

CLIMATE CHANGE IMPACT ON LIVELIHOOD AND  
VULNERABILITY: A CASE STUDY OF MUSHAR  
COMMUNITY IN SAPTARI DISTRICT IN NEPAL



A Dissertation for the Degree of Master in Disaster Management

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## Abstract

Climate change impact and vulnerability towards the change on the poor people has always been significant aspect of issue and discussion worldwide. With the green house gases increasing various consequences of climate change is pressurizing the resources on which people are dependant for their livelihood. Various studies done in country level and worldwide has proven that Nepal is one of the worst sufferers of climate change. Climate change is also being proved as doldrums for making people more vulnerable to shocks and stresses more over burden on livelihood capitals i.e. natural, physical, social, financial and human.

The main objective of the paper was to assess vulnerability and impacts of climate change on livelihood among Mushar communities in Saptari district of Nepal at Koshi basin. For this research participatory tools for assessing climate change was used with various other tools like interview, observation etc for the validating the findings. To assess the information literature were reviewed from different journal article, published books, government policies, meteorological and hydrological data and other unpublished thesis work and articles.

Different livelihood resources like agriculture, water, forest, public health and settlements are vulnerable to climate change. The result shows that there is increasing trend of rainfall and discharge in the Koshi River. Also the average temperature is in the increasing trend for the Koshi basin inviting different trouble for the livelihoods aspect in form of flood, cold wave, illness, livestock disease etc creating more challenge in the livelihood of the Mushar community. Though all households in the VDC( Village Development Committee) are vulnerable to climatic crisis, the problem is more acute for the poor, landless, children, women, large sized family among the Mushar family. To cope with the impacts the community is use saving and credit, wood selling and other activity, disaster preparedness plan and disaster management committee as strategy. Awareness raising and capacity building are among the coping strategies provided by the government institution and NGO's in the area.

Thus the study suggest to address the climate change challenges for the community with the help of study at micro level and making plans policies and programme of adaptation for the Mushar community to withstand the shocks of climate change for the most vulnerable group.

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## **List of Abbreviations**

AAN	Action Aid Nepal
CBS	Central Bureau of Statistics
DADO	District Agriculture Development Office
DFID	Department for International Development
DLS	Department for Livestock Services
DoHM	Department of Hydrology and Meteorology
DRR	Disaster Risk Reduction
GLOF	Glacier Lake Outburst Flood
GON	Government of Nepal
HMG/N	His Majesty Government of Nepal
IPCC	Intergovernmental Panel for Climate Change
IUCN	International Union for Conservation of Nature
LFP	Livelihood Forestry Programme
NAPA	National Action Plan for Adaptation
NPC	National Planning Commission
UKAID	United Kingdom Agency for International Development
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework on Convention of Climate Change
VDC	Village Development Committee
WECS	Water and Energy Commission and Secretariat

# Chapter I

## Introduction

### 1.1 General Background

Climate is commonly defined as the average weather for a long period of time for the given region. Climate encompasses different components like, temperature, precipitation, wind etc. Climate change is a statistically significant change in measurement of either the mean state or variability of the climate for a place or region over an extended period of time due to natural variability or as a result of human interventions (Provention consortium, 2007). This is resulting in the increase in the emission of the greenhouse gases reflecting variation in the climate statistics like temperature, precipitation and wind. (Orindi and Eriksen, 2005).

Greenhouse gases are the ingredients of the atmosphere that add to the greenhouse effect. Some greenhouse gases are present naturally in the atmosphere, whereas few green house gases a consequence of human activity. The greenhouse gases that are present in the atmosphere naturally include water vapor, carbon dioxide, nitrous oxide, methane and ozone. There are a few human activities and massive industrialization, which increase the levels of most of these naturally occurring gases. Since the middle of the 19th century, human agriculture and industrialization have dispensed an enormous quantity of these green house gases into the atmosphere, where these have trapped enough heat to begin climate change.

There are many evidences of climate change that are being experienced by many people especially the poor and excluded around the world in different forms. According to third Assessment Report of Intergovernmental Panel on Climate Change (IPCC), the global average surface temperature has increased over the 20th century by about  $0.6^{\circ}\text{C}$  (Treut et al, 2007). There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities. The global average surface temperature is expected to increase by  $1.4^{\circ}\text{C}$  to  $5.8^{\circ}\text{C}$  by 2100 (Action Aid Nepal, 2007), depending largely on the scale of fossil-fuel burning (IPCC 2001).

The effects of climate changes are comprehensive. Past and current emissions mean that an increase in temperature of  $1^{\circ}\text{C}$  to  $1.5^{\circ}\text{C}$  is inevitable. Yet the increase of  $0.6^{\circ}\text{C}$  that has already occurred is having a severe impact on global ecosystems and especially on poor people. To avoid the most serious impact of global warming and climate change, the global mean temperature should be limited to a  $2^{\circ}\text{C}$  increase above pre-industrial levels

(UK Government, 2003). Temperature rises beyond 2°C are likely to result in reduced crop yields in most tropical, sub-tropical, and mid-latitude regions and some ecosystems will be irreversibly damaged or lost. It will contribute to result in much more flooding in low-lying areas with decline in food production, an increase in disease, and the extinction of plants, animals, and entire ecosystems (IPCC, 2007).

Further, as a result of human activities, atmospheric concentrations of greenhouse gases are rising and with them, global temperatures. In addition to increases in temperature, global warming results in more extreme weather patterns: more rain, longer dry spells, stronger and more violent storms, more fires, and the spread of tropical diseases. As climate change pushes the world towards more extreme weather, more and more people will be exposed to recurrent disasters during their lives. IPCC (2007) predicted that there will be a widespread increase in the risk of flooding for many human settlements. Flooding and landslides, the unavoidable results of climate change, pose the most widespread direct risk to human settlements. It's estimated that by 2025 over half of all people living in developing countries will be highly vulnerable to floods and cyclones.

Food, health, water and energy, the building blocks of livelihoods may face many of the threats from, and responses to, global warming in the days to come. Without stopping the effects of global warming, it is clear that the viability of millions of people's lives and livelihoods will be undermined; without significant new resources, millions of others won't be able to adapt to changes that are already happening. The information is more scant for countries like Nepal as underdeveloped countries are vulnerable to climate because of the factors like persistent poverty, illiteracy and ignorance. World Bank (2003) also mentioned that all countries are vulnerable to climate change but the poorest countries and the poorest people within them are most vulnerable. The scarcity of adequate information flow on climate change trends slow down the task of effective policy formulation regarding adaptation and mitigation (Aryal and Choudhary, 2009), making the poor countries and poor people more vulnerable.

Particularly, the poor and most vulnerable people and the ecosystems in which they live and on which they depend will bear the brunt of the impacts of climate change. In both developing and developed countries, the impact of climate change can be much greater for indigenous and dalits communities who rely most directly on their immediate environments for subsistence and livelihood often living in the more remote and ecologically delicate zone (UNFCCC, 2004).

## **1.2 Statement of the Problem:**

Global warming due to Climate change has kept Nepal rich and diverse bio diversity, ecology and infrastructure in the threat of destruction An increased emission of greenhouse gases into the atmosphere is further aggravating these problems Though

Nepal With the carbon emission of less than 0.025% is one of the worst sufferers of climate change in the world and most vulnerable to climate due to its geophysical and socio economic conditions According to a recent study Nepal's atmospheric temperature is increasing at an alarming rate of about 0.41 °C per decade (Dahal, 2005, Kansakar et al. 2004 as cited in care Nepal 2009).

The term "Dalit" refers to "a group of people who are religiously, culturally, socially and economically oppressed (UNDP 2009). They belong to different language and ethnic groups. The census data of Central Bureau of Statistics (CBS) for 2001 reveals 13.08 percent Dalit population. However, Dalit civil society organizations reliably project that Dalits make up more than 20 percent of the population and have been excluded socially, economically and politically throughout Nepal's history.

Poor people, women, and marginalized communities are highly vulnerable to climate change impacts. Thus, in order to secure their livelihoods, it is imperative that climate change issues be mainstreamed as a key development concern (Care, 2009).

Draft NAPA, (2010) - explains Nepal being a largely agrarian economy is highly sensitive to changes in climate and natural resource availability. Climate change threatens to reduce the effectiveness of development initiatives across Nepal. For example, drying - added to a trend of warming - will reduce food security and affect the availability of water resources. Further increases in the intensity of rains in other parts of Nepal - particularly those where the topography is broken and soils eroded - will experience increased flooding and landslide risks threatening human security, water supplies, urban infrastructure etc threatening all forms of livelihood of the poor people.

Among them Mushar are most marginalized and backward community in the country. Living in the river bank and being poor makes them more vulnerable to the climatic hazards.

Recent studies in climate change forwarded the urgent need for vulnerability assessment of the district and the local areas to identify the vulnerable sectors. Climate change is inviting many problems on public health, infrastructure, and agriculture and food security,

biodiversity. Mushar community depends on these sectors for their livelihood. Mushar are poor and vulnerable to climate change as there are frequent disaster and many other climate change impacts on biodiversity, agriculture, food security etc.

This research will try to explore the impact on the Mushar community due to climate change on their livelihood. Further it will help to identify the vulnerable sectors for Mushar community focusing on livelihood. Hence it will help in making climate change study to defy the negative climate effects on the community further help in developing adaptation plan at very micro level which is the need for today to decrease the vulnerability of the communities Mushar in Nepal.



Picture 1:- Heavy rain fall in May, 2008 caused flood destroying houses and killing more than 400 people and displacing 40000 people, Mushar community were among the worst sufferer from the flood at Koshi Basin

### 1.3 Organization of the Report:

The first chapter deals with the general background of the study relating to science of climate change its implications on global warming. Climate change around the globe is explained along with its linkages to different sectors like change in temperature and precipitation, disaster, biodiversity etc. a precise summary is presented in the introductory part about climate change impacts in general specificity on climate change in Nepal and its impact is presented Thus, introductory chapter deals with sufficient background information to allow the dissertation readers to understand the problems, contexts and significance. Second part of the introductory chapter explains being more specific and

concise about the problem, importance of research topic in the national level as well as global level to know about the climate change vulnerability of the dalits in their livelihood. Problem is stated for readers and other who uses the research findings to give a clear concept on why research was being done though these are further discussed.

Chapter III deals with the justification of the study on the Mushar community. Based on the literature review the particular topic of the dissertation is justified.

First part of chapter IV deals with one overall objective and four specific objectives of the study. This throws light on methodology as well as expected outcomes of the accomplished work. Secondly, the extent of the work is covered. There is detail description of the study area mainly Saptari district and Mushar community in Nepal and specifically in the Joginiya VDC is also presented. Despite the coverage as explained in the scope, there were other limitations in methodology, time, data, field visits which is explained in the limitations. Materials and methods in order to gather information and present them for useful purpose at an understandable level are explained in detail in Chapter V. There is a detail description of the planning of the work. All materials and methods applied are explained in details with information on sampling types of data used for analysis and presentation. A description is provided on detail of field methods and each method is also clearly elucidated. Key informant interview, Climate hazard Ranking, Transect walk and their specific techniques are described. Data collection and analysis procedures are dealt at the end of the chapter.

The information obtained through different methods is presented in Chapter VI. Initially the district profile, climate scenario of district and trend of climate change in the district is presented which is followed by the results in descriptive way as well as given in figures. Initially, data from the field work with the help of participatory techniques are presented and the result given by the community during the exercise.

This follows the information on impact of different livelihood capital of the Mushar community under different headings on the basis of discussion made with the community and the local level stakeholders and expert. More over chapter VI describes on the vulnerability of climate change impact on the community and factor exacerbating the vulnerability of the community. Based on these results discussions are made in Chapter VII. Findings are discussed with sonic relevant literatures where suitable.

Lastly conclusion and recommendation to the study is presented on the basis of findings and discussion which is followed by references cited and pictures of the research sites.

## Chapter II

### Review of Literature

#### 2.1 Definitions of terms used in dissertation report

##### Climate Change

Climate change refers to the statistically significant change in the measurements of either the mean state or variability of the climate for a place or region over an extended period of time either directly or indirectly due to the impact of human action on the composition of the global atmosphere or due to natural variability (Twigg, 2007). When longer term and broader trends cause a shift in the average weather the climate changes. Places that were usually cool become warmer, places that were usually dry get more erratic rain, the intensity and track of cyclone change.

##### Impact Assessment

The study of the impact of climate change on the livelihoods of local populations is increasingly forwarded as an urgent research need (Smit & Pilifosova 2003 as cited by Senbeta). Depending on the discipline literatures use different terms and definitions for the term impact. To limit the scope of the study to climate change impact on livelihood and community of Mushar, the definition of biophysical vulnerability by (Deressa et al cited by Senbeta., 2009), which refers to the *extent of damage inflicted by climate change on livelihood and social systems*, will be used in this study. The impact on livelihood (livestock tending and crop cultivation, fisheries), and consequently on the community is analyzed based on local climatic data, impacts, vulnerability by employing qualitative research strategy and also using appropriate themes or indicators selected from literatures e.g., J. Pulhin et al. (2006), such as livestock status, crop production, people affected by the impact, deaths, malnutrition cases, food and seed shortage, income shortage, production costs or ecosystem damage.

## Vulnerability

Vulnerability in the case of climate change is a socially and spatially changeable incident which may vary over the path of time. It is conceptualized in many different ways in climate change literature and is determined by a wide range of factors (IUCN, 2008). Many scholars and researchers in recent climate change literature suggest separating vulnerability into social and biophysical vulnerability (Cutter, 1996, Brooks, 2003).

This integrated approach is also adopted in the IPCC (2007 b) which defines vulnerability as the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate Change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity. Brooks (2003) define social vulnerability as independent to any external hazard and therefore not a function and frequency of the given type of hazard but are those incorporated to human system i.e. poverty and inequality, marginalization, literacy, food entitlement and health.

Biophysical vulnerability is interpreted as the amount of damage experienced by a system caused by the impacts of a specific type of hazard and is therefore, in contrast to social vulnerability, a function of the frequency and severity of given types of hazards (Brooks, 2003). The factors which are believed to determine biophysical vulnerability are exposure to extreme events, Availability of natural resources, location of residence, housing quality, land use and land cover change (IUCN, 2008). Vulnerability of peoples to global environmental change is mainly determined by the low degree of social and biophysical factors.

## **Vulnerability Assessment**

An impact study is most helpful when focusing on a single stressor, in this case climate change (Nkem et al. 2007). Thus, impact alone is subtle and may not be sufficient to show the consequences of climate impact on different members of the same or different community (McCarthy, 2001). Thus, to evaluate climate change impact in the context of multiple stressors that reduce adaptive capacity, many of which are not related to climate or climate change; Vulnerability assessment is most helpful (Desanker & Justice 2001). Vulnerability assessment also "helps to informs decision



**makers to facilitates decision-making process of specific stakeholders of a sector about their options for adapting to the effects of climate change within the scope of their resources " (Nkem et al . 2007).**

Vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes (IPCC, 2001). In other words, vulnerability is a `set of conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of a community to the impact of hazards, Vulnerability in this study is, thus, defined as the likelihood of households and communities in the Koshi basin, Saptari district, Nepal to suffer from climatic adverse impacts on their livelihood and their inability to respond to stresses resulting from the impacts. Different authors and researcher in the past has used different tools and indicator to assess the vulnerability of rural livelihood strategy in context of shocks and other stressors. Ellis (2000) used indicators such as asset (market, land holding, water availability, biological resources, social interconnectedness, labour or human capita, saving and credit availability) and asset access modification by social relations, institutions and organizations. Thornton et at., (2006) also used several natural capital, physical capital, human capital, financial capital and social capital to analyze vulnerability. As this study is exploratory, the selection of indicators is based on the analysis of responses from local society and previous vulnerabilities, how and why they are vulnerable.

#### **Climate Change Impact in general**

Both global and regional warming are complex phenomena that are, indeed, occurring, and have causes linked to human activity. Global warming has a surplus of predicted effects; however, under this heading of this document we will focus on how climate change has impacted on general. The IPCC predicts that climate change will have both positive and negative effects, but the adverse effects will predominate with greater rates of climate change (IPCC 2001). General trends include more hot days and heat waves, fewer cold days and cold waves, an increase in global precipitation, greater numbers of intense precipitation events, and the destruction of ecosystems, entire species, and biodiversity (IPCC 2001). Table I lists some of the other expected impacts on human and agricultural areas as a result of global climate change as projected by the IPCC.

Table 1. Examples of Climate Variability and Extreme Climate Events and Examples of Their Impact

Projected Changes during the 21st Century in Extreme Climate Phenomena and their Likelihood	Representative Examples of Projected Impacts (all high confidence of occurrence in some areas)
Higher maximum temperatures, more hot days and heat waves over nearly all land areas (very likely)	<ul style="list-style-type: none"> <li>• Increased incidence of death and serious illness in older age groups and urban poor.</li> <li>• Increased heat stress in livestock and wildlife.</li> <li>• Shift in tourist destinations.</li> <li>• Increased risk of damage to a number of crops.</li> <li>• Increased electric cooling demand and reduced energy supply reliability.</li> </ul>
Increased summer drying over most Mid latitude continental interiors and associated risk of drought (likely)	<ul style="list-style-type: none"> <li>• Decreased crop yields.</li> <li>• Increased damage to building foundations</li> <li>• Decreased water resource quantity</li> </ul>
Intensified droughts and floods associated with El Nino events in many different regions (likely)	Intensified droughts and floods associated with El Nino events in many different regions (likely)
Increased intensity of mid-latitude storms	<ul style="list-style-type: none"> <li>• Increased risks to human life and health.</li> <li>• Increased property and infrastructure losses.</li> <li>• Increased damage to coastal ecosystems.</li> </ul>

Source: Intergovernmental Panel on Climate Change,

Other than this more agricultural production is severely compromised due to loss of land, shorter growing seasons, and more confusion about what and when to plant (UNFCCC, 2007). This factor lead to the worsening of food insecurity and increase in the number of people at risk from hunger. Already compromised fish stocks depleted further by rising water temperatures leaving many people jobless and further leading to famine migration

in Africa (Oxfam international, 2009a)-These consequences are further deteriorated by factors like poverty, lack of knowledge, lack of access to resources, armed conflict as they have less adaptive capacity.

Moreover, there will be reductions of crop yields in some areas, although other areas may see increases in yields. Other than this extended drought in many part of the globe has destroyed massive forest due to land degradation and wildfires. (Oxfam international, 2009)

### **Climate Change in the Nepal's Context**

Nepal is a small landlocked country with the area of 147181 sq. kilometers between two giant neighbors China and India. The east-west length of the country is about 800 km, and the average north-south width is 140 km (CBS, 2001). Within this type of landscape Nepal has tropical forest in the south and great Himalayan range in the North.

Nepal with in breadth of less than 200 km is very rich in bio diversity in terms of bio climatic zones, ecosystems and species of plants and animals. Nepal is divided into three ecological zones as follows (WECS, 2002 as cited by Oxfam, 2009).

Table 2: Nepal's ecological zones, climate, precipitation, and temperature

<b>Ecological Zones</b>	<b>Climate</b>	<b>Mean Annual precipitation</b>	<b>Mean Annual Temperature</b>
Mountain	Arctic /Alpine	Snow/150-200 mm	< 3°C - 10°C
Hill	Cool/warm temperature	275 - 2300 mm	10°C - 20°C
Terai	Sub - tropical	1100 - 3000 mm	20°C - 25°C

Various factors like: rugged and fragile geophysical structure, very high relief, high angle of slopes, complex geology, variable climatic conditions, active tectonic processes,

1 It is marshy ground or meadow. It is the flat area lying to the south of the Churia range and extending to the Indian boarder. Geology and soil composition consists of recent alluvial plain, boulders, gravel sands, clay and fine loamy deep soils.

unplanned settlement, dense and increasing population, poor economic condition and low literacy rate have made Nepal vulnerable to natural and climatic hazards (Chettri, 1998)

Nepal is one of the sufferers of climate change as many other developing countries despite the fact that it has very low contribution in the Green House Gas (GHG) emissions. The climate change situation of the Himalayan nation is as bleak as many other developing country around the globe. High altitude and latitude regions are likely to experience a higher rate of temperature rise compared to other regions (Beniston et al. 1997, IPCC 2001), Himalayan countries like Nepal being no exception. From 1977 - 1994 mean annual maximum temperature in Nepal is increased by  $0.06^{\circ}\text{C}$  (UNEP 2002, EBI et al. 2007). Shrestha et al. (1999) in a study based on an analysis of temperature trends from 49 stations for the period 1977 to 1994 indicate a consistent and continuous warming in the period at an annual rate of  $0.06^{\circ}\text{C}/\text{year}$ . Similarly, a study conducted by Practical action (2009), looking at data from 45 weather stations for the period 1996-2005, indicate a consistent and continuous warming in maximum temperatures at an annual rate of  $0.04^{\circ}\text{C}/\text{year}$ .

Precipitation in the country is also being unpredictable with more droughts and short period of erratic rainfall with flash flood and riverine flood. The temperatures in the Himalayas, however, are increasing at a faster rate, which is resulting serious impacts on the glacial lakes-the sources of water for Nepal. Because Nepal has a complex, mountainous landscape, floods and landslides have also become more frequent and severe. Due to the rise in climate snow and glaciers lakes are under tremendous threat of outbursting and creating GLOF.

Draft NAPA (2010) enlighten on precipitation projections with no change in western and up to 5-10% increase in eastern Nepal for winter. During the summer months precipitations are projected to increase for the whole country in the range of 15 to 20%. A regional circulation model study projects both rise and decline in the mean annual precipitation with no clear trends as Nepal lacks more weather stations. In terms of spatial distribution, this study projects an increase in monsoon rainfall in eastern and central Nepal as compared to western Nepal.

Further, the projections indicate an increase in monsoon and post-monsoon rainfall as well as an increase in the intensity of rainfall, and a decrease in winter precipitation. IPCC (2007) projects that there will be a general increase in the intensity of heavy rainfall events in the future and an overall decrease by up to 15 days in the annual number of

rainy days over a large part of South Asia. According to draft NAPA, (2010) Nepal is ranked 6<sup>th</sup> among the 200 countries who will suffer most from the climate change impacts.

A UNEP/ICIMOD study in 2001 has identified 3,252 glaciers and 2,323 glacial lakes in Nepal. Among them, 20 lakes are in risk of bursting in five to ten years time with catastrophic results unless urgent actions are taken. Richardson and Reynolds, (2000) reveal five lakes bursted between 1977 and 1998 washing away agricultural crops, livestock valuable property 100 of kilometers downstream. Moreover there are still at least 20 glaciers lakes in Nepal likely to outburst in next 5- 10 years (UNEP 2002) which make country more prone to hazards and also making people vulnerable toward climatic hazards.

### **Climate Change and its impact in Nepal**

Climate is changing all around the globe and a Himalayan nation is not an exception. Although Nepal's total greenhouse gas emission share is negligible compared to global community, Nepal has already encountered some of the negative impacts of climate change. Studies made by Department of Hydrology and Meteorology show that average temperature in Nepal is increasing approximately 0.06 degrees Celsius per year. The temperature in the Himalayas, however, is increasing at a faster rate, which is **resulting** serious impacts on the glacial lakes-the sources of water for Nepal. Many glaciers are retreating at a faster rate and rapidly melting glaciers means more seasonal variation in river flow resulting more floods and droughts in the country.

The history on the study of climate change Nepal is very short. Less availability of hydrological and meteorological data on the local level is challenge to understand the dynamics of climate change and its impact in Nepal. Though there are few studies in the local level but district level study on climate change is still not in pace.

Regmi and Adhikari (2007) found that the impact of global warming is already being felt by the most vulnerable-the world's poorest people and countries and its impact is severe on Nepal because of the geographical and climatic conditions, high dependence on natural resources and lack of resources to cope with the changing climate. With Nepal's diverse topography and eco system impact of the climate change in the country will be magnified (Oxfam international, 2009).

With the increased intensity of erratic rainfall events hazards like flood and landslide will trigger more than 1300 people mostly poor were killed by floods and landslides between 2000 and 2005(CBS 2006). Change in precipitation will have unconstructive impact on rain fed agricultural system which will cause more problem of food security in the country leaving poor vulnerable. With warmer winters mostly in the higher altitudes less precipitation will fall as snow which will accelerate the glacier retreat reducing soil moisture and accelerating erosion (Oxfam international, 2009). Irrigation is the major input for the better agriculture production. It is estimated that about 80% of all water in Nepal is used for irrigation. But the changes in temperature and precipitation will alter the hydrological cycle hampering the irrigation reducing the crop yield. Ninety one percent of total power production in the country depends on hydropower (Thapa, 2009) which will be affected due to the sudden changes in the runoff and also due to the sediments carried by the floods which will be accelerated by the change in precipitation and erratic rainfall. During the dry winter season the economic impact of 16 hours of load shedding is being felt which will increase in the days to come if the situation prevails.

Regmi & Adhikari, 2007 reveals- climate change is resulting in the low production from the fields, and farmer are more prone to food security and animal husbandry also has a negative effect due to poor availability of the fodder. Climate change is expected to have more negative consequences on human health. Increased risk of vector borne diseases like malaria, kalazar (Visceral leishmaniasis), Japanese encephalitis and dengue (in the terai districts) as well as water borne disease like typhoid, cholera, diarrhea are on the increasing trends from last decades killing many people in the hills and mountain (ibid) which has been attributed in part to water shortages due to winter drought and delayed onset of summer monsoon. (Nagarik dainik, 23rd June, 2009 as cited by Oxfam international, 2009).

Moreover, irregularity in the water supply due to dry winter will impact on water and sanitation leading to different water borne diseases leading to increase in malnutrition due to unhealthy practices.

## 2.2 Livelihood: **The area to be affected by Climate Change**

Livelihood comprises the capabilities, assets and activities required for the means of living (Twigg, 2007). A livelihood comprises people their means of living including food and income.

Livelihood assets:

(I) Natural Capital: The natural resource stock from which resource flows useful for livelihood are derived (e.g. land, water, wildlife, biodiversity, environmental resources).

(II) Social Capital: The social resources (network, membership of group, relationship of trust access to wider institution of society) upon which people draw in pursuit of livelihood.

(III) Human Capital: The skills, knowledge ability to labour and good health important to the ability to pursue different livelihood strategies.

(IV) Physical Capital: The basic infrastructure (transport, shelter, water, energy and communications) and the production equipment and means which enable people to pursue their livelihoods.

(V) Financial Capital: The financial **resources which are available to people** (whether **savings, supplies** of credit **or regular remittances or pensions** ) **and which provide them** with different options of livelihood.

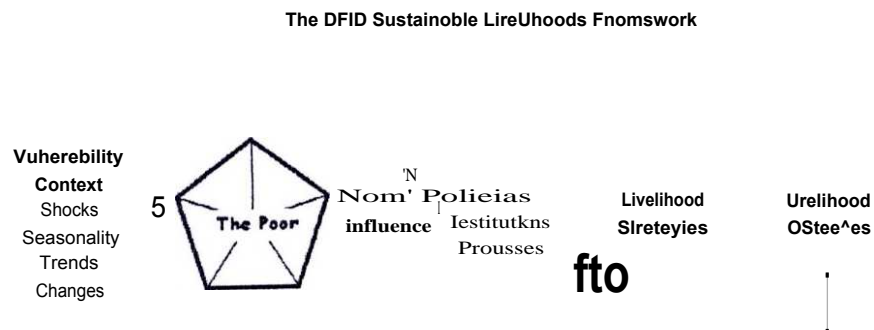


Fig. I Sustainable Livelihood framework

Source: DFIDs Sustainable livelihoods framework, adopted from [www.ceciasia.org/utthan/sla.htm](http://www.ceciasia.org/utthan/sla.htm)

The main components in the sustainable framework are vulnerability context, livelihood assets, institution & processes, livelihood strategies and livelihood outcomes.

### **2.3 Impacts of Climate change in Livelihood Framework**

People centered approach is considered in livelihood framework. And for people's livelihood different assets are required. Climate change increases jeopardy in the livelihoods of the people. Vulnerability is the degree to which a system (household or community) is susceptible to, and unable to cope with adverse effect of climate hazards (IPCC, 2001). Climate change increases the depth of vulnerability. The transformation in external environment changes the natural, social, economic, health condition which makes people/community unable to cope with the events. To change the level of vulnerability is the most challenging job. Influencing policies, institutions and process will help in reducing the vulnerability of the people regarding the climate change.

Though people have poor knowledge on the technical matters of climate change but there are several evidences which demonstrate that they have perceived, felt and experienced about its effects more on their livelihood. Therefore, because of climate change and the rising temperatures, Nepal could face drier phases during dry seasons with wetter monsoon (as much as three times the current level of rainfall) with chances of flooding and landslides during rainy seasons with subsequent impacts on agriculture and livelihoods (Alam & Regmi, 2005). There are many evidences that show that how climate change is affecting peoples' lives and livelihood. The rain pattern over the years is a live experience. People have been facing longer and frequent droughts, erratic rainfall, storms, thunderstorm and hailstone (Action Aid Nepal (AAN), 2007). As a result, crop failures are common; the cases of landslide, flooding/inundation, river side erosion are other phenomenon and further these are in increasing order.

The spread of new water and vector borne diseases are other impacts of climate change. The most vulnerable ecological and socio-economic systems are those with the greatest sensitivity to climate change and the least ability to adapt. (Cruz et al. 2007) describes the evidence of prominent increases in the intensity and frequency of many extreme weather events such as heat waves, tropical cyclones, prolonged dry spells, intense rainfall, tornadoes, snow avalanches, thunderstorms, and severe dust storms in the region. The impacts of such extreme events range from hunger and susceptibility to disease, to loss of income and livelihoods, affecting human survival and well-being.



Gautam et al, (2007) reveal that due to changing patterns of rain, people are continuously suffering water-induced disasters. More cases of landslides, soil erosion are recorded in the hilly region whereas the Terai is affected by the flooding, inundation, river side cutting/erosion, sedimentations, etc. These events have resulted crisis for livelihoods of smallholder farmers as the flood impact more on the live and livelihood of rural poor.

Adger et al, (2003) explains that the communities are faced with many risks from climate change. The risks are apparent in agriculture, fisheries and many other components that constitute the livelihood of rural populations in developing countries. As mentioned by Senbeta (2009) in his study in Ethiopia disclose the fact that drought and delay in the onset of rain led to poor grass regeneration/forage deficit, water shertage and heat stress on livestock, and consequently increased the mortality of the livestock, vulnerability to diseases and physical deterioration due to long distance travel for water and pastures .

Climate change has increased different types of diseases which have affected human health. Predicted adverse health risks will affect the poor in particular throughout the developing world. These risks are in particular those associated with water-borne (such as dysentery or cholera) vector-borne (such as malaria) diseases as well as heat stress, cold waves, morbidity and mortality (IUCN 2003). These health impacts pose a double jeopardy for poor people's livelihoods: the contribution of key productive members of the household is lost and the cost of health care is expensive and time consuming. Such risks will be widespread, but the death of medical care systems in many more remote, poorer areas of Africa and Asia in particular mean that the poor in these areas are the most vulnerable to these risks.

With the current scenario of climate change of the world most of the livelihood assets are under threat bringing misery to the people's life all over the globe. Due to the increasing frequency of natural disaster resulting from climate change, livelihoods are under threat and also people are being poorer as result they are suffering and triggering migration and also increasing workloads on women (Thapa, 2009). Not only the natural capital but physical capital is under threat of getting destroyed by the climate change bringing more difficulties in the lives of people hampering the market linkages and also will slow down the economic growth of the country.

#### 2.4 Government **Plans and policies regarding climate change**

Chaudhary and Aryal (2009) reveals strong need of government, civil societies, involvement of NGO's for the high quality of outcome in the field of climate change and environment management. Various proven studies including Regmi and Adhikari (2007) suggest that Nepal has started some initiative for environmental protection and management. Debates on the issues of climate change have even been started since 1990 (ibid). But now with the preparation of NAPA document it's considered as the priority work for the Nepal government. The following sections highlighted some of the initiatives that Nepal has taken for environmental and climate change sectors.

**The Eighth Plan ((1992-1997):-** Energy sector was highly prioritized in the eight five year national development plan. The other appreciable and noticeable achievement during the plan was the formulation of Enactment of Environment Protection Act (1996) and promulgation of Environment and Protection Regulations (1997).

**The Ninth-Plan (1997-2002):-** Guided by the philosophy: development for the people, with the people and by the people ninth five year plan was launched. The main objective of the plan is to reduce poverty through prioritizing sectors like agriculture, industrialization, tourism development and environment management.

**The Tenth-Plan (2002-2007):** The main objective of the Tenth Plan is to alleviate poverty by mobilizing optimum means and resources with the participation of government, local agencies, non-governmental sectors, private sector and civil society to extend economic opportunities. It planned to enlarge employment opportunities and widen the access to means and economic achievements for women, Dalits, peoples of remote areas and poor and backward groups through programmes like empowerment, human development, security and targeted projects thereby improving the status of overall economic, human and social indicator. The plan acknowledged the importance of weather for economic performance but was almost silence in climate risks issues.

**Medium Term Expenditure Framework (MTEF):-** Shardul et al, (2003) finds that vector-borne disease control and emergency preparedness and disaster management, mitigation of floods and erosion in cultivated areas, and water harvesting to provide year-round water supply for irrigation was discussed in MTEF. In addition to these, MTEF paid some attention on climate-related risks. But the framework is almost silent about relation of hydropower plants due to the variability in runoff, floods (including GLOFS), and sedimentation. The same situation was also observed in road sector. It did not discuss

flood and landslide risks, water supply and sanitation, irrigation sectors due to climate risks.

**Convention on Biological Diversity (CBI):** Nepal signed the CBD in 1992, and ratified it in 1993. The Country's Biodiversity Strategy (2002) was prepared under the UNDP/GEF Biodiversity Conservation Project. It listed several climate-related risks, such as flooding and sedimentation, as threats to biodiversity.

**Sustainable Development Agenda for Nepal (SDAN):**- The SDAN listed Nepal's vulnerability to climate change, natural disasters and environmental degradation among the constraints facing Nepal's sustainable development. Though it did not mention climate change explicitly, there was a specific section on protection of the atmosphere.

**World Summit on Sustainable Development (WSSD):**- Nepal's National Assessment Report for the WSSD (2002) recognizes the links between climatic circumstances and land degradation, erosion and landslides. It also recognizes the increase in landslide risks due to the effects of paddy cultivation and livestock grazing in the hills and mountains. However, adaptation to climate change was not specifically addressed, though the indigenous systems of living in and adapting to challenging circumstances in mountainous areas are recognized.

## 2.5 NAPA and its sectoral impact

**National Adaptation Plans of Action (NAPA) is the document which is being prepared for least developed countries like Nepal to communicate priority actions addressing countries urgent needs and concerns relating to adaptation to the adverse effect of climate change .**

Napa has been prepared through consultative and inclusiveness with the help of government and many other concerned stakeholders. Nepal's NAPA is set within the country's development objectives. These objectives have been clear in the national planning strategies and are aimed at addressing the specific economic and socio-political conditions prevailing in the country. Nepal's development goals, and therefore the NAPA Framework, are set under the overriding aim to reduce poverty in the country through adaptation in climate change addressing immediate needs and issues.

Nepal's low level of development and complex topography leaves it quite vulnerable to climate change. The ongoing climatic changes and changes projected to occur are likely to have impacts on different sectors of Nepal. Impacts on some sectors are likely to be

more severe. The sensitive sectors identified by NAPA are agriculture, forestry, water and energy, health, urban and infrastructure, tourism, industry and overall livelihoods and economy (NAPA document, 2010). NAPA explains the real picture of climate change scenario in Nepal regarding the rise in temperature and change in the pattern of rainfall in the different places of the country. Further, (NAPA, 2010) has identified Saptari district as one of the highly vulnerable district to the climate change which make the basis for the study of the area and Mushar community being socially excluded and marginalized make strong base for the study to know about the climate change impact on the poor population.

The analysis shows that the Nepal is highly vulnerable to climate change. It suggest that more than 1.9 million are highly climate vulnerable and 10 million are increastingly at risk, with climate change likely to increase this number significantly in future ( NAPA, 2010). Moreover it explains - climate change vulnerability is spread across Nepal. However, most of the people living in the Mid and Far western region are amongst the most vulnerable, a situation closely coorelated with the poverty rates in thos areas, the heavy reliance small scale agriculture which is increasingly at risk from more erratic rain fall patterns and the lack of basic servcies and alternative livelihood options in these areas. This implies that there is a need to carry out vulnerability assessment in all the VDCs and community of Nepal and identify vulnerable areas accordingly.

There are numerous vulnerabitlity contexts and it may vary from place to place. Poor people are vulnerable to loss of physical capital (damage to shelter and infrastructure), human capital (malnutrition and diseases), social capital (displacement of communities), natural capital (loss of productivity in agriculture and fisheries) and financial capital (more disasters and lower income). Degradation of livelihoods by climate change will thus leave poor people with less of the assets they need to withstand shocks and stresses. Study carried out by Regmi et al (2009) show that the households with low income, less landholding size and lack of access to information and basic services are more vulnerable than with households with relative rich asset base.

As mentioned above NAPA has identified six thematic areas for the adaptation and urgent research needs have suggested for the vulnerabilitiy assessment. Further it suggests that poor are vulnerable to climate change. Adaptaion strategies for the poor also needs to be sugested to make them able to withstand shocks and stresses.

## **2.6 Research questions**

- Is climate really changing for the Mushar community? How do they perceive this?
- What is the idea of the key district players (DADO, DFO, DSCO, DWSSO, etc) regarding what Mushar communities say?
- Why are Mushar vulnerable? Who are most vulnerable?
- Which are the key climatic hazards?
- What are specific impacts observed by Mushar? Which livelihood **assets are at risk?**

## **Chapter III**

### **Justification of the study**

Many experts in this field have, different views regarding the climate change as some say, it's a natural phenomenon and some argue it as a consequence of excessive emission of Green House Gases. Whatever is the argument the climate is changing and poor community around the globe are suffering.

Mushar Community is a tribal community in the eastern and central part of Nepal who reside in the river basin areas of Narayani, Koshi and other rivers. Mushar communities are poor who have very small land used for farming and they themselves stay in the river basin areas. Farming, daily laborers in the field and fishing are the main source of livelihood for this community. This community is also famous for their mouse hunting in the paddy field which they use as their meal (Ghimire 2007). This community being minority in the country is most neglected in the development discourse.

**Various studies in the past mentioned that poor are more susceptible to climate change and Musahar are very vulnerable to climate change . And recent flooding in 2008 in Saptari and Sunsari district had many of the Mushar community displaced. Climate change is a global consensus and Nepal is no exception . With the melting of glaciers in the Himalayas , the frequency of flood hazard has increased in the country compared to the past (Oxfam , 2009a). And for the community like Mushar who are living in the river basins are the hardest hit by the floods in the recent years. In Nepal there are very few researches that have been done to address the climate change impact on Mushar community, especially on the livelihood and what concerned stakeholders are doing to address this issue.**

Owing the above mentioned facts, it is, thus, crucial to understand the actual dynamics of climate change impact and vulnerability at the lowest levels of the society, such as households, communities and districts, (Deressa et al. 2008). This will help to make the top down approach of government effective and relevant move (Ford & Smith 2004). The material of this study will be based on current climate impact data, participatory assessment tools and techniques with local stakeholders from the Mushar community and interview with government officials from district, Saptari. Few Researches related to climate change have been done in Nepal to address the issues related to livelihood,

vulnerability and poverty but those researches fails to address the problem of Mushar community at micro level.

More over recent documents on NAPA and various studies related to climate change also suggest that more specific and local vulnerability assessment is required to help poor to cope with the impacts of climate change. Thus, the ambition of the study is to; assess vulnerability and impacts of climate change on livelihood of Mushar communities in Saptari district predicting adaptive capacity and constraints of the communities which is exacerbating the vulnerabilities.

**This research will help as a strong foundation for the agencies intending to work with Mushar community or other dalits communities in the country as research will be identifying the key areas of impact on the livelihood resources , livelihood assets at risk and vulnerability of the community to climate change in particular.**

## Chapter IV

### Objectives, Scope and Limitations

#### 4.1 Overall objective

To assess, vulnerability and impacts of climate change among Mushar communities in Saptari district of Nepal at Koshi basin.

#### 4.2 Specific objectives

- Identify how Mushar community perceive climate is changing and verify this through meteorological data and expert opinions
- Explore climate change vulnerability and impacts of climate change of the Mushar community in Saptari district in their livelihood

#### 4.3 Study Area

The study area will be in the eastern part of Nepal in a district named Saptari which is in the terai region of Nepal. Most of the people of the Mushar community live nearby the river bank of Koshi. And this community was one of the worst affected by the flood in 2008. The study area is the Joginiya VDC -1 of Saptari district ward 3 and 4, where approximately 80 household of Mushar community resides. This community was displaced from the nearing VDC named Gobargadha in the flood of 1992, and during the flood they lost their agricultural land, house and many livestock.

Mushar population is found in inner terai, terai region of Nepal and in the Bihar state of India. Around 700 years ago mushers in Nepal migrated from neighboring country like India (Karki, 2009). Mushar of Nepal lives in the river bank in the mud walled houses and fishing, mouse hunting is their main occupation and main food for their living. Now a days with the increase in population these population are also working as daily labourers in the agricultural land and have pig farming, wine production, collection of firewood as their alternative livelihood (Ghimire, 2007).

Mushar communities are found in the 64 district of Nepal having total population of 1,72,434 which is 0.76 percentages of total population of the country (CBS 2001). This community is really backward in social and economic ways. Dalits in Nepal are more marginalized in social, economic, and also in education sector. But within the dalits Mushar community are more socially and economically excluded. Being poor and



knowledge and they live in vulnerable places (i.e. River bank) (Ghimire 2007 as cited by Karki 2009). Also as mentioned by (Thapa, 2009) poor are hardest hit by the climate change and Mushar community are the poorest of the poor living life in misery and suffering.

Other than this, climate change and global warming, is melting the glaciers increasing the frequency of flood so these community would be ideal for the study.

..N.: i



Figure 2 - Joginiya VDC at Saptari District on the basin of Koshi river(Residing area of the Community)

Source: [www.wikimedia.org/wikipedia/commons/e/e9/NepaiSaptariDistrictmap.png](http://www.wikimedia.org/wikipedia/commons/e/e9/NepaiSaptariDistrictmap.png)

#### 4.4 Limitations of the Study

This study is for the fulfillment of the requirement of the Master in Disaster Management. It is exploratory in nature and is study of only one community i.e. Mushar, from Koshi river basin in Saptari district due to limited resources, time and financial constraints.

This is a case study on the Mushar community residing on the bank of Koshi River in Saptari district, in Nepal. Thus, the finding will show climate change impact on livelihood and vulnerability focusing on the Mushar community. It is held that the result generated from this study is relevant to many areas of the county as well as other countries which have similar climate and livelihood pattern.

## Chapter V

### Materials and Methods

#### 5.1 Conceptualization and Research Question Identification

Climate change has been a vexing issues and challenge for development all around the globe. Climate change has its impact on the livelihood of the poor in rural areas. Recognizing this fact the topic was chosen to explain one of the major Climate Change problems. Impact on livelihood and the factor exacerbating vulnerability, for the poor and marginalized was what give rationale for undertaking this research. The concept on the research topic was therefore visualized and as the problem was severe, Saptari district, Koshi basin was taken and Mushar community was taken as unit of study. Based on some of the literatures as well as the site visits, research questions were developed. These research questions are dealt in chapter 11.

#### 5.2 Proposal Preparation , Presentation and Integration of the Comments

Based on the literature review, together with the gaps identified in case of Nepal, the proposal was prepared and presented. Dissertation seminars during the third semester were helpful for the preparation of proposal. Many comments and suggestions were obtained and they were integrated for undertaking the research activity.

#### 5.3 Methods

The study of the impact of climate change on the livelihoods of local populations is increasingly forwarded as an urgent research needs (Thapa 2009, Shrestha 2007 et al). To conduct any study proper research methodologies are needed. So as the topic of the study tell about the impact of livelihood and factors exacerbating their vulnerability on Mushar community. With the different parts of literature, impact and vulnerability has come along repeatedly, so we need to be clear about them to understand the climate change dynamics to the community.

For this study broad framework of analysis will be use to assess the status and situation on each of the key areas of livelihood (natural, human, physical, social & financial capital) a view on each of the other livelihood assets in brief. The participatory tools and techniques for assessing climate change impacts and exploring options. This tool was developed to assess the situation of community and to know about their adaptation

options (LFP, 2010). This tool will be the main guiding tool to collect field level information.

#### 5.3.1 Review of Relevant **literature and Information**

This was one of the methodologies that were followed in order to develop a clear understanding of the concept of global warming and science of climate change. In order to broaden the ideas and concept about the study, relevant reports and documents was reviewed. In addition to these, study reports, reports of other organizations related to DRR, climate change, climate change adaptation, and existing policy and strategy related to DRR were also reviewed to understand the issues and concerns of risks and vulnerabilities on livelihood of the different communities in Nepal and in the context of other countries.

As part of the review of secondary information collection, climatic related data like temperatures and rainfall of the relevant stations within the basin was collected from Department of Hydrology and Meteorology (DoHM) of GoN. A very few **stations lie in** the basins was challenge for the collection of the data but study tries to relate with the other relevant study done in the area.

#### 5.3.2 Source of Data

The source of information for the study will be the primary data source and secondary data. In this study, the current impact, vulnerability will be assessed by collecting primary data from respondents (interviews and focus group discussion ) and secondary data (temperature and precipitation trend, government documents, meteorological data, and published and unpublished information). The data on climate change and impact on livelihood in the community will be collected from local people interview, government, officials, local experts and secondary data from government offices and other literatures.

#### 5.3.3 Data collection tools

Participatory tools and techniques for assessing climate change impact will be used (which is discussed below in brief) from the community as for collecting primary information or data. There will be interview with the government officials and other concerned stake holders on the basis of information required to verify the communities' perceptions through experts' opinion. Some stories will also be given in the report as to give the descriptive picture on the vulnerability of the community people regarding the climate change.

i. **Building Rapport with local level stakeholders**

Preliminary meetings will be organized with local level stakeholders to share the purpose of the study. It was useful to select the study community and clusters within the community.

ii. **Modality of the selection of community**

River basin concept will be while selecting the study community i.e. the Mushar community in the Basin of Koshi River in Saptari district would be the possible community. It will help to explore the perspectives and issues of Mushar community on climate change, its impacts in peoples' lives and livelihood, factors exacerbating their vulnerability and associated adaptation strategies as due to the frequency of disaster is increasing and the people living in the river regime are hampered the most and Mushar is one of them.

5.3.4 Participatory tools **and techniques for assessing climate change impact and exploring adaptation options** at Community Level

In order to examine and map out the climate change adaptation by poor, women, and excluded communities focusing impact on livelihood and factors that increases the vulnerability, various tools and techniques of participatory tools and techniques will be used. The researcher stayed 7 days in the community to collect primary information using participatory tools and techniques, which are discussed here under.

**Transects walks**

This walk was used as method to be familiar with the area and the people that were mostly affected from the flood, fire, droughts, epidemics etc. This exercise was also useful to assess the land use pattern of the study community /cluster.

**Climatic hazard mapping**

Climatic hazard mappings exercise are useful to know the context of people's vulnerabilities from climate change perspectives, occurrence of disastrous events. In the exercise, people were requested to show the social infrastructures along with major vulnerabilities to hazards, the most affected areas from climate change, etc by sketching the community map. The discussion will then focused on the impact of climate change on agriculture land, fisheries and other means of livelihood, in the map as the requirement of

the objectives. The symbol for the appraisal was made on the basis of agreed consensus of the people.

#### **Climatic hazard trend analysis**

The primary objective of this exercise is to gain insight into past climatic hazards and identify trends in their nature intensity and impacts. This exercise will help in understanding historical community reaction to and coping strategies for climatic hazards, investigate historical institutional support following hazard events. It is expected that local people will share the dates and the type of disasters that have occurred and the corresponding results/impacts. Elderly people in the community contributed the information from decades back.

#### **Climatic hazard ranking**

It is one of the important tools to compare and prioritize the most critical local climatic hazards. The objective of this tool is to climate change induced and other natural hazard and how communities perceive and evaluate local hazards. In this exercise participants named the climatic hazards to which their area is prone to and discussion clarifies the impacts made by these hazards in the past.

#### **Climatic hazard impact assessment**

The primary objective of this tool is to identify the most likely impact of local climatic hazards. And the secondary objective is to increase understanding of the uncertainty that is likely to increase with climate change and importance of assessing the risk of climatic hazards that are happening. This tool is simple and flexible and its helps to lead discussion on specific impacts.

#### **Livelihood resource assessment**

Other tool for the study is livelihood resource assessment which will help in identify and categorize local livelihood assets and resources. For this tool participant will call out different livelihood strategies within the community and they discuss the resources they use to secure their livelihoods.

### Livelihood **resource** vulnerability **assessment**

Livelihood is an integral part of people's life. But with the different climatic hazards people's livelihood is at risk so vulnerability assessment of livelihood resource is another tool for the study. The basic objective of this tool is to assess the intensity of impact of climatic hazards on livelihood resources. This assessment will help to characterize and compare how a range of livelihood assets are affected by climate induced hazards.

### **Key Informant Interview (KII)**

**In order to validate** the information from **the discussion** with community **KII was done** with the different **government line agencies** at the district also with the NGO's working in the community. Unstructured interview was done to verify **the answer**.

### **5.3.5 Data collection procedure**

First and foremost relevant literature and information about the place will be gathered. After that different reports and research done in the sector of climate change in the country will be analyzed after that consultation with local experts, government officials would be done To know about the place and to know the people of the area reconnaissance survey will be done. Participatory tools would be used to collect data with the community people, suggestion and necessary adjustment will be done accordingly. After that collection of data with people and local experts and people in the government office face to face unstructured interview will be done to avoid duplication and ensure more reliability and transparency on the data's and information.

### **5.3.6 Data analysis Procedures**

The first part will show the impact of climate change on the livelihood, and consequently on the community. It will include quantitative on the trends of gradual precipitation and temperature, and extreme weather changes. The second and third part presents the vulnerability of Mushar community and finally the factors exacerbating the vulnerability are presented based on the data gathered during the field study which will be more qualitative in nature. And qualitative data will be provided in a descriptive way under different headings as the findings and discussion of the findings is on the separate chapter. Finally study will try to give some recommendations for the future intervention in the particular community.

## Chapter VI

### Findings

#### 6.1 Saptari district profile and climate scenario

Saptari district is in the lowest altitude of Sagarmatha zone and lies in the southern part of the world highest peak in the Eastern development region of Nepal (DPHO, 2008). Saptakoshi the biggest river of Nepal and its system of seven channels that flows from Himalayas from Northeast border of district to the southern part of India. On the northern side Chure<sup>2</sup> range, Balan River on the west and south east is geographically separated by Saptakoshi River. Saptari district is 61 to 305 meter above the sea level and has the area of 1663 sq. km (DADO, 2009). This district consists highest number of Village development Committee VDC's in the country i.e. 114. Saptari district like the other district of terai has temperate climate and remain hot in the summer and cold in the winter. The maximum temperature of the district is 42°C and minimum temperature goes down to 7 °C. Rainy season in the district comes along with the wind from south west and starts from May till October. The average rainfall for the district is up to 2558.68 mm. Among that 81% of rain fall occurs within June to September (DADO, 2009).

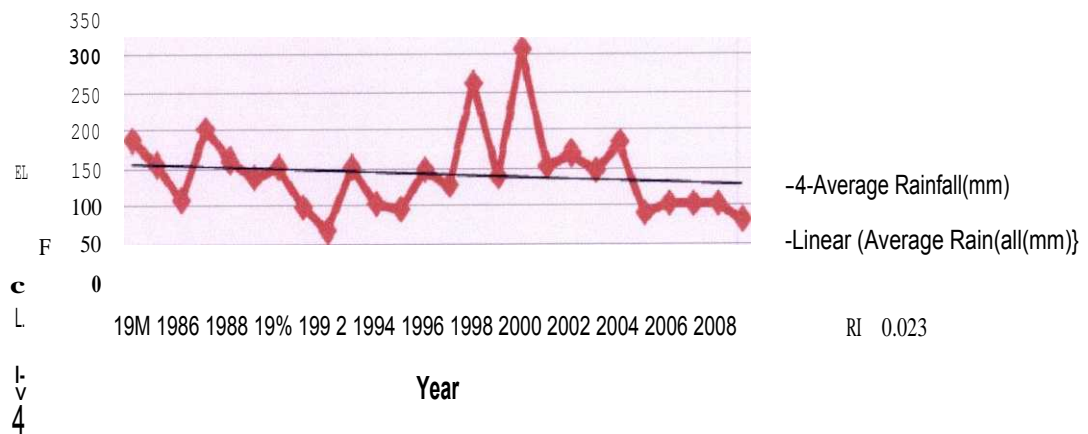
During the discussion with the community Mushar perceive that climate is changing. Old age people in the community use to distinctly separate the season. They used to know what would be the season in the month. Earlier they felt hot from month of April and sowing of the rice seed use to be completed within July. But now a day's these are not accordingly." *Last year due to insufficient rain we were unable to find work in the field monsoon started lately last year*" says 35 years old, Hari Sadha. Earlier, winter used to start from late September to mid of October but nowadays winter starts 15 days to 1 month alter the regular season.

<sup>2</sup> Locally, the word chure is used to describe a single hill crest, and Churia to describe a group or a range of hill crests.

## 6.2 Trend of Climate change in the District

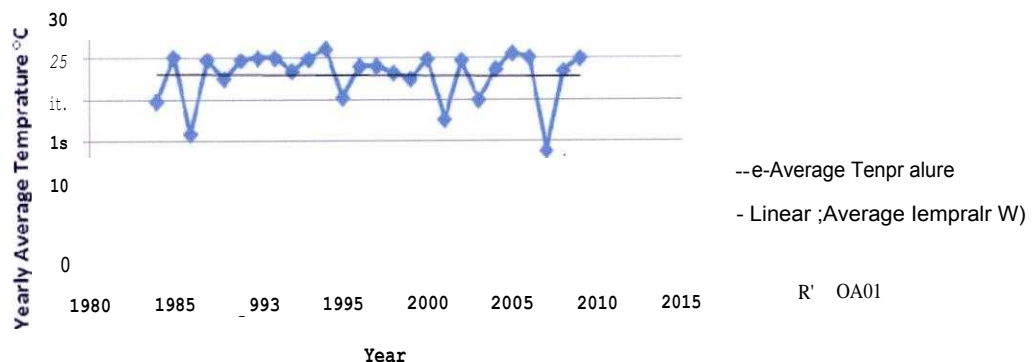
Analyzing annual average temperature for Saptari district climate is being hotter. Rainfall trend for longtime is difficult to analyze due to lack of data's for more than 50 years. According to the data available from 1984 - 2009 it shows increasing trend in the rainfall. Though the frequency and extent of feeling the impact are, the frequently experienced climatic shocks are prolonged drought and delay in the onset of rain, erratic and low precipitation, and heavy and unseasonal rainfall.

### Average Rainfall(mm) of Saptari district



*Fig 3: Trend A nalysis for Average rainfall of Saptari district*  
Source: (Department of Hydrology and Metereology, 2009)

### Yearly Average Temperature °C of Saptari district



*Fig 4: Trend analysis of yearly average temperature of Saptari district*  
Source: (Department of Hydrology and Metereology, 2009)



## Average yearly discharge (m<sup>3</sup>/s) of koshi at chatara station

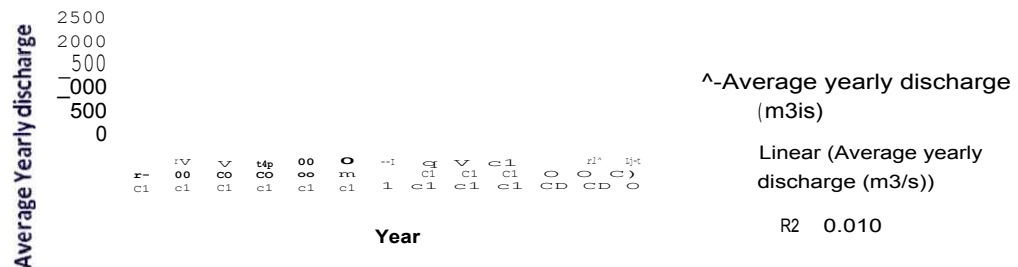


Fig S : Trend analysis of yearly average discharge of Koshi at Chatara station

## Maximum discharge of Koshi at chatara station

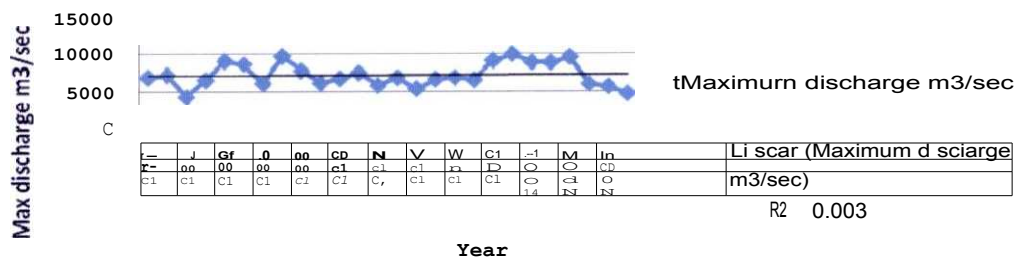


Fig 6: Trend analysis of maximum discharge of Koshi at Chatara station

Source: (Department of Hydrology and Meteorology, 2009)

The annual average meteorological and hydrological data's from Chatara station at Koshi basin and Rajbiraj shows slight increase in the annual discharge, rainfall and temperature. On contrary during the discussion with the community perceived decreasing trend in rainfall but whenever it rains it falls in erratic way.

### 6.3 Collection of primary data

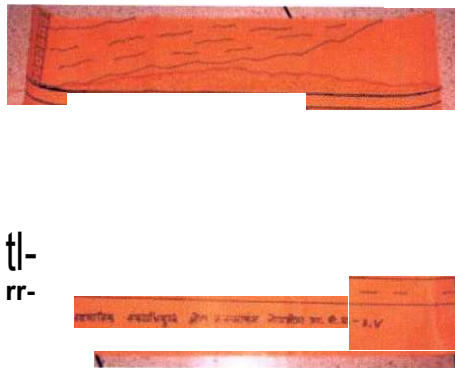
#### 6.3.1. Transect walk

Transect walk was helpful to know about the land use pattern of the people. It helped to know about the hazardous location in the area. It also helped to identify who were most affected by the local hazards. During the transect walk people were found to live in the other side of the road cum embankment i.e. a flood plain. People in the area were of mud

walled houses with no place for light to pass and living standard of the people and sanitation level were observed.

### 6.3.2 Climatic **hazard mapping**

With the help of climate hazard mapping vulnerable areas were identified in discussion with the community. During the discussion with the community areas to be affected by floods, river cutting were shown in the maps.



*Picture 2: Hazard mapping of Joginiya VDC ward 3 & 4*

Agricultural lands which are constantly under the threat by local hazard were also identified. People were requested to show the social infrastructures along with major vulnerabilities to disasters, the most affected areas from climate change, etc by sketching the village map in the ground. The discussion was then focused on the impact of climate change

### 6.3.3 Climatic **hazard trend** Analysis

With reference to past 50 years communities were asked about the major phenomenon including history of area in terms of the disasters occurrence, the experiences of the climate change, etc. Communities identified flood, cold wave, diarrhoea & illness, Animal **illness**, house fire and wind storm as major hazards locally by which they have been impacted a lot. Old age people contributed in the discussion. Local people shared the dates and the type of disasters that have occurred and the corresponding results/impacts.

### 6.3.4 Climate hazard ranking

With the previous exercise major hazards were taken in to account then hazard ranking was done to prioritize the hazard that has been impacting the life of the community most. During the exercise communities were comparing each of the hazards in the vertical column with the hazard in the horizontal column.

Hazard	Cold wave	Flood	Diarrhoea & illness	House fire	Windstorm	Drought
Drought						
Cold wave						
Flood						
Diarrhoea & illness						
House fire						
Windstorm						
Flood						

Picture 3: Prioritization of local *climatic* hazards

Huge discussion was seen among the participants in the field during this exercise as last year drought was major though it was not taken as the critical hazard by the community. And during the ranking flood, cold wave, diarrhoea & illness, house fire and windstorm were in the top five positions respectively.

### 6.3.5 Climatic **Hazard Impact Assessment**

The main motive of the exercise was to know the impact of the hazards on the people of the community.

Hazard	No. of people affected	Impact of hazard on community	No. of people affected by hazard
Drought	III		
Cold wave	III		
House fire	II		
Diarrhoea & illness	II		
House fire	I		
Windstorm	I		

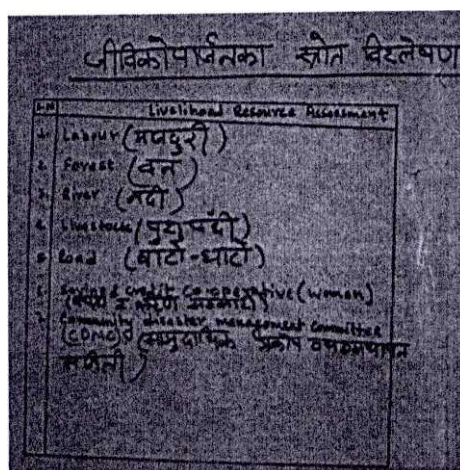
Picture 4: climatic hazard impact assessment

In this particular exercise people identified flood and cold wave has the highest risk of hazard happening with maximum votes as the Mushar community lives in the river bank and are more prone to floods and during winter more on the threat of cold wave due to poverty and low cost housing structure.

Further this exercise helped to found out the impact of hazard and also community idea on risk of hazard induced impact happening for the community on the basis of the discussion and their past experiences. Most of the impacts of the hazards locally were food insecurity, unemployment, death, loss of livestock, human illness, animal illness which later turns in the economic burden for the family.

#### 6.3.6 Livelihood Resource Assessment

As per the requirement of the research other tools used in the field was livelihood resource assessment to identify the major livelihood resource of the community. In the discussion and through mapping, and transect walk resource assessment of livelihood was done. Mushar community mostly depends on the labour, river, forest and livestock for their livelihood.



*Picture 6: Assessment of "livelihood in the community"*

Other than this resources of livelihood identified were roads, saving and credit co-operative, and community disaster preparedness and response committee. Other livelihoods were also identified but above mentioned livelihood were agreed on community consensus as they were mostly used by the community.

### **6.3.7 Livelihood Vulnerability Assessment**

Vulnerability **assessment** of livelihood was done to find out the vulnerability of different **hazards on** the livelihood resources. During the exercises people in the community were asked to rank the level of vulnerability of different hazards on the livelihood **resources**. Among the highest ranked flood and cold wave were found respectively to be hampering the livelihood assets of the community mostly. Other than this diarrhoea **and illness and** animal illness were the hazards which impact the livelihood of the Mushar mostly.

### **6.3.8 Key Informant Interview (KII)**

Key Informant Interview was taken with eight people. Key informant represents different line agencies at district i.e. District Public Health Office, District Agriculture Development Office, District Water Supply and Sanitation Office, District Livestock and Veterinarary Office. From the line agencies mentioned above statistics officer, Junior Technical Assistant, Chief Engineer, Livestock expert respectively. Other Than this local NGO's focal person and elites of the local area and expert from Department of Meteorology and Hydrology were taken the interview on the basis of information needed. Beyond helping as a good source of providing comprehensive information regarding the climate change issues in the district they were also helpful in clarification of gaps created during community exercise.

## **6.4 Impact of Climate Change in the different sectors of livelihood Of Mushar**

While the district specific exact value of damages caused on livelihood by past climate-related events is scarce due to the poor maintenance of data, the subjective evidences gathered during the interview with the experts in the district level and with the community suggests climatic change has been frequently imposing challenge on their livelihood and consequently affecting the societies livelihood resources. Study done for the Joginiya VDC ward 3&4 in Saptari district identifies different livelihood resources for the Mushar community. Brief discussion with the district level stake holder during the field visit is presented as a part of climate change impact on the livelihood of the Mushar community.

#### **6.4.1 Impact of climate change on agriculture**

Solar energy, air, precipitation are the important factors for the agriculture production. Change in the factors responsible for agriculture production may cause deficiency in the agriculture production. Climatic hazards like floods, drought, cold wave and new disease are the challenges for the agriculture sector.

During drought and delay in the onset of rain land becomes dry and lack of precipitation hinders seed cultivation and germination of cultivated seeds. Even weeks delay in the onset of rain was found to have significant difference on the harvest and has deprivation of households' livelihood. Most of the Mushar has low land holding and they work as a daily labourers in the field of elites. Due to less rain during the time of cultivation they have not much to do in the field which directly obstructs their income level. In the district experts opines agriculture sector is mostly affected by the rise of temperature in the summer and decrease of it during the winter especially due to cold waves. Mushar also reveals during the drought it hard for them to find forage for their livestock.

Other than this flood and river cutting in the area also cause deficits in the production. According to the community long term drought, high temperature, cold wave and erratic rainfall are the other causes of decrease in the agriculture output. This decrease in agriculture output has effect on issues like malnutrition, disease, and food security.

Live stock is one of the important livelihoods among the Mushar in Joginiya VDC. Pig rearing, goats, cow are among the livestock pattern they depend on. In the present scenario different illness among the livestock, drought and flood, shortage of forage and fodder and pasture land, lack of water are among the challenge for the livestock rearing. Different disease like uterus prolapsed; diarrhoea, vomiting, mastitis etc are seen in the cattle in the study area.

#### **6.4.2 Impact on water resources**

Change in precipitation and temperature has deep rooted relation with the water cycle. Due to increase in temperature after the rainfall water is absorbed by the top soil and there is increase in runoff

Mushar have fishing as one of the major livelihood. They catch fish in Koshi River and sell it in the local market to earn their living. Community reveals during the summer

season Koshi water is very cold and they have experienced many varieties of fish previously found in the river are not found which is supported by the agriculture expert in the district. The water induced disasters as a result of climate change have hampered the water eco-system in the river. Sedimentation and siltation in the river, many deep parts of the rivers in the basin have risen. Deep parts are believed to be the habitat of aquatic animals including fishes. The siltation also has hampered the natural food like fungi in the river. The shortage of food and reduction in water volume in the river in winter, has kept life of many aquatic animals at risks.

Further during the discussion Koshi river flow during the winter is decreasing and in the summer it is in increasing trend as mentioned by the community. Though there are irregularities in the rainfall in the basin due to regular flooding in the area ground water table get recharge so tube well can extract water from less than 30 ft in ward 3-4 of Joginiya VDC drinking water for the people in the ward is not a problem. But the scenario is different for the districts headquarter where the ground water table has gone more than 50 ft below the normal table.

#### **6.4.3 Impact on forest resources**

For photosynthesis carbon dioxide is absorbed by plant and helps in controlling the amount of green house gases in the atmosphere But this phenomenon is obstructed due to depletion in the forest resources and is coming out as a major challenge which is intensifying the amount of carbon dioxide and other green house gases in the atmosphere.

Vegetation patterns would be altered by changes in temperature and precipitation, which in turn would affect biodiversity in forests. Due to more temperature and droughts, the cases of more forest fire are recorded. Fires destroy the young plants and dried old trees. Mushar community collects firewood from the nearest forest of Koshi Tappu (island) national park. They sell it to the market and earned their living. But due to flooding most of the part in Koshi Tappu has been covered by sand and forest is losing all the important species of vegetation.

**Moreover the availability of forage for livestock, firewood is reducing and authorities in the national park reveals that authorities of the national park sets forest on fire to clean the fire which again strengthen the depletion of the forest resources medicinal herbs in the forest. Due to above mentioned fact Mushar community are forced to use cow dung for cooking their food which exaggerates the emission of GHG in the atmosphere.**

#### **6.4.4 Change in food Habit of Musahar**

Various studies show that Mushar had a typical food habit where they hunted rats for their food. Traditionally, rats are supposed to be a special meal for them. But, as reported by various ancestors of Mushar community, they no more follow the cultural and traditional practice of **haunting** rats. With the changing climate, the numbers of rats have also reduced and they no more have enough rats for hunting. The ancestor **assumes** this might have resulted due to changing weather conditions. Rise in temperature during summer and decreasing temperature during winter might have resulted in loss of favorable habitat for rats. Moreover, they are worried whether their children will get to see rats.

#### **6.4.5 Impact on infrastructure and settlements**

Every year due to flood, river cutting and other disastrous event has cost lots of lives and property in Nepal. Many of the villages gets inundates every year because of the flood due to erratic rainfall in the terai.

Mushar community presently residing on the Joginiya VDC ward- 3 & 4 are displaced from the neighboring VDC of Gobargadha twice. Most of the villages and community in the Koshi basin has disappeared due to flood in the river. Also infrastructures like road and bridges are damaged due to disaster in the area affecting the market linkage. Due to which community is unable to sell firewood's, labours in the field and can't fetch the items of daily necessities from the market from the nearest Indian borders. Increase in temperature is intensifying events like house fire in the community which is destroying their settlements and assets. Other than this wind storm are identified as climatic hazards in the area in the recent years due to the loss causes by them to the assets and infrastructures of the community.

#### **6.4.6 Impact on Public health**

Like in the other places of terai increase in temperature in summer and cold wave in winter has contributed an increase of different diseases like Malaria, diarrhoea, Kala-zaar, and Acute Respiratory Infection (ARI) and Pneumonia.

*Past year's mosquito were mostly seen after May but now days it has been felt from early March. Mosquito and sun fly has been a enemy for us. We don't have good housing condition. Most of the children and old age people from this community suffer from*



**vector borne disease-** Chair person of community disaster management committee (name, age) disclose. Further he says - *We don't have good clothes and warm blanket in the winter. Cold wave is killing the old people and animals every year and making children suffer from pneumonia and common cold making more economic burden for us.*

**But according to Public health office statistics officer-** *these problems prevails in the Mushar community due to their poverty and also their living conditions. Sun fly don't go in the area with sufficient light but to save themselves from the striking cold in the basin they have houses with no windows which creates perfect ground for sun fly in spreading kalazar and for malaria low consciousness of them regarding the issue on vector borne disease* Though public health and NGOS in the areas has been working in the areas to raise awareness to the people on health hazards.

#### 6.5 Who is Vulnerable to climate change impact and why?

Mushar families with no land holding and less household asset are vulnerable to climate change as suggested by the discussion. The Saptari district livestock official reveals large sized livestock tenders, children, women and landless are most vulnerable. NGO officials on the other hand suggested all daily labourers, particularly old, poor, children and women are vulnerable. Experts of Livestock reported the vulnerability is acute on landless and large sized family households<sup>3</sup>. The Mushar depends on daily labour and have low income and fewer reserves to absorb climatic shocks. During the discussion with the community most of them suggested women being more vulnerable while few men said that they were vulnerable to climate change impact.<sup>4</sup>

The men's vulnerability was explained from their prime responsibility of income generation. In cases of no agriculture work (labour) or animal death they are supposed search other off-farm and non-farm activities income sources, take credit and pay it off. Whereas, the vulnerability of women was explained from their lack of access to property, confinement at home caring for children and family members, worry about feeding the family, poor nutritional status and long distance travel to collect firewood and sell it in the markets. According to Junior Technical Assistant (JTA)

<sup>3</sup> Interview with Dr. Kashinath Yadav, Senior Veterinary Officer, Livestock Service Department, Saptari district

<sup>4</sup> Discussion with community

<sup>5</sup> Discussion with community

from Saptari district, *Women's closeness to family members and confinement at home makes them suffer the most, because men can take breath by being away from home as male in the Mushar community are doing by going to india... during the shortage of food women also go for an alternative means of making life.*

As it was possible to understand from the discussion the correlation between climatic impact and vulnerability of widows or divorced women, in particular, is much stronger. Traditionally, in the district at large, women are dependent on income generated by men. most of the male member in the community has gone to neighboring country, so in most of the cases women from the Mushar community, engage themselves on the labour activities like, petty trading or firewood (charcoal) sell, sowing and crops harvesting. Particularly, if women is single and she is landless and has no elders but more dependents, the situation becomes more difficult to manage the event, and thus she is obliged to face the socio-economic pains of the situations. In case she is old the challenge is more intense.

#### 6.6 Major Challenges Exacerbating Vulnerabilities

Vulnerability to the hazards of climate change for a particular community depends on technology, wealth, education, information, skills, infrastructure, and management capability, etc. The major challenges discovered in the community was the poverty prevailed among the Mushar community, inability to afford land on the higher lands, less access to land holdings. Low Income doesn't allow the members in the community to afford standard housing or housing far from river basin. The earning of the Mushar community is based on working as a daily labourer, fishing; collecting firewood's etc. which is only good for them to do hand to mouth.

Other than this extremes climate seen in 2007 - 2009 with drought, flood and cold wave has resulted in the failures of agriculture production. Flood with erratic rainfall has resulted in displacing them from their native place i.e. Gobargadha and are forced to live in the place called Joginiya. Field visit also has given me the witness of the huge area in the basin covered with sand where people are not able to do the regular farming where they used to farm previously. The rise in temperature in the summer is making male and female members of the community work for the livelihood a very tough jobs.

Three years ago there was a epidemics of Diarrhoea, kalazar, cholera in the area. Beside that different illness like diarrhoea, malaria, kala-azar, cholera in the summer season is in the increasing trend in the community due to rise in temperature, low sanitation level and

poor housing conditions. And in the winter season it is expected that pneumonia would be increasing to the children and old age people as winter is harsh near the river basin and no warm clothes is available with Mushar. 6

**Moreover due to different illness in the livestock the community is losing them in regular interval of time. Gandhi Devi Sadha , 42 reported- *that her 12 livestock died in the same year from different disease. She also said that livestock office is far from here and we need to make our livestock walk more than 2-3 hours to reach their so few of them died on the way due to stress and high temper(Iture.***

Mushar community being on the marginalized community in Nepal is vulnerable to climatic shocks and stresses. Poverty, illiteracy blended with climatic stresses **acts as a** major factor that exacerbates vulnerability.

#### 6.7 Adaption to Climate Change by **the Mushar Community**

Climate changing and Mushar community at Koshi basin in Joginiya VDC are impacted by the change has been clarified by the above findings at the field level and discussion with district level stake holders and experts. Though Mushar community is facing different climatic hazardous time and again they were found to have coping strategies from the climatic hazards which are:

##### **a) Saving and credit cooperative**

This saving and credit cooperative was initiated by the revolving fund of Oxfam GB to help community to respond to the climatic crisis. Dinbhadri saving and credit cooperative is also providing credits to help Mushar buy livestock, fishing accessories, rickshaws and agricultural tools. Member of the credit organize themselves and each and every one is responsible for the loans. The saving and credit is run by the women in the community and they feel empowered as they are handling the cash. Most of the women were found to take the loans for their husband.

##### **b) Community disaster preparedness plan and disaster management committee**

Oxfam GB with its partner and community has initiated plan to prepare for hazards and also prepared the response plan after the disaster. It constitutes of different group for the community i.e. early warning task force, first aid task force, search and rescue, recovery

6 Interview with Statistic officer Chedi Yadav, District Public Health Office.

and rehabilitation task force. These groups are provided with the training for effective preparedness and response before and after the disaster.

c) **Wood sell and other** activity

Wood sell from private plantation to illegal government forest was another coping strategy. The Koshi Tappu Wildlife Reserve is the government protected area where there different species of animals and vegetation. As confirmed from the study the dependence on the forest and river is definitely higher during climatic crisis as river carries woods and timber from the upstream which they dry and sell in the market. On the other hand, in spite of its limited opportunity of employment opportunity and its low income return, off-farm and non-farm activity also helps households to retain assets or to withstand climatic shocks. Poor and landless Mushar also make earning from daily labour on better-off farmers' land, construction activities, and pulling carts and on small scale businesses.

## Chapter VII

### Discussions

According to this study of the climate change impact on livelihood, vulnerability and coping mechanisms in Saptari district's Joginiya VDC, the frequency of climatic change is increasing, both in terms of extreme weather frequency and gradual changes, and consequently aggravating the impact to different aspect of livelihood like physical, social, natural, human etc . However, there are local coping mechanisms that are used to reduce the climate change impacts such as saving and credits, wood sell, community disaster preparedness and response plan etc.

The respondent perception, meteorological and hydrological data shows that the trend of climate is getting more difficult to distinguish and more erratic in terms of rain fall. However the yearly average temperature shows hotter climate with increase frequency of drought in the past years. The country level study done by NAPA (2010) and the study on the Banganga basin by Action aid (2007) also has found the increase in the temperature during summer and decrease in temperature during the winter with erratic rainfall. Due to lack of data's of long time and price to pay for the data's from DOHM were the major challenges faced for the analysis of meteorological and hydrological data.

Gradual change in the temperature has also shown the impact on the agriculture and livestock of the community. Different diseases in the paddy like neck blast, head blast were found in the area as reveal by the JTA at district agriculture development office. Further, (Bechyan yadav, 37) - *Disease like neck blast was commonly found in the hilly region where I used to work previously. It amazes inc to see this disease in the paddy field at Saptari. Other than this lack of irrigation facilities during the monsoon and drought are impeding the agricultural production in the district and hindering the work of Mushar community in the field during the pick agriculture season.*

Due to regular flooding in Koshi 5600 hectares of land is not used for wheat production and also due to soil moisture during the cold wave diseases like redness, Sindurey are seen mostly in the region. Various studies done in the terai belt of Nepal shows the similar results which indicate decrease in the agricultural production. Similarly, another study suggested that temperature rises beyond 2°C are, according to the IPCC, likely to result in reduced crop yields in most tropical, sub-tropical, and mid-latitude regions. Apart from these, with increasing temperature, more cases of flooding in low-lying areas

will be high, declines in food production, an increase in crop diseases (Regmi et al, 2007). Gautam et al (2007) finds the major impacts were: river cutting the agricultural land, forceful migration of settlements that reside along the riverbank, and sedimentation of cropland by boulders and sand.

Another study by Bhandari (2008) in two agro-ecological zones, i.e. hills and Terai, revealed that more households (40%) in the Terai than hills (11.6%) reported decrease in crop production from 5-25% due to abnormal rainfall which is consistent with the above findings. Live stock has been one of the prominent livelihood components for the Mushar community. However with the different climatic hazards their number are decreasing and de-motivating the community people to rear them. New disease like new castle disease, prolong of distress, hemorrhagic septicemia, black quarters, uterus prolapsed and liver fluke are seen in these area in the summer where as disease like abortion, nerves paralysis, milk fever disease, diarrhoea are creating impact on the cattle. These diseases are also increasing due to prevalence of intermediate host like snails in Saptari district. More over increasing trend of mortality among the livestock is seen in different region of Nepal. Decrease in grazing land, lack of feed availability, prevails and other demographic factors were causing the decline in livestock population was disclosed by the study (Care Nepal, 2009).

Similarly like agriculture other livelihood resources like forest, water and public health are plagued by climate change. Forest has been deteriorated in many parts of the country by unusual floods, invasion of unwanted vegetation (Chapagain et al. 2009). Moreover, increased in temperature has lead forest fire which is even deteriorated by prolonged drought.

Many of the study done in National level related to climate change reveals snow and glaciers that glaciers are melting in the Himalayas are intensifying and increasing in the runoff of the water. Snow and glaciers are one of the major sources of water for Koshi River. Nepal's major natural resources, biodiversity and water, are at the forefront of climate vulnerability (Raut, 2006). Due to changing patterns of rain, people are continuously suffering water-induced disasters. In the hills, more cases of landslides, soil erosion are recorded whereas the Terai area is affected by the flooding, inundation, river side cutting/erosion, sedimentations, etc.

Some of the top environmental challenges Nepal is going to face due to climate change are anticipated changes in hydrological cycle and the depletion of water resources. The

water related problems as such are likely to be more severe in Asian countries like Nepal where the monsoon, characterized by high precipitation variability, **is the dominating** climatic force (Sharma, 1993 as cited by AAN, 2007). Climate change impacts on water resources will affect country in numerous ways like disaster, irrigation facilities and drinking water problem. These changes, in turn, could place additional burdens not only the livelihoods of communities in highland regions but equally in the middle **mountain** and the Terai (AAN, 2007).

According to the study done by National Physical Lab on climate change impact on human health shows vector borne diseases like Malaria, Filaria, Kala-azar, Japanese encephalitis, and Dengue caused by bacteria, virus, and pathogens like mosquitoes and ticks will be increasing. Diarrhoea, Cholera and intoxication caused by biological and chemical contaminants in water are the diseases which will be increased by extreme weather events and it is consistent to the findings in the Mushar community.

The absence of employment opportunity and landlessness and is also one of the greatest challenges for the Mushar community, and is the indicator for the indiscriminate vulnerability for the community. In Nepal there is opportunity for multiple income sources but is very low in return. More importantly in Nepal more than 85% of people are engaged in agriculture related livelihood. Thus, the exposure of agriculture to climatic change impact is, particularly for the poor and the landless and livelihood, double exposure as they have few assets to absorb climatic shocks and as the employment opportunity further depreciates with the events. O'Brien et al., (2004) also found that landless Indian farmers are poor and have little security and *'in times of agricultural distress, landless labourers are the first to lose their inconc.'* Dalits and poor households from other groups have the lowest education (Sapkota et al. 2006). The study finds an increase in education rate in recent years, with almost all children going to school. However, Dalits children dropped early because of poor financial condition of their families and to meet such needs by working **as labour** which further exacerbates their vulnerability in the future.

Further, **there are also institutional coping strategies such as emergency aid after the crisis, awareness rising on different issues of public health livestock's, water and sanitation etc.** Though, **the coping mechanisms are not sufficient to address the challenges, and community is vulnerable to climatic shocks, and vulnerability is more acute on the poor, landless and unemployed, children, women, livestock tenders and large sized households.** Wedded with **landlessness and unemployment,**

illiteracy, water scarcity, and other stressors, climate change is more likely to continue to gamble and hamper the livelihood activities and exacerbate the communities' vulnerability.

The coping mechanism in the community are well been setup for the community to face the disaster and withstand with stress. But hazardous event related to public health issues, agriculture, alternative livelihood were not yet set for the community to reduce the vulnerability from multiple stressors of climate change. Further large sized livestock household vulnerability, livestock disease, high livestock mortality, public health cases, rising food price, food shortages , school dropouts, shown in this study also partly demonstrates the slow and the insufficiency of institutional intervention in early warning and identification of vulnerable groups at community level. Many of the NGO's working in the area is aware of the climate change issue but still fail to implement climate change programme for the communities.

**Currently government line agencies like Dill 10, DADO and DLS are engaged in various types of development activities like awareness programme, spraying DDT's, orientation on agriculture practices etc. However, there are complaints from government officials that show the existence of societal hindrances such as failure of adopting technology, lack of eagerness to participate in development programs , societies failure to make lesson from advices and previous impacts.**

From this study I strongly advocate to understand the actual dynamics of climate change at district level in relation to the vulnerable community and exploring the adaptation options also assessing vulnerability at the micro level. So communities can be prepared for the climatic shocks and stresses despite of their vulnerability and their livelihood resources can have less impact.



## Chapter VII

### Conclusion and Recommendations

This study shows the increasing trend of climate change and its impact on livelihood of in the district and is exacerbating the vulnerability to different socio-economic activities of the community. People in different parts of Nepal have observed changes in the diverse aspects of livelihood.

The community where study was conducted is already experiencing the unusual changes in weather pattern which were verified by different meteorological and hydrological data's from the stations at basin. Though there is gradual change in the temperature, rainfall and discharge of Koshi River they are continuously affecting different capital of livelihood like human, natural, physical and social. These stresses and shocks are aggravating the problems and vulnerability of communities.

The frequent rain delay, erratic precipitation, drought, and heavy rainfall and unseasonal rainfall, cold wave are also of great concern for the community. Agricultural production of wheat and paddy are in decreasing trend ceasing Mushar's opportunity to work in the field as a laborer crashing their income. Diseases in the crops are also creating inflation in the price further worsening. Livestock as the other main source of livelihood for Mushar has been of poorer quality due to disease. Less availability of fodder and forage are other factors hampering the population of livestock.

Death of livestock due to flood, drought and extremes temperature event has been a common phenomenon for the community making them poorer. The changing climatic events make the outburst of vector and water borne diseases. Lack of Income and availability of food are further aggravating the human health creating malnutrition, diarrhoea and other illness. Hence here is a need of both curative and preventive measures to reduce the effects of new diseases.

The water induced disasters like flood and drought as a result of climate change have hampered the eco-system in the river. Sedimentation and siltation in the river, many deep parts of the rivers in the basin have risen obstructing the habitat of aquatic animals including fishes. The shortage of food and reduction in water volume in the river in winter, has kept life of many aquatic animals at risks and dependency on the water resources is decreasing. Inundating settlement and causing loss of lives and property has

been a common and increased phenomenon due to climate change. Damages in infrastructure like roads bridges are creating difficulties in the market linkages to sell the livelihoods for Mushar's. In the recent years, forest resources have depleted from unidentified diseases and forest fires due to extreme temperature in the summer. Promotion of afforestation programme and buffer zone concept would be helpful in saving the forest and bio diversity within it.

The current local coping mechanisms from climatic events are saving and credit, wood sell, community network for disaster preparedness and response. The government organization (GO) and NGO's is also disseminating awareness, spraying medicines, awareness raising on saving and use of technology, and emergency aid. However, the current coping strategies are not sufficient. The institutional coping mechanisms are also predominantly top-down, and fail to bring the desired change due to various factors like illiteracy, perception of people, poverty etc. Though all are vulnerable to climate change in different ways vulnerability will be heightened on the Mushar as they are poor, landless, large family size, women headed household and predominantly people with large number livestock. As the climatic change continued to increase the degradation of natural resource base and is more likely to exacerbate the community vulnerability if suitable action is not taken from the relevant stakeholders.

### **Recommendations**

Based on the study and discussion made above the study recommendations to reduce the impact of climate change for Mushar community are listed below:

- Detail assessment of vulnerability towards climate change for the community in each of the livelihood sectors by GO's and NGO's.
- The vulnerability of Mushar is due to their dependence on the natural base livelihood alternative livelihood should be explored for the community.
- Promotion of development activities for addressing vulnerable community should be done from GO's and NGO's in short term and long term perspectives.
- Awareness promotion on the different cause and effect of climate should be initiated for the community.
- Hybrid livestock should be given to the community which can bear the extreme heat and needs less fodder and gives more milk.

- Knowledge documentation on the good and prevailing Adaptation options should be explored in the district done by other community and can be replicated for the Mushar's.
- Renewable sources of energy should be explored like solar energy and biogas with improved cooking stoves for the community to decrease the pressure on forest resources.
- Advocacy of climate change should be done in the international forums and climate change should be mainstreamed in each of the development activities of the country.

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