institutional & infrastructural environment

By aggregating the points of above variables sub-index of institutional and infrastructural environment is calculated.

**Table 4.22 Institutional and infrastructural access**

		Frequency	Percent	Valid Percent	Cumulative Percent
	-2	2	.5	.5	.5
	-1	5	1.3	1.3	1.8
	0	44	11.5	11.5	13.3
	1	121	31.5	31.6	44.9
	2	48	12.5	12.5	57.4
	3	88	22.9	23.0	80.4
	4	21	5.5	5.5	85.9
	5	54	14.1	14.1	100.0
	Total	383	99.7	100.0	

Statistics shows that more than 55% households don't have access to institutions and infrastructure. These households are making a contribution of -2 to 2, while overall minimum and maximum value of sub-index is -4 to 9. So these 55% households are having high vulnerability and less adaptive capacity. Because they don't have access to common property, public services and their house location is far from near market and roads, and make them vulnerable by reducing their adaptive capacity.



**Figure 4.13 Sub-index Institutional & infrastructural environment**

Maximum and minimum value of this sub-index lies between -4 to 9. Graph shows that the highest peak is at point 1, which is more close to vulnerability point. So graphical representation of this sub-index also prove that 55% of the total households doesn't have access to institutions and infrastructure.

**4.22 HACI WITH EXTERNAL FACTORS**

By aggregating the points obtained from each sub-index including external factors, household adaptive capacity for individual household can be obtained. After including external factors to HACI the minimum and maximum value of HACI is -11 to 33. -11 shows extreme vulnerability and 33 shows high adaptive capacity.

**Table 4.23 Household adaptive capacity**

	Frequency	Percent	Valid Percent	Cumulative Percent
0	1	.3	.3	.3
1	7	1.8	1.8	2.1
2	10	2.6	2.6	4.7
3	14	3.6	3.7	8.4
4	25	6.5	6.5	14.9
5	32	8.3	8.4	23.2
6	35	9.1	9.1	32.4
7	45	11.7	11.7	44.1
8	50	13.0	13.1	57.2
9	37	9.6	9.7	66.8
10	47	12.2	12.3	79.1
11	30	7.8	7.8	86.9
12	19	4.9	5.0	91.9
13	14	3.6	3.7	95.6
14	8	2.1	2.1	97.7
15	3	.8	.8	98.4
16	4	1.0	1.0	99.5
17	2	.5	.5	100.0
Total	383	99.7	100.0	



Descriptive statistics shows that round about 78% households in rural areas of district Swat are extremely vulnerable to any unfortunate event, because their HACI values lies from 0 to 10, and these values are near to the vulnerable threshold value of the index that is -11. Reasons of this low adaptive capacity of the household in district Swat is that household face problems like high dependency burden, their economic wellbeing is not stable, they don't have such social circle that can assist them during any shock, their dependency on environmental sensitive resources is high that expose them to any disaster.

## CHAPTER 5

### CONCLUSION AND POLICY RECOMMENDATION

#### 5.1 MAJOR FINDINGS

Main aim of the study is to identify the drivers of and barriers to low adaptive capacity of rural households living in district Swat and to construct a household adaptive capacity index (HACI) for household of Swat. For this purpose, primary data is collected from 5 union councils of Swat.

Main findings of the study are:

- 83.6% respondents of total sample size have no economic stability, because the assets they own have low market value. 65% of the household owned assets having market value of less than 150,000. And only 1.6% of total household owns the land named title deeds, which is the most important security considered because this land is a form of personal credit which can be used easily for investment or some other purpose.
- Results show that 86% household are facing the problem of high dependency burden, mostly in form of non-working members of the household.
- Calculated results show that about 99% households are those who doesn't have strong back to rely on in case of emergency. Even if they have family and friends living outside the village still the financial condition of those contacts is not so strong that they could assist them totally.
- 54% respondents are those who are dependent on climate sensitive natural resources like 36% households are directly involved in agricultural activities and they don't have any other source of income, and 34% are those who are partially dependent on agriculture along with any other source of income. Other than this 94% households are using firewood as a

chief source of cooking energy, and 62% are those depending on river water for domestic use. This high dependency on climate sensitive resources make them more expose to any unfortunate event, so their adaptive capacity is low.

- Descriptive statistics shows that round about 78% households in rural areas of district Swat are extremely vulnerable to any unfortunate event, because their HACI values lies from 0 to 10, and these values are near to the vulnerable threshold value of the index that is -11. Reasons of this low adaptive capacity of the household in district Swat is that household face problems like high dependency burden, their economic wellbeing is not stable, they don't have such social circle that can assist them during any shock, their dependency on environmental sensitive resources is high that expose them to any disaster.
- Estimated results of Poisson regression show that HACI has positive and significant relationship with house ownership, safety nets, education level of household members, foreign remittances, market value of assets and subsidy from government.

## 5.2 CONCLUSION

The study concluded that household adaptive capacity of rural household of district Swat is very low, 78% households are living in the condition of high vulnerability. Reasons of this high vulnerability according to field survey result are high dependency burden, lack of social contacts, low income level, lack of land rights and low market value of assets own by them.

Households are highly dependent on natural resources that are susceptible to environmental change, for example they are more dependent on wood fuel as a source of cooking energy. This wood is obtained from forest, and for using wood fuel most of the households are degrading the condition of forest. Though household are aware of environmental change but they doesn't have resources to adapt or mitigate the effects of those changes. Most of the household have up to 6 dependent members, and this high dependency ratio is minimizing the adaptive capacity of the household. Survey results shows that most of the households faces the problem of land erosion and destruction of livestock.

Statistics shows that more than 55% households don't have access to institutions and infrastructure. These households are making a contribution of -2 to 2, while overall minimum and maximum value of sub-index is -4 to 9. So these 55% households are having high vulnerability and less adaptive capacity.

### **5.3 POLICY IMPLICATIONS**

1: Authorities should consider environmental change a big issue, and should take proper measures like empowerment of local people, building side walls along with river banks to reduce the intensity of floods, enhance awareness about environmental changes among local community such as early warning system to improve the household adaptive capacity of rural household. Currently, there is no appropriate strategy in the study area that can reduce the negative environment impacts.

2: Lead actors should take initiatives to preserve and improve the quality of environmental goods or natural resource base. For example; to improve the forest cover and they should reduce the heavy burden of rural household of district Swat on natural resources. As results shows local people are too much dependent on firewood which cause deforestation, so in order to overcome this issue concerned authorities should provide cheap alternative energy sources.

3: Environmental protection is being considered important and acknowledged by the authorities but their interests are usually short termed and are being buried under corruption and personal interests. So these interests should be consistent until result achieved.

### **5.4 LIMITATIONS OF THE STUDY**

There are certain limitations in current study. The problem of low adaptive capacity could be in other union councils of district Swat. This dissertation is limited to 5 union councils of district Swat due to time and resource limitations so this research open ways for other studies to examine the adaptive capacities of other areas in Swat.

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## Appendix-A:

This questionnaire is designed for MPhil thesis entitled “**Vulnerability and Adaptability assessment to climatic stress: a case study of district swat**”. The information collected through this questionnaire will use purely for academic research and will remain confidential.

S.NO\_\_\_\_\_

### Section 1: Basic information, dwelling and location

#### a) Respondent information

Name of the Respondent\_\_\_\_\_

Age of respondent \_\_\_\_\_

Name of Union council (UC) \_\_\_\_\_

Name of village \_\_\_\_\_

#### b) Housing characteristics

Question code	Question	Response	Code
	House ownership		1 Personal 2 rented
	What is the chief source of cooking power in this household?		1 Firewood 2 Charcoal 3 Kerosene 4 Other
	What is the main source of domestic water for the household?		1 Spring/Stream/River 2 Public pipe / Piped water from somewhere else 3 Pipe in the house 4 Other

	Quality of household head' s house		<p>1 Mud-walled &amp; Grass Thatched</p> <p>2 Iron sheet-/Mud-walled &amp; iron sheet roofed</p> <p>3 Semi-permanent: Iron sheets; Mud &amp; Concrete and Cement</p> <p>4 Permanent : Iron sheets/Tiles; Bricks/Concrete/Stone and Cement</p>
	Distance to nearest access road (not foot path) in meters		
	Distance to nearest market (in km)		
	Distance to the divisional headquarters		
	Do you have any type of safety net around your house?		<p>1 Yes</p> <p>2 No</p>

Section 2: Basic individual characteristics (all individuals, including ALL children, house help - start with household head)

ID	Relationship to household head	Age	Sex	Marital status	Health status	Literacy status	Education & Training (highest level)	Years of education	Occupational status
	1 Household head 2 Spouse of head 3 Child 4 Grandparent 5 Other relatives 6 Others		1 female 2 male	1 Single 2 Married 3 Widowed 4 Divorced	1 100% fit 2 Disabled 3 Terminally ill 4 other	1 Neither read nor Write 2 Read only 3 Write only 4 Read and write	1 No formal schooling 2 Primary incomplete 3 Primary complete 4 Secondary incomplete 5 Secondary complete 6 Vocational training 7 University		1 Too young (up to 12)/too old to work 2 student 3 unemployed 4 occupied 5 housework <b>If 4: Fill section 3 for this member now</b>

1									
2									
3									
4									
5									
6									
7									

	Household size (should be consistent with the above table, repeat this number to the respondent in order to make sure you did not forget anybody)	
	No of dependents and code: (Adult Equivalent; <6 = 0.25, <12 = 0.5, <18 = 0.75 & >18 = 1: (1) < 3, (2) 3 - 6, (3) 7-10 & (4) > 10	
	Number of members suffering from long term illness such as TB, Cancer, Diabetes <i>et cetera</i>	
	Age of household head (1) < 30 (2) 30 - 40 (3) 40 - 50 (4) > 50	

	Level of education of household head (same codes education and trainings above)	
	Level of education of highest educated household member other than head( same codes as above)	
	Availability of high school in village?	1 Yes 2 No
	Distance form college and university	

**Section 3: Job characteristics (DON'T FORGET TO PUT THE NUMBER OF THE INDIVIDUAL FROM SECTION 2 FIRST)**

I D s2	Main occupation	How many days per week in this Occupation ?	How much do you earn monthly in this occupation (in Rs) (ONLY IF EMPLOYEE/WORKER )?	Secondary Occupation	How many days per week in this occupation ?	How much do you earn monthly in this occupation (in Rs) (ONLY IF EMPLOYEE/WORKER )?
	1 Farmer 2Employee/Worker 3Non-agricultural self-employment /employer 4Non-paid household member		Only one entry per individual	1 Farmer 2Employee/Worker 3 Non-agricultural self-employment /employer 4 Non-paid household member		


**Section 4: Land ownership and use (Go to section 5 if household does not have land)**

<b>Question code</b>	<b>Question</b>	<b>Response</b>	<b>Code</b>
	Do you own your land or is it rented?		1 Owned 2 Rented (Go to s5q4)
	Which type of land rights do you hold?		1 Title deed 2 Customary rights 3 Other
	Total land size of your owned land (in acres)		
	Do you have separate parcels of land, if yes, how many?		1 No 2 One 3 Two 4 Three or more
	When you started farming how did you acquire your land?		1 Inherited 2 Bought 3 Rented 4 Government allocation 5 Other
	Since you started your farm, how has the size of the farm changed?		1 Increased 2 Decreased 3 Stayed constant
	How have these changes occurred?		1 Sold out land 2 Bought land



			3 Rented land 4 Divided land 5 Inherited land 6 Loss of land due to erosion 7 Other
	Do you have life insurance?		1 Yes 2 No
	Do you have property insurance?		1 Yes 2 No

**Section 7: Other income sources (and migration)**

Question code	Question	Response	Code
	Renting out land or property per month (in Rs)		
	Pension payments per month (in Rs)		
	Other income (interest earnings, dividends etc. per month , other public transfers e.g.unemployment benefits) per month (in Rs)		
	How many former household members have migrated during the last 10 years?		
	What is the amount the household receives from family members living abroad (in Rs)?		
	Amount receive from members working in another city		

	Today you rely more or less on remittances than three years ago?		1 More 2 Less 3 Same

### ACCESS TO HOSPITALS:

Question code	Question	Response	Code
	Does basic health care unit available at your village		1 Yes 2 No (if no go to next question)
	What is the distance of big hospital from your village?		

### Section 6: Assets and Livestock

	s8q1			
	Type of assets	Quantity	Value as of today	Today you own more/less/same of this asset compared to three years ago?
				1 More 2 Less 3 Same
1	Cows			
2	Chicken/other poultry			

3	Goats			
4	Radio			
5	Television			
6	Bicycle			
7	Motorbike			
8	Mobile phone			
9	Rental shops/houses			
10	Sofa sets			
11	Generator			
12	Cars			
13	Tractor			
14	Others			

### Section 7: Agriculture/Farming and other sources of income

Question code	Question	Response	Code
	Contribution of Farming to Household income		1 Main base of Livelihood 2 Equally important base alongside other(s) 3 Not a significant base for livelihood
	How many significant (at least 20% of total income) sources of income does the household have?		1 One 2 Two 3 Three 4 More than Three

## Section 8: The role of the forest

Question code	Question	Response	Code
	Do you think the forest near you is important?		1 Yes 2 No
	How often do household members go into the forest?		1 Never (Go to next section) 2 Once a year 3 Once every month 4 Once a week 5 Several times a w
	Why, major reason?		1 Collect firewood 2 Touring or Leisure 3 Collecting herbs 4 Cattle grazing 5 Land cultivation 6 Employment 7 Water collection 8 Wild honey 9 Charcoal burning 10 Timber, plywood, seedlings 11 Education 12 Other

	Do you have rights to use the forest resources		1 yes 2 no
	Apart from the forest, to which other common property do you have rights?		1 None 2 Grazingland 3 Other

**Section 9: Social Capital and Networking**

Question code	Question	Response	Code
	Is anybody of this household a member of a credit scheme or group?		1 Yes 2 No
	Does the household have an outstanding loan or have you borrowed money during the last 12 months?		1 Yes 2 No (Go to s12bq4)
	This loan is given by		1 Neighbors or friends 2 Savings group 3 Other microfinance institutions 4 Cooperatives 5 Banks 6 Other
	Banks available in your area		1 Yes 2 No

	Is anybody of this household a member of a farmers' organization?		1 Yes 2 No
	Are you a part of any micro finance credit scheme?		1 Yes 2 No
	Is anybody of this household a member of a self-help group?		1 Yes 2 No
	Does the household have somebody located at the district/provincial headquarters or at least 50 km away on which it can rely to bail it out on short notice in case of an emergency?		1 Yes 2 No
	What is the composition of the household's social network?		1 Family & friends outside the household 2. 1 and Traditional leadership within the village 3 1, 2 and lower formal government: Assistant chief, chief, councilor
	Richness of contacts and/or groups with which a household has links		1 Contacts are resource poorer than the household

			2 Low resource access 3 Medium-level access 4 High access level
	In a worst case scenario, can the household rely on friends and relatives to survive for temporary period as long as the tough period persists?		1 Yes 2 No

**Section 10: Shocks and Natural as well as Institutional Environment**

	S13q1	Code		Code	
	<b>Shocks: Has the household been negatively affected by the following events within the past 5 years?</b>	1 Yes 2 No	<b>Rank the 3 most important shocks</b>	1 Most severe 2 Second most severe 3 Third most Severe	<b>When did shock(s) occur (Year)?</b>
1	Drought related crop failure				
2	Weather related loss of livestock				
3	Floods				
4	Wind destruction				
5	Epidemics related to weather/climate change				
6	Crop diseases or pests				

7	Livestock died or stolen				
8	Business failure or loss of job				
9	Large fall in prices for crops				
10	Large rise in food prices				
11	Large rise in agricultural input prices				
12	severe illness of working household member				
13	Death of working household member				
14	Restricted access to forest resources				
S13q4	What did the household do to pull out of the past (weather-event-related) shocks?	1 Reduced consumption/expenditure 2 Assisted by relatives and friends 3 Borrowed from contacts/institutions 4 Sold some assets 5 Other			



	Can the respondent describe any signs of environmental stress based on the experience of the past 5 years?		Rank the 3 most visible/important signs
		1 Yes	1 most severe
		2 No	2 second most severe
			3 third most severe
Drier weather			
Soil erosion			
Soil degradation			
Flood			
Deforestation			

	Other than firewood, what other sources of cooking energy does the household use		1 Charcoal 2 Kerosene (in stoves) 3 Gas 4 Electricity 5 Other
	What can the government and/or private organizations do better in order to help mitigate the challenges posed by environmental stress?		1 Provide more awareness creation 2 Provide more extension services 3 Provide alternative sources of energy 4 Other (Specify)

**Section 11; Labor input, extension, and technology**

Question code	Question	Response	Code
	What is the main source of agricultural information?		1 Agricultural extension 2 Community based organizations 3 NGOs 4 mosques 5 Farmer groups/farmer associations 6 Other 7 None
	Does agriculture extension worker visits your area?		1 Yes 2 No
	How often are you visited by an agricultural extension officer?		1 Not at all 2 1 or 2 times in the past 5 years 3 Once every year 4 Once every month 5 Weekly
	Sources of climate related information		1 TV 2 internet 3 newspapers 4 NGO's

			5 others
	Subsidy from government after floods?		1 Yes 2 No
	Availability of material to build flood resistant houses?		1 Yes 2 No
	Willingness to move away from flood prone area if land at safe site provided?		1 Yes 2 No

	Flood affects your village		1 Yes 2 No
	Do you get affected?		1 Yes 2 No
	Do you start diversifying your income sources after flood?		1 Yes 2 No
	Do you start any business after flood?		1 Yes 2 No
	Do you take any initiative to remain safe from flood in future?		