CHAPTER: ONE

INTRODUCTION

1.1 Context and Problem Statement

> Anthropology reminds us that our task is both epistemological and ontological in, how we grapple with understanding what people know about the world, how they move within it, how they relate to it, how they think and feel about it, and what they say about it.
>
> Mark Nuttal, 2009:293

Anthropological research focus has turned toward global social problems to make the world better. Climate change can be considered a serious global social problem as it is making vulnerable people more vulnerable. It implies change in the average condition of the weather at a particular place over a long period of time. In global context, climate change is one of the most complicated, multifaceted and serious threats which is linked to the pressing concerns of sustainable development of economy, poverty reduction and society (Ban, 2007). It is creating more severe and unpredictable events in the world. Rising sea level, coastal floods, flash floods, erratic rainfall, long drought have serious consequences for human beings as well as plants and animals (Pahl, 2001). Climate change has exacerbated the social, cultural, political, economic and environmental trend, problem, issue, tension and challenge (Crate and Nuttal, 2009).

Fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC) clearly indicates that anthropogenic activities have accelerated the process of global climate change. Increasing green house gas (GHG) emissions (particularly Carbon dioxide) have caused an increase in atmospheric temperature resulting location specific impacts. Changes in rainfall patterns and seasons due to climate change have been

witnessed. Climate change has both direct and indirect impacts on water resources, agriculture, forest, human health, biodiversity, infrastructure development, tourism and livelihoods. Visible evidences of climate change are increasing incidence of drought in some area, flooding in other, rising temperature and sea level, increased severe weather events such as tornadoes and hurricanes, melting of glacier and reduction of mountain snow cover, dying coral reefs and coastal erosion and the loss of costal ecosystem (Shirvastava, 2007).

According to United States, only four percent of the world's population is responsible for 22% of the green house gas emissions. Nepal has less than 0.04% of the world's population and it is responsible for about 0.25% of annual GHG emissions (Rai and Gurung, 2005). However it has been ranked 6^{th} as most risk country as high vulnerable to climate change. The average annual temperature in Nepal is increasing by 0.04^0c- o.06^0C with a higher rate in the mountain than in low land (Shrestha et. al. 1999, Rai and Gurung 2005, Practical Action, 2009).

Climate change is global problem and its impact on various sector are local than global. Climate change is not something that comes in isolation, it magnifies and exacerbates existing problem of rural poor people (Crate and Nuttal, 2009).The impacts of climate change are more pronounced in landlocked, mountainous and least developed country like Nepal. The country is predominantly a rural nation where slightly over 86 percent of the total population lives in the rural area. Rural households derive their income largely from agriculture and wage employment. This means that the most rural households are dependent on agriculture for their livelihood. Opportunities for non agricultural employment are limited in rural area and people are compelled to face problems of

poverty, hunger, malnutrition, poor sanitation and the like, it is correct to say that climate change has magnified such problems.

Impacts of climate change have been greater impacts on rural people's livelihood that is also an issue of cultural survival. Rural people of Nepal are heavily dependent on natural resources for their livelihoods and their main occupation is subsistence farming that is directly affected by climate change, so as the many rural marginalized people who cannot afford fossil fuel; nevertheless they are suffering climate change induced shocks.

It is clear that people who are directly dependent on natural resources are real founder and first encounters of adverse effects of climate change. But these people are rarely consulted in academic researches, policy making and public discussions on climate change. Current climate change researches in Nepal do not adequately address the climate change issue through rural people's eyes and less consider their initiatives and interventions in policy making process. This study has identified the climate change issue through rural people's eyes and has explored initiatives and their interventions to cope with climate change generated shocks.

In order to understand climatic challenge that faces rural people, it is necessary to look at climate change and its impacts through variety of lenses, such as physical, socio-cultural and economic. From anthropological perspective climate change is ultimately about culture (Crate and Nuttal, 2009). Using anthropological lens to study climate change in rural Nepal, this study has sought to answer following questions:

1 How rural people perceive climate change?

2 What are the impacts of climate change on water resources and agriculture in rural area?

3 What are the adaptation strategies of rural people to cope with climatic uncertainties?

4 What are the constraints in resilient path of rural people to climate change?

1.2 Objectives

The general objective of the study is to understand climate change through rural people's perceptions and experiences of changes about their local environmental features and specific objectives are:

1 To understand the rural people's perception on climate change.

2 To explore impacts of climate change on agriculture and water resources.

3 To study adaptive strategies of rural people in response to climate change.

1.3 Study - Rationale

Climate change is real and the risks it poses are real (Clinton 1998, quoted in Shrivastava, 2007). Climate change and its negative impacts on lives and livelihood of people is one of the highly discussed issue today. Poor and marginalized rural people, who are heavily dependent on natural resources for their livelihoods, have become more vulnerable to impacts of climate change. The increased incidence of catastrophic events such as floods, droughts and landslides are directly or indirectly affecting

people's lives and livelihood in vulnerable area, change in weather pattern has directly impacted in human settlement. Millions of rural people in Nepal are estimated to be at risk to climate change (NAPA, 2010).

Central Bureau of Statistics (CBS) has defined Village Development Committee (VDC) as rural areas completely on administrative basis. But understanding of village communities is significant not only for administrative reasons in anthropological research, it is also significant for historical insights and ideas and it is not only significant to describe of change but also for attitude and reactions of people of change (Roy, 2003).

It seems necessary to incorporate local knowledge with scientific knowledge for climate change resilience. Government need local knowledge for culturally/socially appropriate climate change policy and action, therefore we need to seek rural people's understanding of climate change through their eyes and ears

Like many impacts of climate change, climate related disasters are disproportionately affecting the rural vulnerable people. The UN Human Development report (2008) has noted that from 2000 to 2004 about 262 million people were affected by climate related disasters; over 98 percent of them lived in the developing world. In Nepal, between 2000-2005 more than 1300 rural people were killed by flood and landslide related disasters (CBS, 2006)

We need to seek ground reality of climate change through people's eyes rooted in civic science of traditional knowledge. Government and other agencies need to understand rural people's adaptive mechanisms and coping strategies for planned adaptation mechanisms. Public perception

can be helpful to policy makers.

In the war against climate change rural people of developing country are always in the front line and they are capable to identify climate change through their culture though they have no access to scientific data; we can study such rural people's knowledge and negotiate effectively to influence policy makers. Locally or culturally appropriate technology and rural people's knowledge is very important to climate resilience. Engineered approaches may protect communities from normal condition but can leave them highly vulnerable to catastrophic infrastructures failure such as those seen in 2008 Koshi floods in Nepal and India which affected about 3 million people. This anthropological study will be useful to policy makers and other agencies to enhance climatic resilience and to reduce climatic vulnerability. We need to identify vulnerability to plan resilience especially where the impact occur. The resilience of human institutions and ability to monitor and adapt to changing conditions seem to be more important (Rayner and Malone, 1998). This study contributes to enhance climate change resilience and to reduce vulnerability by identifying rural people's perception on it and seeking adaptation strategies adopted by rural people. This study is a hallmark in climate change anthropology in Nepalese context.

1.4 Theoretical Perspective

Anthropology deals with the people, culture and human society. It is dynamic discipline and tends to be qualitative. Anthropology's potential contribution is rooted in its traditional holism (Fricke, 1993). The issue of climate change is directly related with people and cultural and the issue has turned increasingly to adaptations as priority for research and policy, social and ecological resilience is crucial aspect of local livelihoods and

resource utilization (Crate and Nuttal, 2009).

Many theoretical approaches have been developed with different perspective within anthropology. Cognitive theoretical model of anthropology deals with people's knowledge system, cultural ecological model seeks people's relationship with nature. In this study cognitive theoretical model is used to seek people's knowledge system and cultural ecological model is used to understand relationship between people and nature. Cultural model of climate change described a by Susan A Crate and Mark Nuttal provides anthropological lens to study climate change. Rural livelihoods diversification model of F. Ellis and sustainable rural livelihoods model of D. Carney is used to understand rural livelihood, livelihood diversification, and adaptation process in this study.

1.5 Structure of the Study

Chapter one provides problem statement, objectives, study rational, theoretical perspective and scope/limitation of the study. Collected literatures are categorized and reviewed in chapter two and chapter three includes research methods. Socio-economic profile of study area is given in chapter four and chapter five attempts to understand climate change through rural people's eyes. Chapter six includes effects of climate change in rural context; finally, conclusion and recommendation is provided in the last chapter.

1.6 Limitation of the Study

Social scientists have contributed to climate change research by identifying human activities that cause climate change, highlighting environmental changes that affect human welfare and examining the research process itself and its relationship to policy-making. They viewed climate change related issue holistically not just only limiting to reduction

of green house gas. This study is for partial fulfillment of requirement for master degree in anthropology. Perception, impacts, and adaptation strategies of climate change might be location specific, therefore this study and its findings may not apply elsewhere and detailed bio-physical analysis is not included.

CHAPTER: TWO

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 Most General Definitions of Climate Change, Climate, Weather and Seasons

In most general climate change is a change in the statistical properties of the climatic system. Climate is average condition of the weather at particular place over a long period of time. According to Critchfield (2009) weather is the day to day state of atmosphere, consists of short terms variations of energy and mass exchanges within the atmosphere and between the earth and atmosphere. Climatic conditions and geo-physical structure of earth determine the seasons.

2.2 Global Overview of Climate Change

> Climate change is not just an unusually grand problem. It is also an unusually complex one, which crosses and confounds the boundaries that normally define our world, from farming to forestry, shopping to sovereignty, all sorts of interests are brought together in new ways that demand new actions.
>
> The Economist, 2010:9

Climate change is popularly known as global warming, but it is much broader than global warming. Temperature change is just one aspect of the broader subject of climate change. The scientific opinion on climate change as expressed by the UN Intergovernmental Panel on Climate Change (IPCC) and explicitly endorsed by the National Science Academies of the G8 Nations, is that the average global temperature has risen 0.6±0.2°C since the late 19 century and that it is likely that most of

the warming observed over the last 50 years is attributable to human activities (IPCC, 2001).

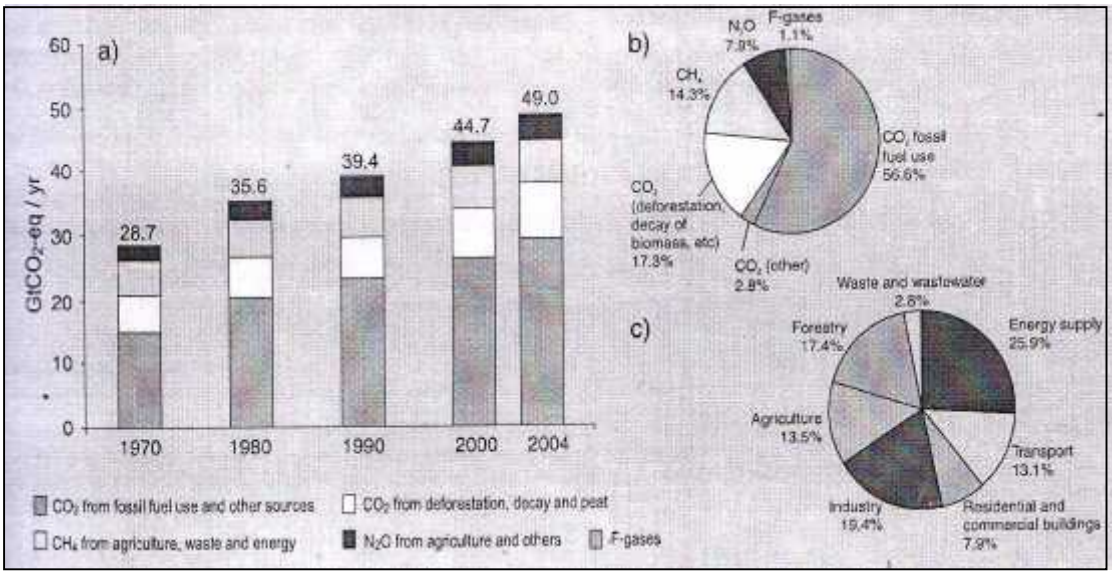
Intergovernmental panel on climate change (IPCC) defines climate change as a change in the state of the climate that can be identified by changes in the mean or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time whether due to natural variability or as a result of human activities. In UNFCCC climate change is used as a change of climate that alerts the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods, UNFCCC definition of climate change differs with IPCC definition (IPCC, 2007: 30). In UNFCCC, climate change is used for human caused change and climate variability for non human caused change.

Climate change will lead to serious problems which all countries must get together to solve. Over the years, several conferences to discuss environmental issues have been held and many agreements signed. The process begun with the Stockholm conference of 1972, but negotiations on the issue of climate change started in 1990. These negotiations resulted in the adoption of United Nation's framework convention on climate change in 1992.

Each release of IPCC reported global awareness of climate change issue higher. Fourth report (AR4) considers scientific research of climate change. Since then global carbon project, an international consortium of research programs established to study the earth's carbon cycle, has released findings that suggest the growth rate of CO_2 emission is increasing faster than projected. From 1990 to 1999 the growth rate of

CO_2 emission average around 1.1 percent per year. From 2000-2005 the growth rate increased to more than 3.3 percent per year. The growth rate of emission is strongest in rapidly industrializing developing countries (UNEP, 2008). Figure 1 illustrates historical trend of global anthropogenic GHG emissions.

Figure 1: Global Anthropogenic GHG Emissions



Source: IPCC Synthesis Report, 2007.

In April 2007 the UN Security Council for the first time discussed the effects that climate change will have on peace and security. Some governments raised doubts regarding the council's role on the issue, while others such as small developing states welcomed the initiative. In Bali, at 13 conferences of parties to the UN framework convention on climate change and its Kyoto Protocol's 3rd meetings of parties, government representatives from 187 countries agreed to launch negotiations and a course of international action leading to final negotiations in 2009 to ensure that new deal can inter into force by 2013 when the first phase of the Kyoto Protocols ends (UNEP, 2008: 14).

Warming trend of this planet is strongly affecting terrestrial biological systems. Earlier timing of spring events such as leaf unfolding, bird migration and egg laying and pole ward and upward shifts in ranges in plant and animal species (IPCC, 2001). IPCC reported there is confidence that there have been a trend in many regions towards earlier ‘greening’ of vegetation in the spring linked to thermal growing seasons due to recent warming (IPCC, 2001).

Anthropogenic activities are depleting resources and producing wastes faster than the earth’s natural system can regenerate and process them. Concern about this problem is growing, especially in the case of green house gases emission and they are causing to climate crisis (UNEP, 2008: 18). World Meteorological Organization (WMO) recorded 2010 as a hottest year and proposes that coming year will be increasingly hotter and hotter. According to IPCC, GHG emission will continue to grow over the next few decades and warming trend will continue (Based on IPCC Projection, 2007).

2.3 Climate Change and Its Impacts in Nepalese Context

In Asian context monsoon is the dominating factor shaping climate, thus the distribution of precipitation is very uneven over space and time and large parts of the continent are water stressed for many months of the year. Climate of Nepal is primarily affected by two major natural features, Himalayan mountain range and south Asian monsoon. Fourth assessment report of IPCC has included Nepal as a 'white spot' region because of scientific information on climate change being limited and its topographic complexity has made more difficult for climate change projection over Nepal (NCVST, 2009).

Majority of Nepalese people depend on agriculture for their livelihood. Only 42 percent cultivated land is irrigated, so any decline or delay in rainfall reduces a farmer's ability to maintain household food security. Argo- crops are also threatened by previously unseen pest intensions and disasters over Nepal (NCVST, 2009).

The study of Shrestha et. al. based on an analysis from 49 stations for the period 1977 to 1994 shows increased temperature trend of Nepal. The study indicates a consistent and continuous warming in the period at an annual rate of 0.06°C. Similarly, a study conducted by Practical Action (2009) using data from 45 weather stations for the period 1996 - 2005 indicate a consistent and continuous warming with maximum temperature at an annual rate of 0.04°C indicating the warming trend in the country. Unlike temperature, precipitation data for Nepal does not reveal any significant trends (Shrestha et al, 2000, Practical Action, 2009).

Nepal has already experienced various disasters such as 2006 Koshi flood in Nepal and India which affected over 3 million people and other heavily impacted disasters in people's lives and livelihoods were the 1998 Rohihi river and other Terai floods, the 2008 floods in far-west Nepal, the 1993 mid- mountain cloudburst and floods, the 2008/2009 winter drought, the 2009 forest fires across the Himalayan region, and 2009 diarrhea epidemic in the mid-western Hills.

In the recent years Government of Nepal has expressed commitment through international conventions and treaties to develop strategies to mitigate the impact of climate change. Nepal signed United Nations framework convention on climate change on 12 June 1992 and became party to it in 1994.

Government of Nepal has formulated climate change policy to inform parties to the UNFCCC about the implementation of the convention to promote climate adaptation, mitigation and carbon sequestration, to implement adaptation program according to the national development agenda, to make natural resource management climate friendly and to increase public awareness to climate change. The objectives of the policy are to implement climatic adaptation – related programs, to reduce GHG emission and to adopt a low carbon development path.

Rayner and Malone (1998) suggest that public policy need to view the issue of climate change holistically, not just as the problem of emissions reduction. Policies also need to take a regional and local approach. Social structure and cultural values play vital role to climate change resilience and climate change vulnerability. The policy of GON (2011) to climate change could not address the local socio-cultural context of climate change resilience and vulnerability.

Nepal is largely an agrarian economy and therefore highly sensitive to change in climate and natural resource availability. Nepal's low level development and complex topography renders it vulnerable to climate change. The ongoing climate change 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 than others. The climate change sensitive sectors are agriculture, forestry, water resources, health, urban settlements, tourism and overall livelihoods and economy (NAPA, 2010).

The agricultural sector has been a major source of production, income and employment opportunities in Nepal and this sector is still primitive, traditional and subsistence in nature which comprises more than half the labor force. Climate change projects significant impacts on conditions

affecting agriculture including temperature, carbon dioxide, precipitation and interaction of elements. Local communities have identified change in climate as being largely responsible for declining crops and livestock production. Nepal's vulnerable subsistence farming economy is facing risk due to changes in reliability of stream flow, a more intense and potentially erratic monsoon rainfall and the impacts of flooding. Decline in rainfall from November to April adversely affects winter and spring crops. Studies show climate change is posing a threat to food security due to loss of some local land races and crops (Regmi and Adhikari, 2007).

Likewise, climate change induced water stresses directly affects agricultural productivity that may lead to malnutrition. Water stresses affects human health and sanitation. Impact of climate change on water resources seems in two forms, too little water i.e. ‘drought’ and too much water i.e. 'floods'. Too much water affects human settlement, infrastructure and agricultural land and too little water affects agriculture productivity, health and sanitation.

Studies show (NAPA, 2010) some local forest species are disappeared and some new species are appeared due to climate change. Increased temperature and rainfall variability have resulted into shifts of agro-ecological zones, prolonged dry spells and higher incidence of pests and diseases. Fire and drought have affected forest and biodiversity sector. Critical ecosystem and resources such as wetlands are depleting due to more frequent disasters and water scarcity.

Impact of climate change on human health conditions can be broken into three main categories, (i) direct impacts of for example, drought, heat waves and flash floods, (ii) indirect effects due to climate induced economic dislocation, decline, conflict, crop failure and associated

malnutrition and hunger and (iii) indirect effects due to the spread and aggravated intensity of infectious diseases due to changing environmental conditions (WHO, 2005 quoted in ICIMOD, 2009). Climate change has impacted on public health both in rural and urban area. In some area communities have been victimized by new diseases. Due to poor health state of Nepal, public health can indeed be at higher risks than before from adverse impacts of climate change. Environmental degradation and pollution have been seen as main causes of diseases. Climate change has become additional contributor to the spread of infectious diseases such as malaria, Japanese encephalitis, and *kalajar*. Infectious diseases that are spread by mosquito have been seen in high altitude due to increased temperature.

2.4 People, Culture and Climate Change

> …there is multiple ways defining reality: there is multiplicity of knowledge communities. Each community has its own cosmology: they: …embody different system of knowledge; different ways of understanding, perceiving, experiencing in sum of defining reality which includes the notion of one's relationship not only to the social milieu but also to the natural environment.
>
> Banuri and Apffel Marglin 1993.9, quoted by Thomson and Rayner 1998

The impact of any climatic event depends on the local social and ecological setting (Hassan, 2009). People interact with nature through their culture. Culture generally implies way of life. People give value to natural resources in terms of their cultural utility. People's relationship with nature is embedded and their knowledge system is considered as contextual and symbolic.

Cultural anthropologist Mary Douglas and other have focused on two causes of climate change, population growth in the less industrialized world and mindless consumption culture in rich industrialized nations.

World's poor's livelihood is dependent on certain resource i.e. not enough for their needs. According to anthropologists assumptions wants and needs do not come from inside the person. Human wants and needs play a role in changing global climate. Lifestyles certainly give raise to consumption patterns that deplete resources (Douglas et. al. 1998). Nature serves to satisfy human needs and wants, it is not infinitely resilient (Thomson and Rayner, 1998).

The components of healthy and sustainable societies are intertwined. Efficient use of land, water, energy and other natural supports make sustainable livelihood and make local enterprises more productive and reduce climatic impact. Climate change has emerged major challenges to human society, it transformed society into transition. Climate change threatens to erode human freedoms and limit choice. It is defined as a human development issue in new generation (UNEP, 2008).

Climate change is human culture (Crate and Nuttal, 2009). Across developing countries millions of people are already being forced to cope with the impacts of climate change. People's adaptation process is a cultural process. Scientific data of climate change might not be available in rural area, although people are capable to identify changes which have undermined their ability to earn a livelihood from natural endowments such as air, land, water, vegetation, crops and livestock. They know how such changes are declining reliability of their traditional knowledge system.

Climate change is perceived by rural people in their own ways. Many people say that they have witnessed deterioration of their local environment in their lifetimes and therefore have a direct experience of environmental problem. Human influence on global climate is recent,

human influence on regional climate is much older (Orlove, 2005). Global climate change has become a concern not just among experts but also among rural lay people.

Rural lay people are unfamiliar with recent international agreements, but being the active part of ecosystem they do perceive environmental change. Global climate change is introduced in rural people's cognitive map. They know it has disturbed their close relationship with nature (Thomson & Rayner, 1998). Anthropologists argue that human societies do not interact directly with their environment; they interact with their perceptions of their environment.

2.5 Anthropological Encounters to Actions

Anthropologists have become involved in climate change research within last decade to an unprecedented degree and three conditions are responsible for this development the irrevocable transformations that climate change is bringing to the people and places traditionally studied by anthropologists, the general recognition of the importance of research on the human dimensions of climate change, and the growing opportunities for anthropologists to participate in interdisciplinary climate application and adaptation research (Rancoli, Crane and Orlove, 2009:87). In contemporary world leading social scientists in climate change research are M. Nuttal, R.E. Rhoades, C. Rancoli, M. Thomson, S.A. Crate, B. Orlove, E. Malone, N.Vedwan, S. Rayner, F.A. Hassan, R.I. Hitchock, whose research projects are largely contributing to climate change research through societal framework.

In 1998 four volumes of Human Choice and Climate Change were published in editing of S. Rayner and E. Malone. *Human Choice and Climate Change volume 1: The Societal Framework* began the

assessment firmly within the context of world's social, cultural, and economic systems. Editors of book concluded that climate change was occurring in a complex and rapidly changing framework of human choice that shapes people's perception of it and the opportunities for human response. This volume provided societal framework for climate change research and policymakers.

Different people perceive the global climate change issue in different way. N. Vedwan and R.E. Rhoades (2001) explored local knowledge of climate among apple growers in Himanchal Pradesh in northern India. They showed how farmers interpret climate change in relation to the annual growth of apples that are highly sensitive to the onset, duration and intensity of snowfall in the region. According to the apple growers noticeable changes in these climate variables have resulted in a significant decline in the regions apple industry in recent years. By attributing the cause of this decline to a natural phenomenon such as climate change, farmers are able to instill greater senses of entitlement into their claims to government assistance.

Vedwan (2006) studied local knowledge and perception of climate change among the apple growers of North Western India using nested model of human environment interactions. He explored local knowledge and perception of climate change and concluded perception of climate change was structured on the hand by apple farmer's activities in terms of the knowledge and intentions they possess and on the other by parts of the landscape that even through pre-existing, made sense only in light of the activities. His study model helps to understand human-environment interaction and people's perception on climate change.

Social scientists have drawn on different approaches to study mitigation and adaptation to climate change (Orlove, 2005). Ben Orlove linked approach from two sets of disciplines to the study of mitigation and adaptation to climate change by reviewing of three historical cases, the Classic Maya of Mexico and centre America, the Viking settlements in Greenland, and the US dust bowl. His comparative study of history of past societies integrates the mitigation and adaptations to climate change. From three historical cases he argued human influence on global climate is recent, human influence on regional climate is much older (Orlove, 2005; 590).

Rancoli, Ingram and Kirshen (2001) studied the costs and risks of coping with drought and its livelihood impacts and farmers' responses in Burkina Faso in 2001. They have illustrated the agro- ecological and social economic context that shapes livelihood options and constraints in an area characterized by high levels of climatic risk and low natural endowment. They documented how food procurement and management practices were shaped by household resource access profiles and livelihood portfolio. Livelihood diversification, encompassing migration, non farm work and social networks, and livestock production were critical dimension of adaptation. They found and pointed to the need for closer integration of drought preparedness efforts, farmers understanding of climate, crop interactions and interventions that bolster the capacity of resource-limited household to respond. This research cleared local adaptation strategies to climate change adaptation by showing farmers striving to uphold with drought and this provides rural agricultural adaptations to climate variability.

The study of Susan A. Crate's with Vilyui Sakha (2009) in Northern Russia depicts that elderly knowledge could be valued and integrated into

contemporary life. Her research project showed communities can both document and use elderly knowledge to bolster local definitions of sustainability at the same time initiate new modes of communication between village youth and elders. In her research project she has documented local expressions about local climate change. She noted that village elder's knowledge is vital in lieu of availability of compressive local climatic data.

Hitchcock (2009) talks about responses and with the impacts of environment change in San community of Kalahari Desert, Southern Africa. In his study all people were familiar with environmental and socioeconomic challenges. His study showed generations experience of serious droughts, floods, cold spells, hot spells and outbreaks of human, livestock and wildlife disease that have affected their livelihoods. He explored tools of coping mechanisms in San community as diversification of their livelihoods. Environmental vulnerability has compelled them to diversify their subsistence. In his research project he explored adaptive strategies of San with short term and long term environmental change.

Based on research in Greenland, Nuttal (2009) illustrates that climate change is different for different people and culture and climate change are interlinked. He illustrates that Greenlanders capacity to adapt to change is highly dependent on the strength of their sense of community, kinship and close social associations. He has emphasized that community’s ability to adapt to climate change has more to do with issues of autonomy.

Bohren (2009) explores anthropology's role in 'car culture' based upon her own experience as an anthropologists working as director of the

National Centre for Vehicle Emissions Control and Safety (NCVCS) at the University of Colorado. She illustrates that cars are cultural phenomenon and are represented differently in different countries. She shows that anthropologists can facilitate culturally appropriate and long lasting change.

Anthropological encounters illustrate direct relationship of human culture and climate change and anthropological actions illustrate role of anthropologist in building climate change resilience.

2.8 Conclusion

Several conferences have been held to discuss climate change issue and many agreements are signed. Intergovernmental Panel on Climate Change (IPCC) and other panels are providing scientific information on climate change. Anthropologists are involved to seek climate change knowledge in people's cognitive map. Anthropological research projects illustrate that climate change adaptation and mitigation needs to consider on the local socio-cultural context. They have found ground reality of climate change.

Nepal is introduced as 'white spot' in the fourth assessment report of IPCC and people of Nepal are estimated at higher risk with climate change. And rural people of Nepal not responsible for climate change and are not familiar with the international conferences, agreements and with scientific information. This study has explored how climate change is introduced in rural farmer’s cognitive map seeking impacts of climate change and people's responses in rural socio-cultural context of Nepal.

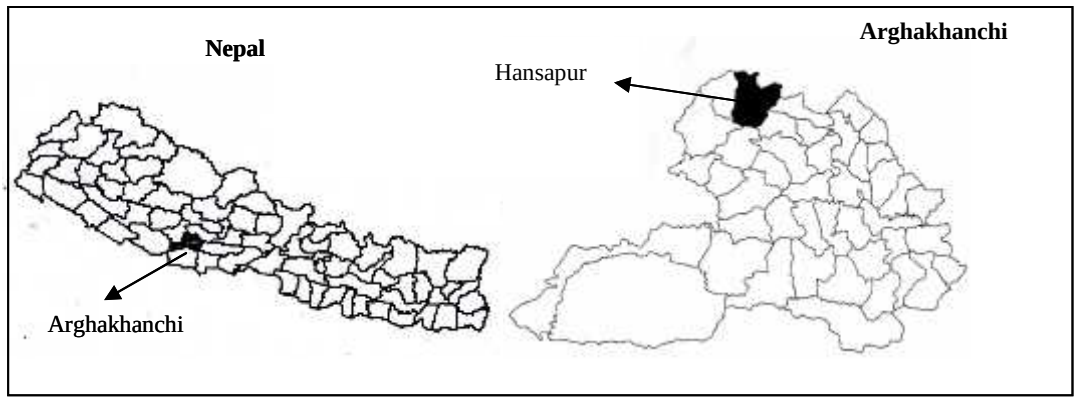
CHAPTER: THREE

STUDY-METHODS

3.1 Materials Collection, Study, Review and Site Selection

To be conceptually clear in understanding climate change perception, impacts and adaptation, essential literature that were conducted through societal framework were collected and studied. More studies were held in High Mountain comparing with hilly region and impacts were highly pronounced in high mountainous regions. In Nepal, studies of hilly people of climate change through anthropological perspective were not found till the date. Therefore in this study rural people of hilly area have been selected to fill the research gap and to understand their perception regarding climate change, its impacts and people's adaptive strategies. Figure two shows location of study area.

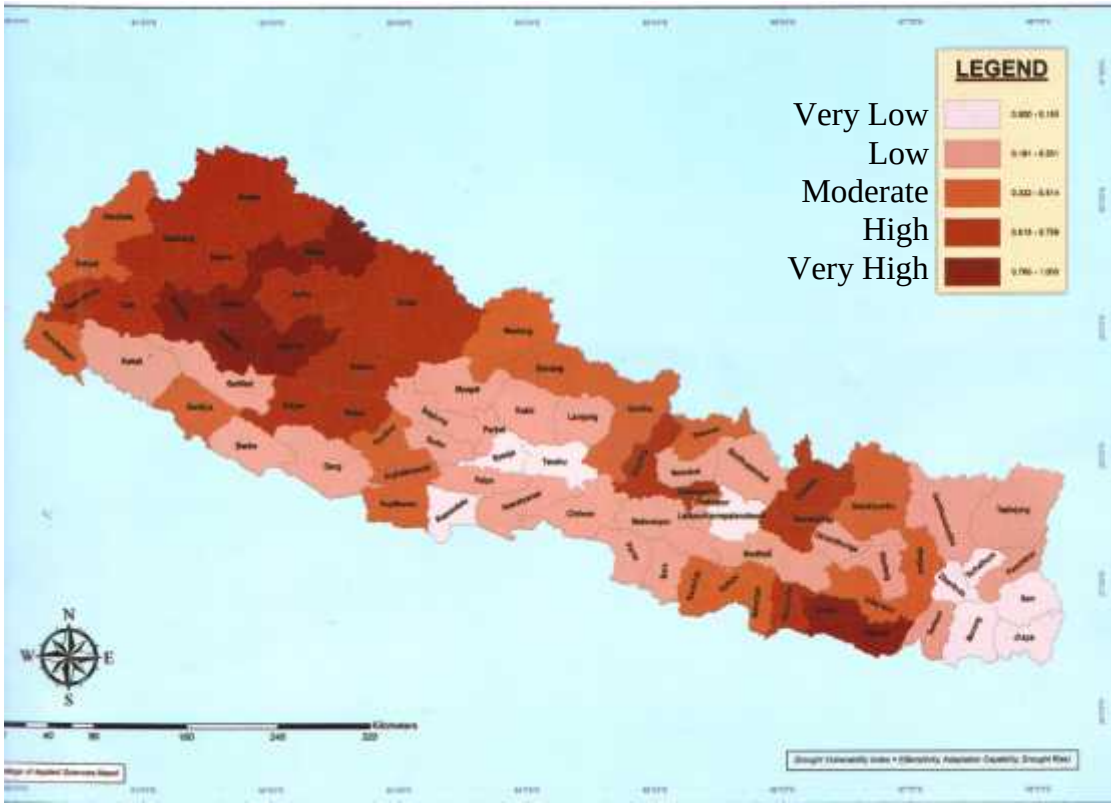
Figure 2: Location of Study Area



Peoples of Hansapure in Arghakhanchi district were selected for the study (See Chapter Four for Socio-Economic Profile of study area). Arghakhanchi district is situated between $27^{o}45$ 'N' to $28^{o}6$ 'N' and $80^{o}45$ 'E' to $83^{o}23$ 'E' covers a total 1193 Km^2 areas. The District lies in Lumbini Zone of western Nepal. The district bounded by Palpa in the east, Gulmi in the north, Kapilbastu and Rupandehi district in south and

Dang and Pyuthan in the west. About 68% of the total area in here lies in the Mahabharata range and the remaining lies in the Siwalik region. The population of district is 208391 (CBS 2001). It is situated between 305-2575 m above sea level; about 40% of its total area is covered by forest.

Figure 3: Drought Vulnerability Map of Nepal



Source: National Adaptation Programme of Action (NAPA), 2010

Figure three shows drought vulnerability map of Nepal. In Nepal, hilly areas are ranked more vulnerable to drought and landslide than other natural disasters. Arghakhanchi district is ranked in climate change vulnerability Map of Nepal as moderate to drought and landslide and very low to glacier outburst and flood (NAPA, 2010). This district has two meteorological stations, Khanchikot and Sitapur. In Khanchikot, temperature data were recorded since 1985 and rainfall data were recorded since 1990. Similarly in Sitapur station, only rainfall data recorded since 1950 were found. Khanchikot is located 22 km south and

Sitapur 27 Km South from Hansapur. Khanchikot lies in Mahabharata range and has similar ecological setting with Hansapur. Hansapur is moderate temperate climatic zone.

3.2 Pilot Survey of Selected Area

To understand if the selected area was appropriate for the study, a pilot survey was conducted within 10 days. In pilot survey, study area was visited. Unstructured interview was taken with rural people who were randomly selected. Informal talks and group discussion were held to understand their socio-cultural as well as economic activities and to become familiar with them. Secondary data such as VDC profile, available journals and some primary data were collected in pilot survey. After pilot survey's data analysis preparation for filed survey was completed.

3.3 Study Unit and Respondents Selection

To explain climate change through rural people's eyes is major objective of this study. The rural farmers were key targeted respondents of this study. Knowledge of rural elderly people who were witness of four generations; grandfather/grandmothers, fathers/mothers, sons/daughters and grandsons/granddaughters, is highly emphasized and prioritized in the study.

3.4 Data Collection and Analysis

This study is an exploratory study and descriptive in nature. Both qualitative and quantitative data have been used in the study. Primary data are collected through focus group discussion, in-depth interview and household survey. In focus group discussion, representatives of agricultural groups and elderly members of village were selected. In-

depth interview was held with rural elderly farmers. Participation in rural work with people was another technique of data collection. Secondary data were collected through central bureau of statistics, districts profiles, VDC profiles, published or unpublished materials such as magazine, news bulletin, website, reports of government and the like. After completion of the initial research, obtained data were analyzed and documented and it was summarized with the view of eliciting the major findings.

CHAPTER: FOUR

SOCIO-ECONOMIC PROFILE OF THE VILLAGE

People of Hansapur village in Arghakhanchi district are selected to study. Geo-physically the Hansapur village of Arghakhanchi district is situated in the elevation 1900 m - 2500 m from the mean sea level. The total area here lies in the Mahabharata range, it is a hilly region. The socio-economic profile of the people are presented based on occupation, food sufficiency, water availability, agro-land availability, fuel use systems and by assessing people's access on communication, health, transportation, education, electricity, drinking water from field survey and secondary data analysis.

In Hansapur majority of population are dependent on natural resources and monsoon rainfall for their livelihoods. Agricultural land is mainly of two types: upland *bari*, without surface irrigation, and terraced rice fields known as *khet* with surface irrigation from local streams. Farmers consider *khet* more valuable land than *bari.*

Majority people live in thatched house and house types of village are determined by the climate, soil and the materials available in the region or locally available resource. Residences are built on barren lands.

The main occupation of the people is subsistence farming and nowadays their mobility has increased toward off-farm sector with the wider population dispersal. In addition few households are involved in service, business and local traditional industry. Young people tend to work outside the village.

People do not have full access to infrastructure of development. There is no access to road to majority population. There is no college in the

village. Likewise, there is no electricity and no proper drinking water system. In the area sanitation is poor. Spring water is the main source of drinking water of people. For sanitation people use water of traditional ponds, rainfall, and stream water. Local streams and seasonal rainfall are main source of irrigation purpose. Local stream are irrigation source of paddy field. People have less paddy field comparing with *pakhabari*. People are not dependent for their livelihood with paddy crop i.e. paddy product is very low. Main agro products in village are maze, buckwheat, wheat, soybean millet and potato.

People still use their traditional knowledge in all kinds of agro production such as cultivating, harvesting and weeding. Both male and female involve in farming. Agricultural product is not sufficient for people's livelihood. Food security status shows most of the people have no sufficient food for round the year from their agricultural land. *Dalit* people have been involved in share cropping system because of insufficient food from their cultivated land. There are a few households that have sufficient food for round year from their agricultural land. Table 1 shows food sufficiency status of households.

Table 1: Food Sufficiency Status of Households

S.N.	Food sufficiency	Food sufficiency status of households	
		Households	Percent
1.	12 months or more	2	11.12
2.	7-11 months	7	38.89
3.	6 months or less	9	50.00
		n = 18	

Source: Field Survey, 2011.

Main energy source of the local people is dry wood mainly for cooking purpose. A few households use commercial energy for cooking. For lighting almost 36 percent of the households use solar and remaining households use kerosene for lightings.

Many people have not been advantaged with health post. Most of the people follow traditional healers for treatment. People are in transition between traditional belief system and modern medicine.

Community forests are helping people largely as they have access to grazing land, dry wood, leaf litter, grass, wood and medicinal-herbs. Main source of cooking fuel and grazing land in the village comes from forestry sector.

The problem of open defecation still exists in the village; of the total households 32 percent do not have their own toilet. In the village a few household have *pakka* toilet and majority household are seen having own *kachcha* toilet.

Natural disasters have significant impacts on the livelihoods of the people. Long drought and erratic rainfall are directly impacting on local social and economic system, mainly *pakhabari,* forest, grazing land and settlements have been affected by natural disasters such as landslides, droughts, flashfloods and the like. Table 2 shows effects of natural disasters during five years.

Table 2: Largely Affected Households due to Natural Disasters during Last Five Years

S.N.	Natural Disasters	Number of largely affected households	Percent
1.	Landslides	4	22.21
2.	Flash floods	2	11.12
3.	Strom	7	38.89
4.	Hailstorms	5	27.78
		n = 18	

Source: Field Survey, 2011.

People are tied by social relationship that crosses caste and ethnic groups. They are organized through informal group such as mother group, youth clubs and other social institutions. They share common social and environmental and similar life experiences like storm, landside, epidemic and the like. Each ward has agricultural groups, livestock groups, vegetables and groups of local fruit production. These groups are creating platform for uniting local products.

People think for the development of their village in terms of public utilities. Management and maintenance of law and order of village is rested on a headman who is an elder of the village and respected by all members in the village.

CHAPTER: FIVE

CLIMATIC PERCEPTION

5.1 General Perception

Where are seasons gone?

Climate change has been perceived and debated throughout the world. Different people have different ways of expression about climatic change. Rural people of Nepal also have their own way to express the change in climate. The perception regarding any matter, issue, object and subject may vary from community, country and time.

One of the objectives of this study is to understand the local knowledge and perception regarding the change in climate through rural people's eyes. Though the rural people have felt the change in climate, they are not sure what the term “climate change”. They can express the changes in terms of extreme heat in summer, presence of mosquitoes in high altitude, thick aerosol in winter, less and erratic rainfall during monsoon. They also relate changes in terms of increasing frequency of natural disasters such as drought, storms and hailstorm.

Arghakhanchi District has two meteorological stations, Sitapur and Khanchikot stations. Khanchikot is located 22 km from Hansapur in south and Sitapur lies 27 km from Hansapur in south. Khanchikot lies in the Mahabharata range and has similar social and ecological setting with Hansapur. In Sitapur, rainfall data have been recorded since 1990 (DHM) and in Khanchikot, temperature data have been recorded since 1985 and rainfall data since 1990 (DHM). Hydrological or metrological data show erratic rainfall and increased temperature in Arghakhanchi.

Figure 4: The Average Monthly Precipitation of Sitapur Station (Data Records from DHM)

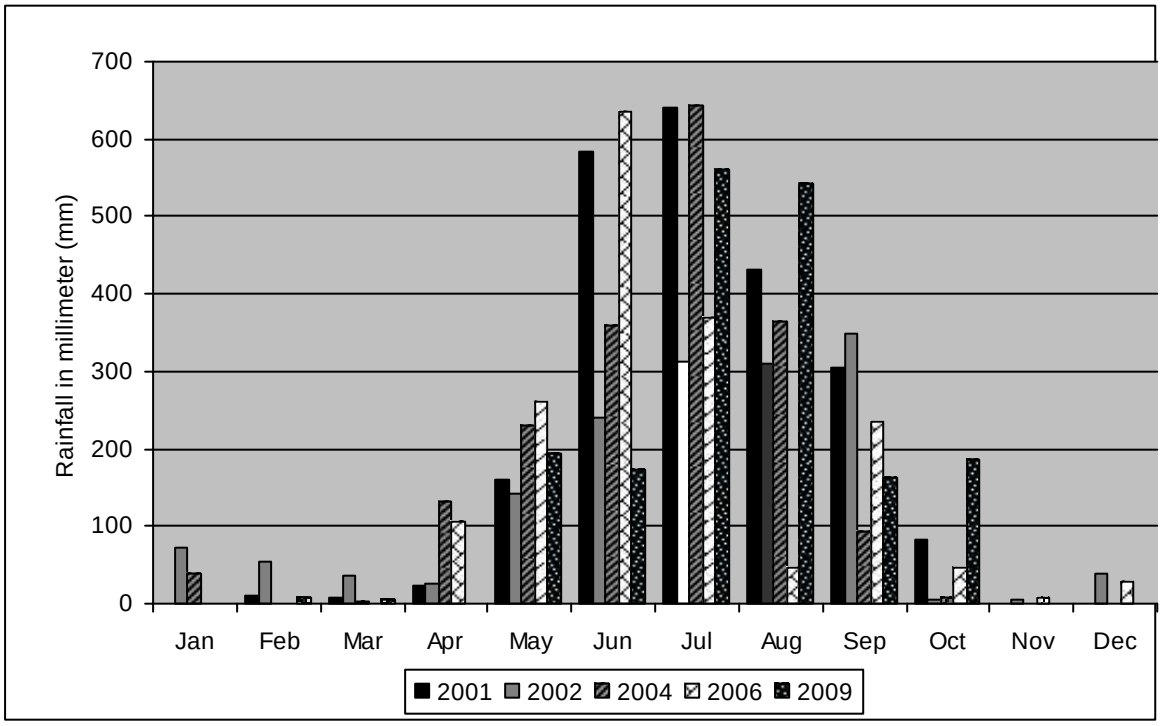
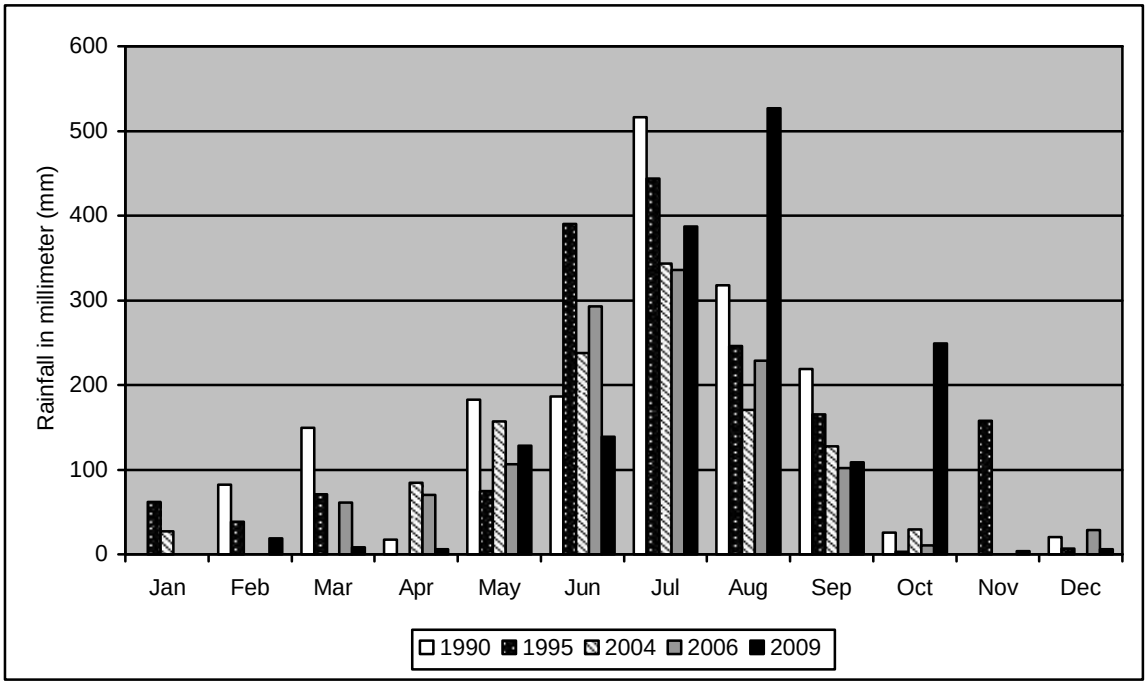


Figure 5: The Average Monthly Precipitation of Khanchikot Station (Data Records from DHM)



The figures 4 and 5 show the trend of erratic rainfall trend. Winter rainfall has decreased and which largely affecting winter agro crops such as wheat, buck wheat and other vegetables. Similarly monsoon plays a crucial role in terms of agro-crops that is linked with livelihood of rural people. Decreasing rainfall has adversely affected rural people's lives and livelihoods. The rainfall has now shifted to autumn, however people need rain in June and July for their crops. Shift of monsoon season has created confusion among farmers as it changes traditional cropping calendar. This change has pushed people towards cultural transition. Declining rainfall from November to April has seriously affected the winter and spring crops. People are worried with this declining tend of rainfall, because it poses a threat to their food security. People perceived that erratic rainfall and temperature has increased since the last decade. An elder resident of village has said:

> The rainfall and temperature are quite different compared to the past. Temperature has increased day per day and monsoon and winter rainfall has decreased during last five years, production of wheat has decreased because wheat crop need rainfall in Magh (February) month. Machhapuchhre Himal has no snow as in the past when I observed it form Laharilek. The peak of Himal nowadays without snow, compared to white peak when I was a kid.

Respondents said that it is very difficult to differentiate seasons nowadays as it has completely changed or overlapped. 90 percent of the respondents have said that seasons were changed. Past seasons have become nostalgia for rural people. An elder male said being nostalgic:

> Where has gone sunny winter, where has gone funny winter, where is Saune Jhari, these days Saun is not like Saun, Chaitra is not like Chaitra. Every season has changed. Where have rainy seasons gone?

People mentioned that six seasons in a year are difficult to find. Some of them mentioned that seasons have blended and three seasons have dominated in a year. Before the autumn and late autumn seems the same. People said few days after the end of rainy seasons, the winter season starts. This means that differentiation between autumn and late autumn has not much seen today. People have felt their knowledge system is not reliable like past, an elder shared his feelings.

> Queer days have come. In past, we used to hear many insect's whistling in the evenings, they used to tell time. As there were no watches, I used to notice time correctly, looking at earlier roosters were indicator of time. Now they do not crow in time. Similarly, dog's mating time has become a round year. Everything has become different. Unknown pests are appeared; our *phapre charo* (species of bird, which was good symbol in rural context) has disappeared for five years. The ripping time of our local fruit and agro-crops is getting earlier.

Rural people's perception to climate change seems similar with scientific data. Available scientific data show increasing trend of temperature, declining in monsoon rainfall and people have perceived same. Scientific projection of climate change indicates that disaster of mosquitoes would appear in higher altitude, some local species would disappear and toxic weeds would appear. People said that lowland pests and toxic weeds have appeared at higher elevations mostly during last ten years, a female elder has said;

> The village was cold temperate zone. Nowadays I am feeling hotness in *Hansapur* like in Terai. There was not presence of mosquitoes, nowadays mosquitoes have seen even in the cold months. *Ban Mara* weeds have appeared everywhere and this weed has destroyed our local herbs. We could not destroy it, because even a little remaining, it starts to grow fast.

People have shown their experience comparing with the past. Presence of mosquitoes, toxic weeds, and presences of unseen pests is sign of climate change. They are unfamiliar with the term 'climate change' or *jalavayu paribartana*. But they know local environment is changing. They have perceived global climate change through their local indicator. They have felt something is disturbing with their close relationship with nature and 'climate change' has become discussion issue among rural lay elderly people, not only among 'experts'.

5.2 Perception on Natural Disasters

Natural disasters are not new for rural people. The disasters have seen very common in the village. People perceived that these disasters have occurred in different ways, not like the past. Effects of disasters such as drought, less rainfall storm and hailstorms, flash floods are increased and people have been compelled to count the loss of properties due to disasters every year. People have mentioned that they were largely affected from storm and landslide, hailstorm, drought, less rainfall and flashfloods. They mentioned that effects of flash floods and landslide have decreased comparatively during last ten years because of less rainfall and drought. Effects of storm, hailstorm, drought, less rainfall have increased. Table 3 shows perception on natural disasters of respondents during last 10 years.

Table 3: Perception of Natural Disasters during Last Ten Years

S.N.	Name of Respondents	Age	Perception on Effects of Disasters During Last Ten Years			
			Drought	Storm	Hail storm	Less Rainfall
1	Rabin Gharti	72	+	+	+	+
2	Thakur Pr. Pokhrel	56	+	=	+	+
3	Masine Kami	78	+	+	+	+
4	Gayatri Adhikari	63	+	+	+	+
5	Dal Bdr. Pun	67	+	=	=	+
6	Sarada Khatri	50	+	-	+	+
7	Jit Bdr. Thapa	83	+	+	+	+
8	Manamaya Pariyar	66	+	+	+	+
9	Til Bdr. Rana	48	+	+	+	=
10	Prem Pun	64	+	+	+	+
11	Basanta Regmi	56	+	+	=	+
12	Prem Pande	71	+	+	=	+
13	Kumar Khadka	43	+	=	=	+
14	Som Bdr. Chhetri	89	+	+	=	=
15	Purna Nepali	65	+	+	+	+
16	Kamala Panthi	43	+	+	+	+
17	Durga Sunar	75	+	+	+	+
18	Bhojendra Thapa Magar	66	+	+	=	+

+ = Increased

Source: Field Survey, 2011.

- = Decreased

= = Stationary

Research Ethics: Real Names are listed with the permission of individual respondents.

5.2.1 Drought

Drought is one of the natural disasters. Almost all respondents mentioned some personal experiences on this. People feel that they have been affected with drought especially during last five years. People said drought normally appears during the month of *Chaitra-Baisakha* (April to May) and in case of no rainfall, the duration of drought gets prolonged. Apart from immediate crops loss drought has long term implications for deterioration of soil quality, decrease vegetation and dry water resources.

People mentioned that it is very difficult to cultivate maize crop if the drought gets prolonged. Erratic precipitation during rainy season or no rainfall in the winter has made the soil dryer. An inhabitant of Sakindhara (Hansapur-6) said “maize is nature dependent crop, if no rainfall it is very difficult to cultivate maize crop, we have no paddy field, maize is our life, if any delay or decline in maize crop we will get starvation.’’

5.2.2 Strom

Strom is one of the climatic change indicators and it is main natural disaster in the village. People mentioned that storm is not new disaster for them; according to respondents frequency of storm has increased, a farmer said “generally storm affects during *Chaitra-Baisakha*, but nowadays it appears earlier and gets prolonged. It appears in erratic forms”. People said that they are compelled to loss huge quantity of property due to such disaster.

5.2.3 Less Rainfall

People have said that total rainfall period is declining day to day. In the past the rainy seasons would start in the month of June and during this time heavy rainfall is occured. Precipitation would occur in the beginning

of *Asar* (June) and continue to *Vadra* (September). At that time many springs were appeared and ponds were full with water. Nowadays ponds are empty and many monsoon springs have been dried.

5.2.4 Hailstorm

Generally hailstorm occurs during the month of March and April. The rural people could forecast the coming of storm with hailstorm after seeing the black dark sky in the west and heavy wind blow. People mentioned that hailstorm destroys crops, flower of fruits, livestock, small trees and damage house roofs. Some birds are harmed when storm with hailstorm occur and blow. Informants said that today hailstorm does fall but not such as in the past. Respondents mentioned that hailstorm occurred erratically even during *sauna* (July).

CHAPTER: SIX

IMPACT ON AGRICULTURE AND WATER RESOURCE

6.1 Impact on Agriculture

The recent trend of climate change has emerged with adverse impact on agriculture sector. Less rainfall and prolonged drought already turned the agro land into barren. If the amount of fertile agro-lands decrease developing country like Nepal will face food insecurity due to less production in future. According to the FAO, if temperature rises by 2.5^{o}c about 45 to 75 million people will go hungry.

According to IPCC current decade is the warmest decade in last 10,000 years and poor developed countries are the critical vulnerable areas due to temperature rise and increasing drought, which affect water resources adversely. Food and water insecurity are likely to increase because of the greater frequencies of droughts and floods which have direct impact on areas vulnerable to malnutrition. In the study area climate change induced disasters such as drought, hailstorm, storm, and less-rainfall have damaged the agro-crops, house, livestock, and infrastructure. The lives and livelihoods of the people is affected by climate change, thus the people are striving by coping with changes. However every year they count loss of properties due to natural disasters caused by climate change.

On the other hand there have been outbreaks of many diseases due to change in nature and this leads the rural people further vulnerable situation. Fever, cough, high fever, diarrhea and some other complex disease have seen today and these disease cause major impact on the lives of people. The impact of climate change in the villages is seen as loss of properties by natural disasters and adverse impact on agriculture, water

resources and health. In this study impacts on agriculture and water resources were observed.

In rural area agriculture is the riskiest enterprise to climate change. In the race between population and food supplies even minor fluctuations of climate over a few years could lead to widespread malnutrition and starvation. The principle climatic factors affecting agro crop production are temperature, length of growing season, moisture conditions, sunlight and wind. The influences of climate factors on crops are closely interrelation and each modified by the others.

In Hansapur, in terms of agriculture and food security people have identified changes in climate as being largely responsible for declining crop and livestock production. The climate induced disasters such as drought, hailstorm, storm, less rainfall and erratic rainfalls have damaged the agro crops. Largest population of the villages depend on subsistence farming, however there is no food sufficient year-round.

People mentioned that a new disease has appeared on their local species of maize and it was damaging the crop for the last three years. Leaves-burn disease has appeared on maize crop for three years. They mentioned last year even single maize was not harvested. Disease has destroyed their all maize crop. Respondents said after a during two month leaves start to burn and maize plant die. People mentioned that was a new disease on maize crop.

People mentioned that their crops especially maize, wheat, mustard have been victimized by long drought. They have never experienced such kind of drought comparison with last five years.

People said that on their maize crop new pest has seen which destroys maize-core. When maize starts to grow this pest destroys the core of maize. This pest has appeared as a new pest which destroys maize crops within a month of cultivation. Seen and unseen pests are affected to spring and monsoon vegetables frequently in villages. Especially core of cucumbers, gourds, and maize are victimized by such pests.

People mentioned that in the last five years they would cultivate mustard and wheat in huge quantities today due to lack of rain and attack by the pests there is declining of these products as large quantities. Informants said that they would cultivate cash crops such as tomato, potato, onions and garlic but due to lack of rainfall and damaged by natural disasters such as drought, hailstorm and storm, the cultivation of these crops is declining today in comparison with last five years. Wheat, mustard, millet products are also declining comparing with last five years. A farmer said "drought and less rainfall are declining to potato product. Potato yield is affected by dried disease, leaves are burn and plant is died."

Intensity of natural disasters such as drought, less rainfall, erratic rainfall, hailstorm, storm, seen or unseen pests are declining agro- products in large quantity in the villages. Increased temperature is creating various problems to traditional cultivation system. It has created various problem and harmed local variety of crops, and it seems very clearly increased temperature is becoming suitable for various pests.

6.2 Impact on Water Resources

In rural community water is not just physical natural resource. Water resource concerns with rural people as religious and spiritual resource. In rural community there are many songs, verses and myth linked with water

resource and of all the natural resources none is culturally or socially valuable than water for people.

Water availability at different times and places is a function of weather and climate. The restless atmosphere is the most active agent in the constant redistribution of water in the earth's surface. In the study area the seasonal changes in climate and subsequent water availability determining the calendar for sowing and harvesting agro crops and other livelihood activities such as herding, trade or house construction and cultural calendars for religious and other festivities.

In the study area there are three sources of water completely on the basis of use system of people, springs water resource, rainfall water resource and stream water resource. Stream water resource is used for irrigation purposes to paddy field; mostly rainfall water is used for sanitation and for drinking and spring water resource for drinking and for sanitation. People have less paddy fields comparing with *pakhabari* and local streams are enough to irrigate to paddy field. The paddy product in village is negligible. Some of local streams in the villages are *Hiun-Khola, Panchadhara Khola, Bhuskata Khhola*, *Ponjing Khola* and all streams have little basin.

People have little paddy fields which completely depend on monsoon rainfall. People mentioned that in the village monsoon dependent paddy field have been transformed into *pakhabhari* due to long drought and erratic rainfall during last five years.

People have not water security over villages; there is more or less water crisis. People have faced drinking water problem more than other water-use purpose. Elderly people of village mentioned that many seasonal springs have dried up.

People said that there were many traditional ponds in the villages, and today are seen as empty. People said these ponds have long history, were built by their grandfather and used to be full of water. These ponds were built for rural cattle, after grazing cattle used to drink those ponds water. Now almost ponds have seen empty due to less rainfall and drought. People have been compelled to reduce number of livestock because of scarcity of water for livestock.

According to the rural farmers quality of water in local stream has deteriorated and quantity of water is decreasing due to long drought and less rainfall. People argue that if such problems continue all local streams may dry in the near future and people would face many stresses.

Climatic impacts on water resource and agriculture are interlinked. Large amount of water resources are used for agro-crops especially for irrigation purposes. Most direct impact of climate change seems on water resources and other adverse impacts have been occurred through impacts of water resources. This means declining of water resource means declining in agro products and agro production declining means directly impacts on livestock. It is an issue of human survival. Impact on water resources is linked directly or indirectly with malnutrition and public health.

In study area, especially local agro-seeds are victimized by climate change. People have monoculture, which practice has not seen suitable for environmental change. People mentioned that hybrid seeds are not victimized by burn disease where it was practiced. Especially domestic vegetable are victimized by such changes. People said that wild potatoes are not victimized by such disease. Climate change has created transition

to monoculture and autonomously people have been intended towards adaptation process. Some explored local intervention and initiatives to cope with uncertainties are included in chapter seven.

CHAPTER : SEVEN

ADAPTATION STRATEGIES AND CONSTRAINTS IN RESILIENT PATHWAYS

7.1 Adaptation Strategies

In general adaptation is moving toward resilient pathways. According to UNFCCC adaptation is adjustment in natural or human systems in response to actual or expected climate stimuli or their effects, which moderates harm or exploits beneficial opportunities, and according to IPCC adaptive capacity is intimately connected to social and economic development, but it is not evenly distributed across and within societies.

The available scientific evidence suggests that climate change will place significant stress on the rural livelihood of developing countries. Spontaneously rural people are striving to uphold their livelihood by adapting with changes. Livelihood comprises the capabilities, assets (material and social resources) and activities, required for means of living and sustainable livelihood includes the idea of coping with and recovering from stresses and shocks and maintaining or enhancing existing capabilities and assets (Carney, 1998). Climate change may new issue for local people; they have long history of adapting to uncertainties to other related and unrelated environmental changes and to ecological surprises whether through mobility of people and land uses of flexibility in livelihood strategies and institutional arrangements (ICIMOD, 2000). In the study area people have already faced poor health, lack of adequate shelter, food insecurity and water crisis.

One of the main objectives of the study is to seek rural people's adaptation strategies to cope with climatic change and climate change

induced disasters. In the study area the rural communities are adopting some strategies to cope with climatic changes and its uncertainties. Income diversification has emerged as a central adaptation strategy in the village. People with diverse income source have appeared more resilient than those with fewer income sources. Some local intervention and initiatives in resilient path are explored as following:

7.1.1 Commercialization of Local Products

The communities are attracting towards cash crops from subsistence farming. They have commercialized local product such as fruits, livestock product, local medicinal-herbs etc. In village people produce huge quantities of orange fruit to sell and they have formulated orange product groups for uniting rural orange fruit. People are commercialized cardamom and their local product *siltimur* (medicinal herbs) in recent time which process has diversified rural income source and people have become more resilient.

7.1.2 Social Network

Social networks in rural area play crucial role to climate change adaptation. According to Ensor and Berger social networks are the glue between many of the elements of adaptation. They draw attention to the relationship between actors and can be visualized as a web of connection that link diverse individuals and institutions either directly or via other actor (Ensor and Berger, 2009:27).

In villages there are different ethnic and caste groups with a majority of *Magar* ethnic group. People live harmoniously in the community. Communities are tied by social relationship that crosses caste and ethnic groups. People are organized into informal groups such as youth clubs, mother groups, and farmer groups and with other social institutions.

Support from such agricultural groups and social institutions are inadequate to climate change adaptation, however these networks provide sympathy, loan and help to make resilient way.

Farmer group are uniting rural agro producer and rural product. In village, there is hybrid seed centre of maize formulated by local farmer. Last year maize crop was damaged by leaf-burn disease. People mentioned that maize seed has high drought tolerance; leaves of hybrid maize are not burned in this year where it was cultivated. Farmers said that it was not victimized by disease and pests. Farmers have actively involved in agricultural group and these groups are creating platform to unite local productions. Table 4 shows involvement of respondents in agricultural and livestock group.

Table 4: Respondents Involved Agricultural and Animal Husbandry Groups

S.N.	Name	Location	Established Date	Female Members	Male Members	Total Members
1	Hariyali Multipurpose Farming Group	Hansapur-3	2062/8/1	5	16	21
2	Hilly Fruit Business Group	Hansapur-2	2062/6/10	9	16	25
3	Malarani Women Farming Group	Hansapur-6	2063/4/29	19	-	19
4	Jagriti Women Farming Group	Hansapur-8	2063/3/26	20	-	20
5	Cooperative Women Farming Group	Hansapur-9	2063/9/4	30	-	30
6	Cooperative Farming Group	Hansapur-3	2064/2/5	18	-	18
7	Fruit Development Farming Group	Hansapur-6	2064/12/16	14	11	25
8	Progressive Goat Husbandry Group	Hansapur-9	2066/9/6	20	-	20
9	Cooperative Goat Husbandry Group	Hansapur-9	2063/9/4	32	-	32

Source: Field Survey, 2011.

Informants said that there are twenty three farmer groups and four animal husbandry groups in their village. These groups concern with local

product, seed selection of crops, local vegetable, and fruit and livestock management. Group representative consult with agro-technician and apply knowledge in their area.

7.1.3 Manpower Utilization

Remittance is largest income source of people over village. The majority of people in the villages have no sufficient food more than six months. Rural youth people have seen busy in income source such as moving urban areas and moving out of country. Transportation has mobilized rural people for alternative source of income. Majority of youth force in the village are holding job in Arab and Qatar. Some youth are busy in urban construction and India to seek job. Nowadays in the villages off-farm activities have increased. Government job comprises little manpower in the villages. Women also have been actively involved toward off-farm activities. They are actively engaging in co-operative groups, mother group and other social groups. Utilization of manpower has seen very supportive way to climate change adaptation in village.

7.1.4 Storage of Rainy Water

People have made cement vessels to store rainy water with a capacity of thousand liters. Especially where water problem is larger, people have made such kind of water storage to reduce water induced shocks. Household have made two vessels with a capacity of two thousand liters. It is good strategy to cope with water shortage shocks. Storage water is used for drinking, sanitation and for livestock.

7.1.5 Traditional Beliefs

Traditional beliefs, social norms and values seem pro-adaptive to climate change in the communities. Traditional belief system is seen environment

friendly. I have explored some traditional beliefs which were environment friendly and pro-adaptive to climate change. People worship *pipala* trees and they have strong belief those three trees *bara*, *pipala* and *sami* are symbol of god. In community there is strong social norm that cutting more tree is bad sign, who cut more tree, he/she would die sooner and his/her generation would be no longer. Who plants more trees, those futures would be bright. People value to forest and water resources religiously and spiritually. In this community who makes more pond, plants more trees, gains high social prestige.

7.2 Constraints in Resilient Pathways

Above mentioned adaptive strategies were not followed by communities directly for climate change resilience. Above mentioned process were not directly adopted to adapt with climate change induced shocks and uncertainties. The following explored elements depict constraints in resilient pathways of people.

7.2.1 Unsupportive Government-Bodies

Rural lay people have been neglected by government bureaucracy which hinder directly or indirectly to climate change resilience. People mentioned that public administration was not supportive and cooperative. They have complained with office of village development committee which was not pro-people oriented. They are compelled to waste their important time due to negligence of public administration, and that is hindering people's resilience way to climate change.

7.2.2 Socially Constructed Restrictions

Some socially constructed restrictions have seen as constraints to climate resilience in communities. Traditionally determined occupations are

hindering to diversify income source. There are many socio-cultural and religious taboos, those directly or indirectly hinder to climate change resilience, there is restricted to Brahmin and Chhetri in tailoring work. Magar ethnic group are defined as a 'liquor' makers. Socially women have been restricted in some social work. Culturally determined occupation and restriction have seen directly or indirectly as constrains to climate change adaptation. Nowadays these social taboos are in transition.

7.2.3 Inaccessible Infrastructures of Development

Infrastructure of development includes education, transportation, health, drinking water, communication and electricity. Some people have not transportation facility yet. Sakindhara (Hansapur-6) is famous for orange production; nevertheless due to lack of motor-road the village could not be advantaged properly from orange production.

People have no electricity yet. Almost people have mobile phone but due to lack of mobile tower, mobile phone could not work properly. Among villagers there is no a campus yet. Motor road could not advantage to all people. Majority of people still depend on *dhami/jhakri* (traditional doctor) for treatment. Such poor development infrastructure are hindering to climate change resilience.

7.2.4 Local Topographical Factors

In the study area almost land and landscape is very slope. Somewhere the land is very rocky and somewhere it is very fragile. It seems very difficult to construct road and to continue with sustainable. Hansapur have rugged geo-physical condition, if long drought continues, there many problems appear and if long and heavy rainfall, landslide and flash flood damage properties. Eensor and Burger (2009) suggest that it is impossible to

isolate the local topographical factors, weak geological structures, steep slopes and socio-economic activities such as reforestation, faulty agricultural practices and weak institutional arrangement for land management for climate change adaptations activities from the need for improved natural resource management and disaster prevention work.

7.2.5 Unfamiliar with Induced Adaptation Strategies

Selection of appropriate seeds and verities determine the success of harvests. It was a challenge for farmers to identify the best variety and quality seeds in the market. Adaptation requires a continual process of reviewing livelihood strategies and environmental changes and experimenting on a regular basis with new crops. Agricultural adaptation include adjustments in planning and harvesting dates, change in tillage practices, crop varieties, species and rotations, fertilizer, herbicide and pesticide application, improvements in irrigating efficiency and instillation of new irrigation facilities (Parry and carter, 1990, Reilly 1996 in O'Neil, MacKellar and Lutz, 2007). Farmers are unfamiliar with induced adaptation strategies, which is directly hindering in resilient pathways.

CHAPTER: EIGHT

CONCLUSION AND RECOMENDATION

It is clear that among many global social problems climate change is serious global social problem which is threaten to mankind and hindering the world to make better. Anthropological research has turned increasingly toward such global social problem to make the world better. Obviously poor rural lay people who cannot afford fossil fuel are not responsible for climate change, being the active part of the ecosystem they are considered as real founder of climate change and first encounter the adverse effect of climate change. Climate is not major cause of poverty, hunger, malnutrition, poor sanitation and the like for rural people, it has magnified such problems.

The impacts of climate change differ with altitude (Ensor, Burger and Bhandari, 2008) and its leading impacts are occurred in high altitude comparing with low attitude, means climate change is less visible in Terai and hilly area comparing with high mountainous area. Nonetheless hilly rural farmers are perceived it and spontaneously they are developed adaptive strategies to cope with adverse impacts of climate change.

The study is conducted through anthropological perspective. Rural people and culture were primary concern of the study. The main objective of the study was to explore rural perception on climate change and to identify the impacts of it on agriculture and water resources. The study is examined adaptation strategies adopted by people to climate change resilience and its constraints in rural context.

The hilly rural people were selected to study. Subsistence agriculture was the main source of livelihood of the people. Climate related disasters such as drought, less rainfall, increased temperature, hailstorm and storm are

declining agro products. Drought and less rainfall have been caused of depleting water resources which directly or indirectly affects agro-crops, livestock and people's health.

The rural people have perceived to climate change as disturbances of their close relationship with nature. People are unfamiliar with the term 'climate change' or *jalavayu paribartana,* but they have felt that seasons are changing comparing with past and their knowledge reliability is declining. They have known drought duration, less rainfall, erratic rainfall and other natural disasters were occurring in different ways. People have adopted spontaneous ways to respond such changes.

Livelihood diversification and social networks were central adaptation strategies of rural people to cope with climatic uncertainties. Some adopted strategies of people to climate induced shocks were: diversification of income sources, commercialization of local products, and formulation of agricultural groups. They are facing some constraints in their resilient path such as unsupportive government-bodies, socially constructed restrictions, inaccessible infrastructures of development and rugged geo-physical condition.

It is real that climate change is largely depleting natural resource in rural community. Hardin's much cited article (1968) 'The Tragedy of the Commons' was described the degradation of shared resource under conditions of uncontrolled access. The article was limit in citation than reality. But climate change may real cause of 'tragedy of commons'. Toxic weeds are covering forest and grazing land in rural area, long drought and less rainfall are depleting water resources, fertility of land and quality of soil is decreasing. Rural farmers are compelled to use chemical fertilizers which reduce quality of soil and it is also cause of

reduction of carrying capacity of earth. So though, it is correct to say that if continuous such process ‘tragedy of commons’ is certain.

The spontaneous adaptation strategies adopted by rural communities are not sufficient to climate change resilience. But rural intervention and initiatives may blue print to planned adaptation for climate change. Public policy should address socio-cultural resilience and vulnerability. Implementation of public policy is necessary to climate change adaptation. Government bodies need to be supportive and cooperative for rural people. Policy maker need to consider climate change issue holistically, not just carbon reduction one. Rural communities responses need to consider continuously in the assessment of climate change and need to promote awareness to adapt with their changing environment and to develop alternative livelihoods.

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REFERENCES

Ban, K. M. (2007); Address to High Level Event on Climate Change *http://www.un.org/webcast/climatechange/highlevel/2007.*

Bohren, L. (2009); "Car Culture and Decision Making: Choice and Climate Change", In S.A. Crate and M. Nuttal, eds., *Anthropology and Climate Change; From Encounters to Action*, Walnut Creek Calif; Left Coast Press.

CBS, (2001); *Population Monograph of Nepal*, Central Bureau of Statistics, Kathmandu, Nepal.

CBS, (2006); *Environments Monograph of Nepal*, Central Bureau of Statistics, Kathmandu, Nepal.

CBS, (2010); *District Profiles* Central Bureau of Statistic, Kathmandu, Nepal.

Crate, S. A. and Mark Nuttal (2009) eds.; *Introduction*: *Anthropology and Climate Change* 9-36, Walnut Creek Calif; Left Coast Press.

Crate, S.A. (2006); Elder Knowledge and Sustainable Livelihood in Post Soviet Russia: Finding Dialogue across the Generations, *Arctic Anthropology* Vol. 43, 40-51.

Crate, S.A. (2008); Gone the Bull of Winter? Grappling with the Cultural Implications of and Anthropology's Role in Global Climate Change, *Current Anthropology* 49(4), 569-595.

Crate, S.A. (2009); Gone the Bull of Winter? Contemplating Climate Changes Cultural Implications in Northern Siberia, Russia, In S.A. Crate and M. Nuttal, eds., *Anthropology and Climate Change;*

From Encounters to Action 139-152, Walnut Creek Calif; Left Coast Press.

Critchfield, H. J. (2010); *General Climatology*, Fourth Edition, PHL learning Pvt. Ltd., New Delhi.

D., Carney; (1998) eds.; *Sustainable Rural Livelihood*, London, DFID.

DHM, (2010); *The Monthly Average Precipitation and Temperature Records of Khanchikot, Arghakhanchi (1985-2009) and the Monthly Average Precipitation Records of Sitapur, Arghakhanchi* (2001-2009), Department of Hydrology/Meteorology, Kathmandu, Nepal.

Douglas, M., D. Gasper, S. Nay & M. Thomson (1998); Human Needs and Wants, In S. Rayner and E.L. Malone, eds., *Human Choice and Climate Change: Societal framework Vol*. 1, 195-263, Battelle, Columbus.

Ellis, F.(1998)*; Rural Livelihoods and Diversity in Developing Countries*, Oxford Press.

Ensor, J. and R. Berger (2009); *Understanding Climate Change Adaptation*, Practical Action Publishing Ltd, UK.

Frick, T.E. (1993); *Tamangs Demography and Domestic Processes*, Book Faith India.

GON, (2011); *Climate Change Policy* 2011, Ministry of Environment, Kathmandu.

Hardin, G. (1968); *The Tragedy of the Commons, Science* 162, 1243-1248.

Hassan, F.A. (2009); "Human Agency, Climate Change and Culture: An Anthropological Perspective", In S.A. Crate and M. Nuttal, eds., *Anthropology and Climate Change; From Encounters to Action*, Walnut Creek Calif; Left Coast Press.

Hitchcock, R.K. (2009); From Local to Global: Perceptions and Realities of Environmental Changes Among Kalahari San, in S.A. Crate & M. Nuttal, eds., *Anthropology and Climate Change: From Encounters to Action*, 250-261, Walnut Creek Calif; Left Coast Press.

ICIMOD, (2000); *A Strategy for Climate Change Adaptation in the Himalayas*, International Centre for Integrated Mountain Development, Kathmandu, Nepal.

ICIMOD, (2009); *Local Responses to Too much and Too little water in the Greater Himalayan Region*, International Centre for Integrated Mountain Development, Kathmandu, Nepal.

IPCC, (2001); Climate Change Impacts, Adaptation and Vulnerability, A contribution of Working Group II to *The Third Assessment Report of the Intergovernmental Panel on Climate Change*, J.J. McCarthy, eds. Cambridge University Press.

IPCC, (2007); *Synthesis Report*, Contributions of Working group I,II and Third to the Forth Assessment Report of the Intergovernmental Panel on Climate Change, Core Writing Team, Pachauri, T.K. and A. Reisinger, eds., IPPC Geneva, Switzerland.

MOE, (2010); *National Adaptation Programme of Action to Climate Change*, Kathmandu, Nepal.

NCVST, (2009); *Vulnerability through the Eyes of Vulnerable*: *Climate Change Induced Uncertainties and Nepal's Predicaments*, Institute for Social and Environment Transition, Nepal (ISET-N Kathmandu) and Institute for Social and environmental Transition (ISET, Boulder, Colorado), for Nepal Climate Vulnerability Study Team (NCVST), Kathmandu.

Nuttal, M. (2009); Living in a World of Movement; Human Resilience to Environmental Instability in Greenland, in S. A. Crate and M. Nuttal, eds., *Anthropology and Climate Change: From Encounters to Action* (292-310) Walnut Creek Calif; Left Coast Press.

O'Neil B., F. Mackellor and W. Lutz (2001); *Population and Climate Change*, Cambridge University Press, The Press Syndicate of the University of Cambridge.

Orlove, B. (2005); Human Adaptation to Climate Change: A Review of Three Historical Cases and Some General Perspectives, *Environmental Science and Policy,* Vol. 8, 589-600.

Pahl, G. (2001); *Saving the Environment*, Alpha Books.

Practical Action, (2009); *Temporal and Spatial Variability of Climate Change over Nepal* (1976-2005), Practical Action, Kathmandu.

Rai, S.C. and A. Gurung (2005); Raising Awareness of the Impacts of Climate Change, *Mountain Research and Development*, Vol. 25, 316-320.

Rancoli, C, T. Grane and B. Orlove (2009); Fielding Climate Change in Cultural Anthropology, in S.A. Crate & M. Nuttal, eds., *Anthropology and Climate Change: From Encounters to Action* 70-115, Walnut Creek Calif; Left Coast Press.

Rancoli, C. (2006); Ethnographic and Participatory Approaches to Research on Farmers Responses the Climate Predicting, *Climate Research,* Vol. 33, 81-99.

Rancoli, C., K. Ingram and P. Kirshen (2001); The Costs and Risks of Coping with Drought Livelihood Impacts and Farmer's Responses in Burkina Faso, *Climate Research*, Vol. 19, 119-132.

Rayner, S. and E.L. Malone (1998) eds.; *Human Choice and Climate Change, Societal Framework, Vol. 1*, xiii-xxvi, Battelle Columbus.

Rayner, S. and E.L. Malone (1998); *Ten Suggestions for Policymaker, Guidelines from an International Social Science Assessment of Human Choice and Climate Change,* Battelle, Columbus.

Regmi, B.R. and A. Adhikari (2007a): Climate Risk and Vulnerability in Nepal: Country Case Study Nepal, Human Development Report 2007/08, Fighting Climate Change: Human Solidarity in a Divided World, *Human Development Report, Office Occasional Paper.*

Regmi, B.R. and A. Ahdikari (2007b); Climate Change and Human Development: Risk and Vulnerability in Warming World, Country Case Study Nepal, Human Development Report, UNDP, Kathmandu.

Roy, I.B. (2003); *Anthropology: The Study of Man,* S. Chand and Company Limited, New Delhi, India.

Shrestha, A.B., C.P. Wake, P.A Mayeski and J.E. Dib (1999); Maximum Temperature Trend in Himalayas and its Vicinity: An Analysis Based on Temperature Records from Nepal for the Period of 1971-1994, *International Journal of Climatology*, 12, 2775-2787.

Shrestha, A.B., C.P. Wake, P.A. Mayeski and J.E. Dib (2000); Precipitation Fluctuation in the Nepal Himalayas and its Vicinity and Relationship with some large-scale Climatological parameter, *International Journal of Climatology* 20, 317-327.

Shrivastava, A.K. (2007); *Global Warming*, APH Publishing Corporation, SB Nangia.

The Economist, (2010); Climate change 9-10, Farms and Forest 44, January 2nd -8th , V. 394, Economist Newspaper Ltd.

Thomson, M. and S. Rayner (1998); Cultural Discourse, in S. Raynar and E.L. Malone, eds., *Human Choice and Climate Change, Societal Frame work Vol., 1*, 265-343, Battelle, Columbus.

UNDP, (2007); Human Development Report 2007/2008, Fighting Climate Change: Human Solidarity in a Divided World, United Nations Development Program, New York. *http://hdr.undp.org/en/reports/reports/global/hdr2007-8.*

UNEP, (2008); *An Overview of our Changing Environment, Division of Early Warning and Assessment*, (DEWA), United Nations Environment Program.

Vedwan, N. (2006); Culture, Climate and Environment: Local Knowledge and Perception of Climate Change Among the Apple

Growers of North Western India, *Journal of Ecological Anthropology*, Vol. 10:4-17.

Vedwan, N. and R.E. Rhoades (2001); Climate Change in the Western Himalayas of India; A Study of Local Perception and Responses, *Climate Research*, Vol., 9:109-117.

ANNEX 1: HOUSEHOLD SURVEY FORM

Form No. : …….. Name of Respondent: ……. Age ……..

District: …… VDC …….. Village …….

Household Size …….. Sex …….

Caste group ……. Religion ……

1. Education ……..

   (Code: Literate - 1, Illiterate - 2, Higher education - 3)

2. Occupation ……..

   (Code: Farming - 1, Service - 2, Wage labor - 3, other - 4)

3. Types of house

   (Code: Thatched - 1, Concrete - 2, Other - 3)

4. Main income source:

   (Code: Agriculture - 1, Remittance - 2, Service - 3, Other - 4)

5. Types of Toilet:

   (Code: Sanitary - 1, Kachcha - 2, Open field - 3)

6. Sources of fuel materials in your family:

   (Code: Dry wood - 1, Clean energy - 2)

7. Sources of drinking water:

   (Code: Spring - 1, Tap - 2, Well - 3, Other - 4)

8. Food sufficiency:

(Code: > 6 Month - 1, Round year 2, enough to sell - 3)

9. How many seasons do you observe locally?

(Code: 3 - 1, 4 - 2, 6 - 3)

10. Do you consider cycle of seasons is changing?

(Code: Yes - 1, No - 2, Cannot mention - 3)

11. If yes, please note in brief why seasons are changing.

12. Please fill following tables from your experiences during last ten years;

Climatic Parameters	Increased	Decreased	Stationary	Cannot mention
Rainfall				
Temperature				
Frost				
Mist				
Dew				

(Code: Increased - 1, Decreased - 2, Stationary - 3, Cannot mention - 4)

Natural Disasters	Effects of disasters			Cannot Mention
	Increased	Decreased	Stationary	
Landslide				
Strom				
Hailstorm				
Drought				
Flash floods				

(Code: Increased - 1, Decreased - 2, Stationary - 3, Cannot mention - 4)

13. Do you know about climate change?

    (Code: Yes - 1, No - 2)

14. Source of climate change knowledge:

    (Code: Radio - 1, Television - 2, Newspaper - 3, Other - 4)

15. Why do you consider that climate is changing and whom do you consider are responsible for such change?

    (Please Note in Brief)

16. Are you participated climate change mitigation/adaptation training?

    (Code: Yes - 1, No - 2)

17. If yes, which organizations/institutions provided?

    (Please Name of organizations/institutions)

18. Which natural disasters do you consider as threat for your locality?

    (Code: Less rainfall = 1, Drought - 2, Hailstorm - 3, Strom - 4, Landslide - 5, Flash Foods - 6, other - 7)

19. Which disasters do you consider are destroying agricultural system, live, and livelihood of your locality?

    (Code: Less rainfall = 1, Drought - 2, Hailstorm - 3, Strom - 4, Landslide - 5, Flash Foods - 6, other - 7)

20. Are any agricultural crops destroyed due to natural disasters during last five years?

    (Code: Yes - 1, No - 2)

21. If yes, reason for damage?

    (Code: Less rainfall = 1, Drought - 2, Hailstorm - 3, Strom - 4, Landslide - 5, Flash Foods - 6, other - 7)

22. Number of livestock damaged due to natural disasters during last five years?

    (Code: Yes - 1, No - 2)

23. If yes state the reasons for livestock damage?

    (Code: Less rainfall = 1, Drought - 2, Hailstorm - 3, Strom - 4, Landslide - 5, Flash Foods - 6, other - 7)

24. Do you consider that cultivation period is decreasing due to natural disasters?

    (Code: Yes - 1, No - 2, Cannot mention - 3)

25. Do you consider that farmers are not encouraged in cultivating a variety of crops due to natural disasters?

    (Code: Yes - 1, No - 2, Cannot mention - 3)

26. Do you consider that disasters are occurred in different ways comparatively with past?

    Code: Yes - 1, No - 2, Cannot mention - 3)

27. To reduce disaster influence for people whom issues need to given emphasize as a important and why?

    (Please Note in Brief)

28. How your knowledge and experiences can be use by government and other agency to reduce risk of disasters?

    (Please Note in Brief)

29. What are the important issues do you consider to mitigate risk of natural disasters in your community?

    (Please Note in Brief)

30. Are you involved in any agricultural groups?

    (Code: Yes - 1, No - 2)

31. In what ways are agricultural groups advantaged in your live and livelihood?

    (Please Note in Brief)

32. Please note in brief of water availability on your locality comparing with last ten year.

ANNEX II: GENERAL OVERVIEW OF RESPONDENTS

S.N.	Respondents	Age	Sex	Education	Occupation	Food sufficiency	Caste/ Ethnic-group
1	Basanta Regmi	56	Male	Literate	Farming	6-12 months	Brahmin
2	Bhojendra Thapa Magar	66	Male	Illiterate	Farming	< 6 months	Magar
3	Dal Bdr. Pun	67	Male	Literate	Farming	< 6 months	Magar
4	Durga Sunar	75	Male	Illiterate	Farming	6-12 months	Dalit
5	Gayatri Adhikari	63	Female	Illiterate	Farming	>12 months	Brahmin
6	Jit Bdr. Thapa	83	Male	Illiterate	Farming	<6 months	Chhetri
7	Kamala Panthi	43	Female	Higher	Teaching	6-12 months	Brahmin
8	Kumar Khadka	43	Male	Higher	Service	6-12 months	Chhetri
9	Manamaya Pariyar	66	Female	Literate	Farming	<6 months	Dalit
10	Masine Kami	78	Male	Illiterate	Farming	<6 months	Dalit
11	Prem Pande	71	Male	Illiterate	Farming	<6 months	Brahmin
12	Prem Pun	64	Male	Literate	Farming	<6 months	Magar
13	Purna Nepali	65	Male	Literate	Business	6-12 months	Dalit
14	Rabin Gharti	72	Male	Illiterate	Farming	<6 months	Magar
15	Sarada Khatri	50	Female	Literate	Business	>12 months	Chhetri
16	Som Bdr. Chhetri	89	Male	Illiterate	Farming	<6 months	Chhetri
17	Thakur Pr. Pokhrel	56	Male	Higher	Teaching	6-12 months	Brahmin
18	Til Bdr. Rana	48	Male	Literate	Teaching	6-12 months	Magar

Source: Field Survey, 2011

Research Ethics: Real Names are listed with individual permission of respondents.

ANNEX III: RAINFALL DATA OF KHANCHIKOT STATION, ARGHAKHANCHI

Latitude (deg/min): 2756

Longitude (deg/min): 8309

Elevation (m): 1760

(Rainfall in Millimeter)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	0.0	82.4	149.3	17.1	182.7	186.7	516.4	317.9	218.8	25.3	0.0	20.4
1991	45.3	20.8	34.3	28.1	44.0	392.1	112.4	552.2	212.7	0.0	6.3	68.2
1992	20.7	27.4	0.0	94.9	84.2	197.1	332.8	370.9	87.9	128.6	11.2	11.0
1993	10.2	13.1	6.7	42.1	97.9	261.2	362.9	576.8	627.6	0.0	0.1	0.0
1994	21.9	53.8	7.5	26.9	101.5	405.5	286.8	380.5	152.7	0.0	0.0	0.0
1995	61.6	38.6	71.2	0.0	75.0	390.5	444.1	246.1	165.2	2.9	157.7	6.8
1996	71.2	190.9	0.5	57.2	6.4	359.7	659.0	697.0	219.5	156.3	0.0	0.0
1997	29.3	3.9	16.0	89.7	138.3	256.6	577.7	308.5	113.6	103.36	45.2	190.7
1998	9.5	21.6	69.4	27.8	136.0	432.2	875.0	529.0	90.7	112.9	23.0	0.2
1999	13.7	3.1	6.8	6.8	DNA	238.2	393.4	464.9	144.5	78.2	0.0	12.5
2000	9.5	43.8	35.1	61.6	125.2	456.3	394.0	438.2	356.3	0.0	0.0	0.0
2001	0.0	21.0	6.3	75.9	175.2	458.4	392.6	366.9	279.2	18.6	4.3	0.0
2002	60.9	60.6	47.4	23.4	39.3	148.8	144.1	270.3	190.5	0.0	15.1	0.0
2003	51.4	90.6	91.9	30.7	60.7	238.1	612.9	465.8	243.2	46.2	0.0	24.2
2004	26.8	0.0	0.0	84.2	157.0	237.4	343.2	170.6	127.6	29.3	0.0	0.0
2005	61.9	26.1	61.8	14.8	26.8	156.5	725.2	498.1	103.2	115.2	0.0	0.0
2006	0.0	0.2	61.5	70.0	106.6	292.7	336.2	228.5	102.2	10.9	0.0	28.5
2007	0.0	125.1	57.9	28.4	104.4	92.4	714.3	433.2	451.5	31.3	0.0	2.1
2008	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
2009	0.0	18.7	8.2	6.2	128.5	138.8	387.2	526.8	108.9	249.0	3.7	6.2

Source: DHM, 2010.

ANNEX IV: RAINFALL DATA OF SITAPUR STATION, ARGHAKHANCHI

Latitude (deg/min): 2754

Longitude (deg/min): 8309

Elevation (m): 1201

(Rainfall in Millimeter)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	0.0	11.5	8.7	23.0	159.5	584.8	639.7	432.2	305.7	83.0	0.0	0.0
2002	72.1	55.0	36.5	25.7	142.1	239.9	313.2	309.2	348.2	5.9	5.1	39.0
2003	24.9	48.2	60.1	47.7	68.0	71.4	563.1	715.7	561.8	164.8	28.3	0.0
2004	39.5	0.0	2.0	131.9	229.5	359.4	644.0	364.6	93.4	9.0	0.0	0.0
2005	0.0	70.6	34.4	24.5	20.5	78.9	594.4	736.5	265.8	149.0	107.5	0.0
2006	0.0	0.0	0.0	106.5	261.4	636.4	368.9	47.5	235.9	46.5	8.8	27.5
2007	0.0	36.6	159.0	2.5	115.0	163.5	DNA	DNA	371.5	374.5	0.0	0.0
2008	0.0	0.0	0.0	200.0	104.9	571.7	722.0	531.1	516.7	73.0	DNA	DNA
2009	0.0	6.5	5.0	1.0	194.5	173.0	561.5	541.3	163.0	186.5	0.0	DNA

Source: DHM, 2010.