IMPACT OF CLIMATE CHANGE ON SOCIO -ECONOMIC CONDITION OF TSUM VALLEY PEOPLE, CENTRAL HILL, GORKHA, NEPAL

A THESIS

Submitted in Partial Fulfillment of the Requirement for the Degree of

DOCTOR OF PHILOSOPHY IN ECONOMICS

By

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December, 2014

CERTIFICATE TO ACCOMPANY THE THESIS

It is certified that

Thesis entitled *Impact of Climate Change on Socio-Economic condition of Tsum valley People Centre Hill Gorkha Nepal* Submitted by *Chet Kumari Gurung* is an original piece of research work carried out by the candidate under my supervision. Literary presentation is satisfactory and the thesis is in a form suitable for publication.

Work evinces the capacity of the candidate for critical examination and independent judgment.

. ……..

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I understand that my thesis will become part of the permanent collection of Singhania University. My signature below authorized release of my thesis to any reader upon request for scholarly purpose.

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Chet Kumari Gurung, Degree Candidate

ABSTRACT

The main objective of this research is to assess and further explore decision-support tools in the context of adaptation to climate change in rural mountain people's livelihood. People's experience has been described in this study with the help of different research tool such as observation, Interview, Focus Group discussion, and PRA (historical time line). Mixed method has been used where as more qualitative than quantitative. It is comparatively analysis based on 20 years past experience and the present scenario. In the research hundreds participants have been selected seventy were men and thirty were women by the use of purposive sampling.

The findings of research are:

- Snow melting and river shrunken
- Change in Rain and Snow Fall pattern
- Change in cycle of Seasons
- Bio -Diversity has in Endanger
- New disease has been find in the crops
- Agricultural production has been decreased
- Increased in natural hazards(landslides, draught)

These findings shows the impact on Peoples' livelihood, Economic development, Bio diversity, Tourism development, Imbalance on ecosystem, Change in breeding, nesting time of birds and animals, Culture, Religion, and Customs. One of the focuses of the study was to find the adaptation practice for mitigation to climate change. Finally there is found some adaptation practices in the local level through a community. Such as traditional cropping system, System of pray to nature and people are involve to collect the medicinal herbal collection trade as for new income sources in the study area. In conclusion, it is suggested that responses to climate change impacts require plural institutions and that approaches must follow incremental solutions at local, regional and national scales for further research.

Abstract Approved by

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Degree Candidate Supervisor

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Chet Kumari Gurung

DECLARATION

I Chet Kumari Gurung, the undersigned, a PhD scholar at the Singhania University and the author of the thesis titled "Impact Of climate change on socio-economic condition of Tsum valley people Central Hill, Gorkha, Nepal" hereby solemnly declare that this thesis is an original work done and prepared by myself for a degree at this University. the work has not been previously formed as the basis for the award of any degree of similar title at this or any other University, the materials borrowed from others sources and included in my thesis have been properly acknowledged.

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CHET KUMARI GURUNG

Degree Candidate

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ACRONYMS AND ABBREVIATIONS

IPCC	:	Intergovernmental Panel on Climate Change
MoE	:	Ministry of Environment
UNDP	:	United Nation Development Program
HDI	:	Human Development Index
HDR	:	Human Development Index
GDP	:	Gross Domestic Production
CBS	:	Central Bureau Statistics
WWF	:	World Wildlife Fund
GoN	:	Government of Nepal
LI-BIRD	:	Local Initiatives for Biodiversity, Research and Development
COP	:	Conference of Parties
FIP	:	Forest Investment Program
SCF	:	Strategic Climate Fund
CIF	:	Climate Investment Fund
MDGs	:	Millennium Development Goals
GHG	:	Green House Gas
CO2	:	Carbon Dioxide
NCAR	:	National Center for Atmospheric Research
GCMs	:	Global Climate Models
BAU	:	Business-As-Usual
HDO	:	High Development Option
GNP	:	Gross National Production
NPC	:	Nepal Planning Commission
OECD	:	Organization for Economic Co-operation and Development
MOC	:	Meridional Overturning Circulation
UN	:	United Nations
HIV/AIDs	:	Human Indune Virus
NGO	:	Non Government Organization
CHT	:	Chittagong Hill Tracts
WB	:	World Bank

ADB	:	Asian Development Bank
TEAP	:	Tropical Forestry Action Programme
UNPFII	:	United Nation Permanent Forum on Indigenous Issue
CERD	:	Committee on the Elimination of Racial Discrimination
ACAP	:	The Annapurna Conservation Area Project
NTNC	:	National Trust for Nature Conservation
GEF	:	The Global Environment Facility
CCMF	:	Climate Change Mitigation Facility
PRSPs	:	Poverty Reduction Strategy Papers
OHCHR	:	High Commissioner for Human Rights
TK	:	Traditional Knowledge /Indigenous Technology
ETS	:	The European Union's Emissions Trading Scheme
UNFCCC	:	United Nation on Framework for Climate Change Conference
REDD	:	Reduced Emissions from Deforestation and Forest Degradation
TAAN	:	Trekking Agencies Association of Nepal
NTB	:	Nepal Tourism Board
NAPA	:	National Adaptation Programmes of Actions

CHAPTER I
INTRODUCTION

General background

Nepal is an under developed small Himalayan country located in South Asia between the well-known two big economically booming countries China and India. Geographically, the country is landlocked and lies on the 26°22'-30°27' north latitudes and 80°4'-88°12' east longitudes. It has the total area of 147181sq km carrying about thirty million populations. Population growth rate is 1.4 percent per year. Absolutely poverty rate is 25.16, per capita income US$ 642 (CBS, 2011). Human Development Index (HDI) of Nepal is 157th place in the world (UNDP, 2011) which was 144th and 138th place in 2009 and 2006 respectively showing negative trend over the years. The percentage of GDP generated from agricultural activities was 39 percent (Adhikari, 2011).

In total population 52 percent are women and 48 percent man. There are 35 different Languages and 59 ethnic groups. The official language is Nepali spoken throughout the country. Nepal's boarder line touches to China in north and East, West and South with India. As 70 percent of the developing world's 1.4 billion extremely poor people living in rural areas, key areas of concern are sub Saharan Africa and mountain people. Nepal, situated in South Asia, unfortunately is still in its traditional style in large parts of the country, particularly in hills. It is therefore truly said that poverty anywhere is threat to everywhere. The agricultural sector that contributes one-third to country's Gross Domestic Product (GDP) could not be modernized and commercialized yet. The industrial sector, that was expanded as the result of the reforms carried out after the first People's Movement, had contributed up to 9 percent in GDP in the FY 2000/01,which is now limited to 6 percent (Budget Speech of Fiscal Year 2014/15).

Climate change is currently taking place at an unprecedented rate and is projected to multifaceted the pressures on natural resources and the environment associated with rapid urbanization, industrialization, and economic development.

Using current climate change trends, by 2100, the average global temperature may rise by 1.4-5.80C (IPCC, 2001b; Wigley, 2005). As through much of its history, the earth's climate is changing. Right now, it is getting warmer. Most of the warming in recent decades is very likely the result of human activities (IPCC, 2007).As mentioned earlier, since Nepalese agricultural sector is highly dependent on the weather, climate change has serious consequences (Alan &, Regmi, 2005). Average rainfall is 1,500 mm, with rainfall increasing from west to east. The northwest corner has the least rainfall, situated as it is in the rain shadow of the Himalayas. Rainfall also varies by altitude areas over 3,000 mm experience a lot of drizzle, while heavy downpours are common below 2,000 m. There is also significantly greater warming at higher elevations in the northern part of the country than at lower elevations in the south. This finding is reinforced by observations by Liu and Chen (2000). Much of Nepal falls within the monsoon region, with regional climate variations largely being a function of altitude (USCSP, 1997).

The impacts are severe in several regions of the country. As many as 70 percent people in a part of Nepal and Indian Himalaya believe water sources are drying up, which could have direct impacts on agriculture, wilder biodiversity, ecosystem health, and daily water use in already water-scarce hills and mountains. People may experience yield loss in major staple crops. Change in floral composition is also inevitable due to change in water regime on ground. On the other hand, several life-threatening Glacial Lake of outburst (GLOF) are not far from reality (Ives, 1986; Bajracharya et al., 2007). Scientists have alerted that about 25 glacial lakes in Nepal are prone to outburst, which may cause massive damage on forests, agricultural lands, physical properties, and human lives as history shows. Scientists have linked this catastrophe with increased snow melting and glacial retreat resulting from increased temperature (Bajracharya et al., 2007).

Nearly half people among 250 from Darjeeling and Illam Himalayas have experienced an early flowering in selected species, which include rhododendron, magnolia, peach, pear, and marigold. The study found out food shortage, crop failure, loss of livestock, and water scarcity as the major shocks to the shifting cultivators,

which were highly influenced by the climatic hazards and their variability (Thapa et al, 2012).Temperature rise has also benefited the high altitude regions. An increase in temperature has resulted in the shifting of climatic suitability of crops in the Mustang (a mountainous) district of Nepal. In the case of apple, there is a clear notice of unsuitability of apple cultivation in lower elevation unlike in past years but apple cultivation is expanded in the higher altitudes (Pradhan et al, 2012). People now can also grow cabbage, cauliflower, tomato, chilly, mango and other tropical species that were not possible about a decade ago due to cold, frost, snow, and intense cold.

Above-mentioned changes have draw on the following impacts: drying up of water table, early flowering and budburst in some species; adaptation of natural vegetation, cultivated crops, weeds, crop pests, and mosquitoes to higher altitude regions; and early crop maturity leading to yield loss. Similar result has been obtained by (Shrestha, 2009; Bhusal, 2009; Poudle, 2011) in Nepal. This result verifies people's perception that warming is increased than ever before. Increased temperature can pose a number of threats mainly to arid environment since its first and the foremost impact on desiccating effect due to accelerated evaporation. Climate change has made the future of mountain indigenous people and their livelihoods more vulnerable and uncertain. The available scientific evidence suggests that climate change will place significant stress on the rural livelihoods of mountain people.

Since the mid-1970s, the average air temperature measured at 49 stations of the himalayan region raised by 10^{o}C with high elevation sites warming the most (Hasnain, 2000). This is twice as fast as the 0.60^{o} C averages warming for the mid-latitudinal northern hemisphere over the same time period (IPCC, 2001a) and illustrated the high sensitivity of mountain regions to climate change (Oerle manns et al., 2000 as cited in WWF, 2006).

Local people are the live witness to climate change information and valuable source where meteorological stations are unavailable and long term data are missing. This can have great socio-economic and biophysical concern in himalayan region owing to high population, marginal agriculture based on subsistence, high dependency

on natural resource, seasonal farming, poor and vulnerable life style (Shrestha & Balla, 2011).

Not only the developing countries but also the developed ones have not been able to protect themselves from the negative effect of neighboring countries facing the problem of poverty the major cause seen as climate change. According to MoE (2010), pre-monsoon rainfall is decreasing and post-monsoon is increasing in some pockets of Western Nepal. Similarly, early monsoon and delayed withdrawal of monsoon has become normal (GoN, 2004). However, it is paradoxical that precipitation has been increasing in the high rainfall regions and decreasing in low rainfall or drier regions (GoN, 2004). For instance, precipitation has increased by 774mm in Lumle (high rainfall region) and increased by 36mm in Mustang (low rainfall region) over the past four decades (DoHM, 2007). Nepalgunj, one of driest cities, also sustained a wettest monsoon season in the last 123 years in 2006 (Sharma, 2006).

The study also found out a gradual increase in maximum and minimum temperature in the terai region and an abrupt change and erratic precipitation trends were observed in the high mountain areas. Alteration of climate change is corroborating with the observed changes is the perception of the people of the himalayan region (Chaudhary & Bawa, 2011). People have perceived change in their climate and are based on their day-to-day observations of weather change patterns and impacts resulting from it (Chaudhary &Aryal 2009). They also associate various effects occurring at local level with the change in weather and climate based on their experiences in planning agricultural activities according to weather patterns. From local perceptions, it is obvious that temperature is rising, rainfall patterns have become erratic and unpredictable, and snow is melting faster than before in the Himalayas (Sharma et al., 2009; Chaudhary & Bawa 2011; Chaudhary et al., 2011).

A study done in the Siddhi village of Central Nepal also reported the farmers' perception in the increase of temperature as well as decrease in rainfall (Shrestha & Shrestha, 2010). Another perception study on the trend of climatic hazards done among 486 shifting cultivators of eastern and central Nepal found that 45 percent and

55 percent households have experienced heavy but short-duration rainfall and prolonged drought, respectively (Thapa et al., 2012). Studies done in the western Nepal also report similar trend of temperature and rainfall (Gurung et al., 2010).

Extreme events are also increasingly replacing normal monsoon seasons (Baidya et al., 2008); short-duration heavy downpours are more frequent than ever. In Laprak Gorkha, a total rainfall was recorded 341.8mm between 4pm to 7am (15 hours) in July 3, 1999. In Nepane Kaski, 128mm rainfall occurred between 11pm to 12:30am (1.30 hours) in July 15, 2006. Similarly, in Nepalgunj, Banke, 336.9mm rainfall was recorded in 24 hours in Aug 27, 2006 (SOHAM, 2006; Gurung, 2006). Similarly, increase in average temperature of Rasuwa, Dhading, Banke and Bardiya districts was also noted between 1977 and 2007. The degree of increase was higher in Rasuwa (0.30^{o}C), a high mountain area, followed by Dhading (0.020^{o} C), a middle hill area, and Bake and Bardiya (0.010^{o} C), the Terai area (CARE/LI-BIRD, 2009).

People also experience hotter summer, shorter and less intense winter, intense but short down pours, less cold days, and reduction of frost and fog (Chapagain et al., 2009; Gurung et al., 2010; Chaudhary & Bawa, 2011). Thapa (2012) suggests that there is a delay in onset of monsoon season (shift from June-August to July-September), which is in contrast to Chaudhary & Bawa (2011) findings from Darjeeling (India) and Ilam (Nepal) hills. As already mentioned, a report by the Government of Nepal suggests an early onset and late withdrawal of monsoon. The differences in trends reported in various literatures might be the function of spatial variation as sites considered by different studies differ. People also associate several local level impacts with weather and climate change.

In the Himalayan, range snowmelt has been felt rapidly growing. Mountain people's livelihood has affected by ice melting and changes in its pattern. In the Himalayan during October to March has better for freezing the ice if it falls in on normal time. Since a year there is changed in snow fall, it has shifted to May to April. Livestock and agriculture has serious problem in the mountain region of Nepal. It is the main economic source of people's livelihood in that area. Based on these

evidences, we decided to find out what is the impact of climate change on livelihood of mountain peoples' Tsum valley in Nepal.

Focus of the study

Majority of traditional and indigenous peoples who live in the tropical developing world get very little or no consideration. Furthermore, while all the analyzed documents put their emphasis on monetary, knowledge and technology transfer from developed to developing countries, traditional and indigenous peoples' own coping and adaptive strategies are hardly recognized(IPCC,2007).

Mountain people are more vulnerable due to climate change. Main effect of climate change is on agriculture and the livestock. It has long been based on subsistence farming, particularly in the rural regions as mountain. Where peasants used to farm in a small level plots and depend on snow fall or in rain fall to do agriculture. Government programs to introduce irrigation facilities and fertilizers seems inadequate, their delivery has been difficult by the rural setting. The change in snow fall and rain fall leads to people under employment, though programs to grow cash crops and tourism business have shown some successes over the years in the mountain region.

In this regards, the focus of the study has Tsum people are indigenous and marginalized in Nepal. They are considered the most disadvantages due to their limited access to economic opportunities and basic social services and excessive burden of remoteness and overlook by Government. The population of Tsumba has 1911 according to population census 2011. The study focus on their agricultural economy which is dependence on weather conditions especially snow fall time, a considerable livestock population of cattle, sheep, horse and yak exists, but decreasing the productivity and pastureland in that area a part from Peoples' adaptation practices of climate change impact in this valley.

Problem of the statement

Millions of Nepalese people are estimated to be at risk to climate change. Due to climate change, Nepal has experienced an average maximum annual temperature increase of 0.60^{o}C (NPC, 2010). This rate of increase is higher in the mountains than in other regions. The glacier recedes from rapid snow and ice melting. The timing and duration of rainfall has changing. The annual rainfall cycle has been changed. Similarly, both days and nights are presently warmer. Day to day lifestyle has been difficult by increasing the atmospheric temperature.

In this regard, there are very few studies about the effects and likely impact of climate change in Nepal. The detailed impacts from climate change on agriculture, water resources, forest and biodiversity, public health, disaster incidence, tourism and other related sectors has yet to be assessed. There is not any study on impact of climate change have done in the Tsum valley yet. The pattern of rainfall and snow fall is irregular, too much rainfall too much dry effect the crop production system. People have experienced of hunger and some have been migrated to the outside of Tsum valley, looking for opportunity. There can be many other problems, the researcher will find it in the field.

Purpose of the study

The purpose of this study is to find out the impacts of climate change on socio -economic condition of Tsum valley people in Nepal. This kind of study would be baseline for the government for further development of the study area and also could be replicate other similar places in future. Many researches did not focus on that issue in this valley.

Objective of the study

General objective of this research is to find out the impact of climate change on their socio-economic condition of Tsum valley, people. Specific objectives

To analyze the socio -economic changes of Tsum people within 20 years regarding the climate change.To find the adverse consequences of climate change that people have faced in the study area.

To assess the traditional adaptation practices for mitigation to climate change impact in the study area.

Research questions

What are the changes faced by Tsum people due to climate change?

What are the adverse consequences of climate change that people have faced in Tsum valley?

How do people have practiced adaptation for mitigation of climate change impact in Tsum valley?

Limitations and delimitations

The study of Tsum valley does not represent the whole climate change and its impact of Nepal. However, the impact of climate change on socio- economic condition in Tsum valley people would be representative in this regards.

Significance of the Study

Geographically mountain people are also excluded from the mainstreaming of development. There is a wide gap between women and men when it comes to access to health, nutrition, education and participation in decision- making. My study contributes explores the status of the mountain people and supports the policy makers in order to make economic reform. Due to climate change, agricultural sectors, forestry, glaciers, fresh water and biodiversity is facing various adverse impacts in Nepal but we still do not have clear idea of its impacts in Tsum valley. Thus, there is strong need to enhance understanding on impact of climate change in all these sectors in the study area. There is need to verify impact of climate change in the area with

some facts and figures. There is highly essential that we developed an adaptation strategy to reduce the threat from climate change.

Climate change could bring unprecedented reversals in poverty reduction, nutrition, and health. Secondly the study analyzes the existing situation of year after of Tsum Valley. It supports for development interventions to be modified. Thirdly it has shown the problem of mountain peoples' livelihood regarding the climate change impact. Lack of economic opportunity and the recent conflict resulted in many of the most productive members of households to migrate and leave the villages. Finally, it explained real life picture of mountain people's livelihood, health, education, communication, transportation, irrigation and many more in detail. This information helps to the researchers working in different fields like demography, population studies, and social science and for development interventionists regarding climate change.

Organization of the thesis

The thesis is divided into seven chapters. First chapter contains setting of the study, research problem; purpose of the study, research question, significance and chapter summary. In a second chapter, written a comprehensive literature review.

Chapter three discusses the data management, research design, tools of data collection and methodology and research procedures in detail. General information of the study area has written in the fourth chapter. The main empirical findings are analyzed in chapter five. Chapter six contains the results of the research findings regarding the impact of climate change on socio- economic condition of Tsum valley. Similarly, chapter seven deals with the discussion and last chapter illustrates summary of the study and conclusion of the study.

Operational definition of the key terms

Adaptation

Adjustment in natural or human systems to a new or changing environment is known as adaptation. Adaptation is a process by which individuals, communities and countries seek to cope with the consequences of climate change. ‘Adaptation is not coping’, it is about the capacity to shift strategies as conditions change and to develop systems that are resilient and sufficiently flexible to respond to change. It may be planned or autonomous. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.

Adaptation strategies

These are long-term changes in behavior and practice in response to continuing stresses. They are the responses of people to their analysis of risk. People may respond to climate change by changing their agricultural practices or using new technologies. For example, they might start rainwater harvesting or they may try to diversify their livelihood activities and focus on those less affected by natural hazards. Certain family members may migrate to another place. The extent to which people can adapt usually reflects their access to and ability to use different types of assets. In areas where there are very few assets or people lack the capacity to utilize them, vulnerability will be high.

Adaptation to climate change

An initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects is known as adaptation to climate change. Crucial to reducing vulnerability to climate change, understanding how individuals, groups and natural systems can prepare for and respond to changes in climate is known as adaptation. The 5 broader concept of adaptation also applies to non-climatic factors such as soil erosion or surface subsidence.

Adverse effect

Changes in the physical environment or biota resulting from climate change which have significant deleterious effects on the composition, resilience or productivity of natural and managed ecosystems or on the operation of a socioeconomic systems or on human health and welfare is known as adverse effect.

Bali action plan

Decision that was adopted by 1/CP.13 of the COP-13 is known as Bali action plan. It also includes the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP) negotiations and their 2009 deadline, the launch of the Adaptation Fund, the scope and content of the Article 9 review of the Kyoto Protocol, as well as decisions on technology transfer and on reducing emissions from deforestation. The Conference of Parties decided to launch a comprehensive process to enable the implementation of the Convention through long-term cooperative action, now, up to and beyond 2012.

Carbon dioxide (CO_2)

CO_2 is a naturally occurring gas and a by-product of burning fossil fuels or biomass, of land-use changes and of industrial processes. It is the principal anthropogenic greenhouse gas that affects Earth's radioactive balance. It is the reference gas against which other greenhouse gases are measured and therefore it has a global warming potential of one.

Carbon market

A carbon market is a market (institution of exchange) where carbon shares are traded (bought and sold). Carbon shares are also known as pollution credits. Carbon market functions with a limit on allowable level of emissions. Polluters who are under this set cap can sell their excess emission rights to those concerns who have crossed this cap.

Climate change

It refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate Change may be due to natural processes or external forcing or to persistent anthropogenic changes in the composition of the atmosphere or in land-use. This means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. The UN Framework Convention on Climate Change (UNFCCC) uses the term "Climate Change" for human-caused change and "climate variability" for other changes.

Climate change impact assessment

Impacts that affect ecosystems or human welfare but that is not directly linked to market transactions, for example, an increased risk of premature death. The analysis of positive and negative consequences of climate changes on natural systems and human societies, both with and without adaptation to such changes is known as climate change impact assessment.

Climate change mitigation

Strategies and policies that reduce the concentration of greenhouse gases in the atmosphere either by reducing their emissions or by increasing their capture are known as climate change mitigation.

Climate change vulnerability assessment

A range of tools that exist to help communities understand the hazards that affect them and take appropriate measures to minimize their potential impact is known as climate change vulnerability assessment.

Climate hazard

The harmful effect of climate change on livelihoods and ecosystems is known as climate hazard. They can be caused by gradual climate variability or extreme weather events. Some hazards are continuous phenomena that start slowly such as the increasing unpredictability of temperatures and rainfall. Others are sudden but relatively discrete events such as heat waves or floods.

Climate risk

The likelihood that the harmful effects will happen is known as climate risk or it is a measure of the probability of harm to life, property and the environment that would occur if a hazard took place. Risk is estimated by combining the probability of events and the consequences (usually seen as losses) that would arise if the events took place. It denotes the result of the interaction of physically defined hazards with the properties of the exposed systems i.e. their sensitivity or social vulnerability. Risk can also be considered as the combination of an event, its likelihood and its consequences i.e. risk equals the probability of climate hazard multiplied by a given system's vulnerability.

Community based adaptation

Community based adaptation is one where the explicit objective is to reduce vulnerability to climate change.

Conference of parties

The supreme body of the UNFCCC, comprising countries that have ratified or acceded to the UNFCCC is known as conference of parties. The first session of the Conference of the Parties (COP- 1) was held in Berlin, Germany in 1995, followed by COP-2 in Geneva, Switzerland 1996, COP-3 in Kyoto, Japan 1997, COP-4 in Buenos Aires, Argentina 1998, COP-5 in Bonn, Germany 1999, COP-6 Part 1 in The Hague, Netherland 2000, and COP-6 Part 2 in Bonn, Germany 2001, COP-7 in Marrakech, Morocco 2001, COP-8 in New Delhi, India 2002, COP-9 in Milan, Italy 2003, COP-

10 in Buenos Aires, Argentina 2004, COP-11 in Montreal, Canada 2005,COP-12 in Nairobi 2006, COP-13 in Bali, Indonesia 2007, COP-14 in Poznañ, Poland 2008, COP-15 in Copenhagen, Denmark 2009, COP-16 in Cancún, Mexico 2010 and COP-17 to be held in Durban, South Africa 2011.

Coping strategies

Households develop short-term responses to specific shocks known as coping strategies. These are 'next best' efforts to make do in a difficult situation with the hope that the household can return to normal activities and their normal livelihoods strategy.

Deforestation

Conversion of forest to non-forest is known as deforestation. Deforestation is one of the causes to climate change.

Degradation

Degradation, changes which negatively affect the structure or function of the site and thereby lower the capacity to supply products or services.

Drought

The phenomenon that exists when precipitation has been significantly below normal recorded levels causing serious hydrological imbalances that adversely affect land resource production systems is known as drought. A drought is an extended period of months or years when a region notes a deficiency in its water supply. Generally, this occurs when a region receives consistently below average precipitation. It can have a substantial impact on the ecosystem and agriculture of the affected region. Although droughts can persist for several years, even a short intense drought can cause significant damage and harm the local economy.

Earth summit

Conference held in Rio de Janeiro (June 3-14, 1992) to reconcile worldwide economic development with environmental protection is known as earth summit. It was the largest gathering of world leaders in history with 117 heads of state and representatives of 178 countries.

Environmental refugee

These are people forced to migrate away from their homeland due to sudden or long-term changes to their local environment. When the migration is considered to be forced and not a matter of choice, additionally, if the causes for the migration are believed to be due to global warming related environmental disasters, the term climate refugee is sometimes used.

Flood

A flood is an overflow of an expanse of water that submerges land. Flooding may result from the volume of water within a body of water, such as a river or lake, which overflows or breaks levees with the result that some of the water escapes its usual boundaries.

Food security

It's availability of food and one's access to it. A household is considered food-secure when its occupants do not live in hunger or fear of starvation."Food security exists when all the people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary and food preferences for an active and healthy life."(World Food Simmit 1996).

Forest investment program

The Forest Investment Program (FIP) is a targeted program of the Strategic Climate Fund (SCF), which is one of two funds within the framework of the Climate Investment Funds (CIF). The FIP supports developing countries' efforts to reduce

deforestation and forest degradation (REDD) and promotes sustainable forest management that leads to emission reductions and the protection of carbon reservoirs.

Global environment facility

The Global Environment Facility (GEF) unites 182 member governments in partnership with international institutions, nongovernmental organizations, and the private sector to address global environmental issues. As an independent financial organization, the GEF provides grants to developing countries and countries with economies in transition for projects related to biodiversity, climate change, international waters, land degradation, the ozone layer, and persistent organic pollutants. These projects benefit the global environment, linking local, national, and global environmental challenges and promoting sustainable livelihoods.

Global warming

The gradual increase observed or projected in global surface temperature as one of the consequences of radioactive forcing caused by anthropogenic emissions is known as global warming.

Global warming potential

An index, describing the radioactive characteristics of well well-mixed greenhouse gases that represent the combined effect of the differing times these gases remain in the atmosphere and their relative effectiveness in absorbing outgoing infrared radiation is known as global warming potential. This index approximates the time-integrated warming effect of a unit mass of a given greenhouse gas in today's atmosphere, relative to that of carbon dioxide.

Globalization

The growing integration and interdependence of countries worldwide through the increasing volume and variety of cross border transactions in goods and services,

free international capital flows and the more rapid and widespread diffusion of technology, information and culture.

Greenhouse effect

Greenhouse gases effectively absorb thermal infrared radiation, emitted by the Earth's surface, by the atmosphere itself due to the same gases, and by clouds. Atmospheric radiation is emitted to all sides, including downward to the Earth's surface. Thus, greenhouse gases trap heat within the surface-troposphere system. This is called the greenhouse effect. Thermal infrared radiation in the troposphere is strongly coupled to the temperature of the atmosphere at the altitude at which it is emitted.

In the troposphere, the temperature generally decreases with height. Effectively, infrared radiation emitted to space originates from an altitude with a temperature of on average, –190C, in balance with the net incoming solar radiation, whereas the Earth's surface is kept at a much higher temperature of on average, +140C. An increase in the concentration of greenhouse gases leads to an increased infrared opacity of the atmosphere and therefore to an effective radiation into space from a higher altitude at a lower temperature. This causes a radioactive forcing that leads to an enhancement of the greenhouse effect, the so-called enhanced greenhouse effect.

Hydro meteorological hazard

Process or phenomenon of atmospheric, hydrological or oceanographic nature that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption or environmental damage is known as hydro meteorological hazard.

Indigenous peoples

People whose ancestors inhabited a place or a country when persons from another culture or ethnic background arrived on the scene and dominated them

through conquest, settlement, or other means and who today live more in conformity with their own social, economic, and cultural customs and traditions than those of the country of which country of which they now form a part (also referred to as “native,” “aboriginal” or “tribal” peoples) is known as indigenous peoples.

Intergovernmental panel on climate change (IPCC)

The Intergovernmental Panel on Climate Change (IPCC) is a scientific intergovernmental body tasked with reviewing and assessing the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. It provides the world with a clear scientific view on the current state of climate change and its potential environmental and socio-economic consequences, notably the risk of climate change caused by human activity.

The panel was first established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), two organizations of the United Nations, an action confirmed on 6 December 1988 by the United Nations General Assembly through Resolution 43/53 mechanism.

Kyoto protocol

The Kyoto Protocol to the UNFCCC was adopted at the third session of the conference of the parties to the UNFCCC in 1997 in Kyoto, Japan. It contains legally binding commitments, in addition to those included in the UNFCCC. Countries included in Annex B of the Protocol (most countries in the Organization for Economic Cooperation and Development, and countries with economies in transition) agreed to reduce their anthropogenic greenhouse gas emissions (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride) by at least 5% below 1990 levels in the commitment period 2008 to 2012.

Livelihood

A livelihood comprises the capabilities, assets and activities required for a means of living. A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels in the long- and short-term.

Millennium development goals (MDGs)

A set of time-bound and measurable goals for combating poverty, hunger, disease, illiteracy, discrimination against women and environmental degradation, agreed at the UN Millennium Summit in 2000 is known as Millennium Development Goals.

Mitigation

In the context of climate change, mitigation is a human intervention to reduce the sources or enhance the sinks of greenhouse gases. Examples include using fossil fuels more efficiently for industrial processes or electricity generation, switching to solar energy or wind power, improving the insulation of buildings and expanding forests and other sinks to remove greater amount of carbon dioxide from the atmosphere. Tackling climate change by limiting greenhouse gas emissions is known as mitigation. In climate change policy, “mitigation” is defined differently, being the term used for the reduction of greenhouse gas emissions that are the source of climate change.

National adaptation programmes of actions (NAPAs)

Documents prepared by least developed countries (LDCs) identifying urgent and immediate activities useful for coping with climate change is known as national adaptation programes of actions. The NAPAs are then presented to the international

donor community for support to start adapting to current and projected adverse effects of climate change.

Nationally appropriate mitigation action:

Nationally Appropriate Mitigation Action (NAMA) refers to a set of policies and actions countries undertake as part of a commitment to reduce greenhouse gas emissions. The term recognizes that different countries may take different nationally appropriate action on the basis of equity and in accordance with common but differentiated responsibilities and respective capabilities. It also emphasizes financial assistance from developed countries to developing countries to reduce emissions.

Natural hazard

Natural process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption or environmental damage is known as natural hazard. Natural hazards are a sub-set of all hazards. The term is used to describe actual hazard events as well as the latent hazard conditions that may give rise to future events.

Natural hazard events can be characterized by their magnitude or intensity, speed of onset, duration, and area of extent. For example, earthquakes have short durations and usually affect a relatively small region, whereas droughts are slow to develop and fade away and often affect large regions. In some cases hazards may be coupled, as in the flood caused by a hurricane or the tsunami that is created by an earthquake.

OECD countries

Organization for Economic Co-operation and Development (OECD) was established at 1992 to promote policies that will improve the economic and social well-being of people around the world. The OECD provides a forum in which governments can work together to share experiences and seek solutions to common problems.

Parts per million (ppm**)**

This is a way of expressing very dilute concentrations of substances. Just as per cent means out of a hundred, so parts per million or ppm means out of a million. Usually describes the concentration of something in water or soil. One ppm is equivalent to one milligram of something per liter of water (mg/l) or one milligram of something per kilogram soil (mg/kg).

Resilience

The capacity of a system, community or society potentially exposed to hazards to adapt by resisting or changing in order to reach and maintain an acceptable level of functioning and structure is known as resilience. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures. The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions. It is the amount of change a system can undergo without changing state.

United Nations framework convention on climate change (UNFCCC)

The Convention was adopted on 9 May 1992 in New York and signed at the 1992 Earth Summit in Rio de Janeiro by more than 150 countries and the European Community. Its ultimate objective is the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." It contains commitments for all Parties. Under the Convention, Parties included in Annex I aim to return greenhouse gas emissions not controlled by the Montreal Protocol to 1990 levels by the year 2000. The Convention entered into force in March 1994. See also Kyoto Protocol and Conference of the Parties (COP) (IUCN, 2011)

Chapter summary

In this chapter, I tried to mention about the research problem that I tried to explore from mountain peoples' livelihood regarding the climate change impact in Tsum Valley. Objectives of research, organization of the research, significance of the study, research questions and delimitation of my research. This chapter is indeed a reflection of my whole thesis. I focused on the overall setting of Tsum valley. In the next chapter, researcher has illustrated literature review in detail.

CHAPTER- II
REVIEW OF LITERATURE

Introduction

In this chapter, researcher have described all the global scenario of global warming and its impact on global, national and in local level including an adverse consequences, adaptation practices to mitigate the climate change impact.

General review

What is climate change?

Climate change relates to changes in the average weather patterns. It is a global phenomenon. The Forth Assessment Report of the Intergovernmental panel on climate change (IPCC) defines climate change as: A change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/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 activity." IPCC (2007b) The IPCC concludes that the warming of the climate system is unequivocal" (IPCC, 2007d).

Observations presented in the Physical Science Basis report of the IPCC show an increase of the global average surface temperature of 0.74^{o}C to 0.18^{o}C over the period from 1906 to 2005. More changes in the climate system, such as global sea-level rise, changes in precipitation patterns and extreme events have been observed in the last century. They indicate that global mean sea level has risen from 1960 to 2003, with an average rate of 1:8 to 0:5 mm per year and precipitation patterns have changed (Solomon et al., 2007).

They observed long term increasing precipitation trends in eastern parts of North and South America, northern Europe and northern and central Asia from 1900 to 2005.While areas in the tropics and subtropics are affected by more intense and longer drought periods since the 1970s. In addition, they observed an increase in extreme events, such as heavy precipitation events and more frequent heat waves over

the last 50 years (Solomon et al., 2007). In addition to observations, the IPCC has made projections of future climate change effects (IPCC, 2007d), based on available scientific literature. Taking into account a range of emission scenarios and presenting different uncertainty intervals, they project a warming of about 0.2 C per decade for the next two decades. Model based projections of global average sea-level rise at the end of the 21st century are between 0.18 and 0.59 m and changing precipitation patterns are expected to result in more frequent and intense flood and drought events (Solomon et al., 2007).

Average global temperature has become a popular metric for the state of the global climate. We know that the world is warming and that the average global temperature has increased by around 0.7°C (1.3°F) since the advent of the industrial era. We know also that the trend is accelerating: average global mean temperature is rising at 0.2°C every decade. With the global rise in temperature, local rainfall patterns are changing, ecological zones are shifting, the seas are warming and ice caps are melting. Forced adaptation to climate change is already happening across the world.

Fifteen years have now passed since the on United Nations framework convention on climate change (UNFCCC) set out the broad objectives for multilateral action. Those objectives include stabilizing greenhouse gas concentrations in the atmosphere at "a level that would prevent dangerous anthropogenic interference with the climate system". Indicators for the prevention of danger include stabilization within a time frame that allows ecosystems to adapt naturally, the avoidance of disruption to food systems, and the maintenance of conditions for sustainable economic development (Solomon et al., 2007).

Thematic review

Is Climate change natural phenomenon?

Climate change also asks tough questions about how we think about our links to people in the future. Our actions will serve as a barometer of our commitment to cross-generational social justice and equity and as a record against which future

generations will judge our actions. Today, every credible climate scientist believes that climate change is real, that it is serious, and that it is linked to the release of Carbon dioxide (CO2). Governments across the world share that view. Scientific consensus does not mean that debates on the causes and consequences of global warming are over. The Easter Island story is a case study in the consequences of failure to manage shared ecological resources. Climate change affects all people in all countries. However, the world's poorest people are on the front line. They stand most directly in harm's way-and they have the least resources to cope. This first catastrophe is not a distant future scenario. It is unfolding today, slowing progress towards the Millennium Development Goals (MDGs) and deepening inequalities within and across countries. Left unattended, it will lead to human development reversals throughout the twenty first century. The second catastrophe is located in the future. Like the threat of nuclear confrontation during the cold war, climate change poses risks not just for the world's poor, but for the entire planet-and for future generations.

Global warming is a natural phenomenon which has been occurring over the past 15,000 years on earth. It can be described as a struggle between human progress (in the form of industrialization, population increase, and economic growth) and nature. The process of global warming occurs when greenhouse gases (primarily CO2, NO2, methane, nitrous oxide, hydro fluorocarbons, per fluorocarbons, and sulfur hexafluoride) are released into the atmosphere. These gases continue to increase in concentration in our atmosphere creating a "greenhouse-like" effect by trapping in heat from the sun, resulting in an increase in Earth's average temperature.

Current studies from the IPCC indicate that earth's surface temperatures could rise by 3.8 to 11.2 degrees Fahrenheit over the next 50 years, based on current greenhouse gas (GHG) emissions. This would have drastic consequences for the planet's biodiversity, including the human race. This increase in temperature would have profound effects across the globe, ranging from increased sea-levels, more severe storms, and the melting of large glaciers and icebergs. These changes in nature would in-turn produce devastating results in the form of floods, loss of plant and

animal life, more frequent droughts and famine, and a greater risk of human casualties in all parts of the world (Motavalli, 2003).

History of climate change

Throughout its history, the earth has experienced oscillations between warm and cool Periods. These shifts in climate have been traced to a wide variety of 'climate forcing, including orbital variations, solar fluctuations, volcanic activity, water vapor, and the atmospheric concentration of greenhouse gases, such as CO2. The changes that we see happening today are occurring at a more rapid rate, with stronger magnitudes and patterns that cannot be explained by natural cycles. Average global surface temperature is the most fundamental measure of climate change. Temperatur in the past half-century have probably been the highest of any 50 year period for the past 1,300 years. The world is now at or near the warmest level on record in the current interglacial period, which began around 12,000 years ago.

There is strong evidence that the process is accelerating. Eleven of the twelve warmest years since 1850 occurred between 1995 and 2006. Over the past 100 years the Earth has warmed by 0.7°C. There are large inter annual variations. However, on a decade-by-decade basis, the linear warming trend for the past 50 years is nearly twice that for the past 100 years (UN, 2013).

There is an overwhelming body of scientific evidence linking rising temperatures to increased atmospheric concentrations of CO2 and other greenhouse gases. The effect of these gases in the atmosphere is to retain part of the outgoing solar radiation, thereby raising the temperature of the Earth. This natural 'greenhouse effect' is what keeps our planet habitable: without it, the planet would be 30°C colder. Throughout the Earth's four previous glacial and warming cycles, there has been a high correlation between atmospheric concentrations of CO2 and temperature.

Since pre-industrial times, atmospheric CO2 stocks have increased by one-third-a rate of increase unprecedented during at least the last 20,000 years. Evidence from ice cores shows that current atmospheric concentrations exceed the natural range

of the last 650,000 years. The increase in stocks of CO2 has been accompanied by rising concentrations of other greenhouse gases. Atmospheric concentrations of CO2 are on a sharply rising trend. They are increasing at around 1.9 ppm each year. For CO2 alone the annual concentration growth rate over the past 10 years has been around 30 percent faster than the average for the past 40 years.(UN, report HDI, 2013).

In fact, in the 8,000 years prior to industrialization, atmospheric CO2 increased by only 20 ppm. Current rates of absorption by carbon sinks are sometimes confused with the 'natural' rate. In reality, carbon sinks are being overwhelmed. Take the world's largest sink-its oceans. These naturally absorb just 0.1 Gt more CO2 per year than they release. Now they are soaking up an extra 2 Gt a year-more than 20 times the natural rate. The result is serious ecological damage. Oceans are becoming warmer and increasingly acidic. Rising acidity attacks carbonate, one of the essential building blocks for coral and small organisms at the start of the marine food chain. Based on current trends, future carbon dioxide releases could produce chemical conditions in the oceans that have not been witnessed in the past 300 million years, except during brief catastrophic events.(UN, report HDI, 2013).

Looking back-the world since 1990.

Experience under the Kyoto protocol provides some important lessons for the development of a 21st Century carbon budget. The Protocol provides a multilateral framework that sets limits on greenhouse gas emissions. Under the auspices of the UNFCCC, it took 5 years to reach an agreement-and another 8 years before that agreement was ratified by enough countries to become operational.68 The headline target for greenhouse gas emissions cuts was 5 percent from 1990 levels measured in terms of aggregate global emissions the Kyoto protocol did not set particularly ambitious targets. Moreover, quantitative ceilings were not applied to developing countries. The decisions of Australia and the United States not to ratify the protocol further limited the size of the intended cuts. The implication of these exceptions can be illustrated by reference to energy-related CO2 emissions. From the 1990 base year the commitment made under the Kyoto protocol translates into a 2.5 percent reduction

of energy-related CO2 emissions in real terms by the 2010/2012 target date(UN, 2013).

International cooperation has a critical role to play at many levels

Looking back, trends since the 1990 reference-point for the Kyoto Protocol are cause for concern.

- The European Union made average emission reduction commitments of 8 percent under Kyoto. Actual cuts have amounted to around 2 percent and European Environment Agency projections suggest that current policies will leave this picture unchanged by 2010. Large increases in renewable energy supply will be required to meet the Kyoto targets, but the European Union is falling short of the investments needed to meet its own target of 20 percent provision by 2020.
- The United Kingdom has surpassed its Kyoto target of a 12percent emissions reduction, but is off track to meet a national target to reduce emissions by 20 percent against 1990 levels. Most of the reduction was achieved before 2000 as a result of industrial restructuring and market liberalization measures that led to a switch from carbon-intensive coal to natural gas. Emissions increased in 2005 and 2006 as a result of switching from natural gas and nuclear to coal (chapter 3).
- Italy and Spain are far off track for their Kyoto targets. In Spain emissions have increased by almost 50 percent since 1990, with strong economic growth and increased use of coal power following droughts. In Italy, the primary driver of increased emissions has been the transport sector.
- Canada agreed under the Kyoto Protocol to target a 6 percent cut in emissions. In the event, emissions have increased by 27 percent and the country is now around 35 percent above, it is Kyoto target range. While greenhouse gas intensity has fallen, efficiency gains have been swamped by an increase in emissions from an expansion in oil and gas production. Net emissions associated with oil and gas exports have more than doubled since 1990.

- Japan's emissions in 2005 were 8 percent above 1990 levels. The Kyoto target was for a 6 percent reduction. On current trends it is projected that the country will miss its target by around 14 percent. While emissions from industry have fallen marginally since 1990, large increases have been registered in emissions from transportation (50 percent for passenger vehicles) and the residential sector. Household emissions have grown more rapidly than the number of households.
- The United States is a signatory to the Kyoto Protocol but it has not ratified the treaty. If it had, it would have been required to reduce its emissions to 7 percent below 1990 levels by 2010.

Overall emissions have increased by 16 percent. By 2010 projected emissions are 1.8 Gt above 1990 levels on a rising trend. Emissions have grown across all major sectors despite a 21 percent decline in greenhouse gas intensity of the United States' economy, as measured by the ratio of greenhouse gas emissions to GDP.

- Like the United States, Australia did not ratify the Kyoto Protocol. Overall emissions have grown at around twice the rate that would have been required had the country participated, with emissions rising by 21 percent since 1990. High levels of dependence on coal-fired power generation contributed to large increases in the energy sector, with CO2 emissions rising by over 40 percent. Looking to the post 2012 period, the challenge is to forge an international agreement that engages all major emitting countries in a long term effort to achieve a sustainable carbon budget for the 21st Century. There is little that governments can do today that will have significant effects on emissions between 2010 and 2012 like oil tankers, energy systems have large turning circles. What is needed now is a framework for beating dangerous climate change.

That framework will have to provide a far longer time-horizon for policymakers, with short term commitment periods linked to medium-term and long term goals. For developed countries, those goals have to include emission reductions of around 30 percent by 2020 and at least 80 percent by 2050-consistent with our

sustainable emissions pathway. Reductions by developing countries could be facilitated through financial and technology transfer provisions.

The world is warming

One of the early pioneers of climate science, the Swedish physicist Svante Arrenhuis, predicted with surprising accuracy that a doubling of CO2 stocks in the Earth's atmosphere would raise average global temperatures between 4 and 5°C-a marginal overestimate according to recent IPCC models. 36 Less accurately, Arrhenuis assumed that it would take around 3,000 years for atmospheric concentrations to double over preindustrial levels. On current trends that point, around 550 ppm, could be reached by the mid 2030s. Future temperature increases will depend on the point at which stocks of greenhouse gases stabilize. At whatever level, stabilization requires that emissions must be reduced to the point at which they are equivalent to the rate at which CO2 can be absorbed through natural processes, without damaging the ecological systems (UN, 2013).

Causes of global warming

Recent decades have seen record-high average global surface temperatures. Thermometer readings sufficient to provide reliable global averages are available back to at least 1880 (Smith et al., 2008). In the past century, global surface temperature increased by about 1.4 °F (Figure 1; Smith et al., 2008, updated through 2011).

In the past three decades, according to satellite measurements, the lower atmosphere warmed by 0.24 °F per decade, equivalent to 2.4 °F per century, indicating an acceleration of warming in the past few decades (Christy & Spencer 2005; Mears & Wentz 2005) updated May 2012. As a consequence of this accelerated warming trend, the 16 warmest years recorded so far all occurred in the last 17 years (Smith et al., 2008) updated 2011. May 2012 was the 327th consecutive month with a global average temperature above the 20th century average (NOAA-NCDC, 2012).

In theory, this well-documented warming trend could potentially result from several different factors that influence the earth's climate. Some of these are natural, such as changes in solar radiation and volcanic activity, and other result from human activities. This science brief describes major progress in the past decade that identifies the primary factors contributing to the observed warming. The global surface temperature varies over time in response to "*climate forcings* "physical factors external to the climate system that drive a net gain (positive forcing) or net loss (negative forcing) of heat in the climate system as a whole (Hansen, Sato et al., 2005).

This type of change is distinct from "*internal variability"*, in which heat is transported by winds or ocean currents between different regions of the globe or components of the climate system (e.g., from the atmosphere to the ocean), without changing the total amount of heat in the climate system as a whole. Because observed warming over the twentieth century results from a net increase of total heat in the global climate system, it can only be explained by one or more external forcings, not by internal variability (Hansen, et al., 2005). So the task for scientists studying climate change is to identify external forcing(s)-either natural or man-made-that have changed in such a way that they could explain the observed warming.

The greenhouse effect

The greenhouse effect is a natural phenomenon whereby heat-absorbing gases in the atmosphere, known as greenhouse gases, act as a positive climate forcing by slowing down the escape of heat from the Earth's surface to outer space. This heat originates from visible sunlight that warms the earth's surface. Sunlight that is converted to heat radiates from the surface into the atmosphere, where some of it is absorbed by greenhouse gases and radiated back to the surface. Scientists refer to the recent increase in the strength of the greenhouse effect resulting from increased emissions of man-made greenhouse gases as the enhanced greenhouse effect.

Until recent centuries, climate forcing was exclusively natural, such as changes in the amount of sunlight reaching the earth's surface and changes in emissions of dust from volcanoes. During modern times, human activities have

introduced a mix of additional forcing, such as increases in atmospheric greenhouse gases that cause warming (positive forcing), and sulfate aerosols, miniscule particles that reflect sunlight and cause cooling (negative forcing). The histories and magnitudes of various forcing are estimated from direct observations, such as satellite measurements of solar radiation in recent decades, or from proxies, such as sunspots for solar radiation in earlier decades (Foukal et al., 2004).

Surface warming

The twentieth-century warming of the Earth's surface progressed in a distinct pattern, with rapid warming from 1910 to 1940, more or less stable temperatures from 1940 to 1970, and another period of rapid warming since 1970. Scientists at the National Center for Atmospheric Research (NCAR) looked for fingerprints of various natural (solar radiation, volcanic particles) and manmade (greenhouse gases, sulfate aerosols) forcing in this record of observed climate change (Meehl et al., 2004). The change in global average surface temperature calculated by the model for each forcing or combination of forcing was then compared statistically with the observed record of surface temperature change over the twentieth century. However, different forcing dominated at different times during the century (Takemura et al., 2006). For instance, the temperature rise in the early part of the century was dominated by natural forcing, whereas the warming after 1970 was dominated by man-made greenhouse gases. The stable temperature during the mid-century was consistent with a combination of volcanic and manmade aerosols temporarily canceling out a portion of the greenhouse warming ((Nagashima et al., 2006).

The results of this study implicate the human enhanced greenhouse effect as the dominant cause of global warming over the past three decades. If not for the temporary cooling between 1940 and 1975 from volcanic and man-made aerosol emissions, the earth would likely be even warmer than it is today (IPCC, 2007).

Ocean heat content

Oceans exhibit natural temperature cycles, with some oceans cooling at the same time that others warm. This natural internal variability of climate results from

heat transport from one place to another, but it adds no new heat to the ocean as a whole. In addition to these fluctuations, the global oceans have been warming on average for the past five decades (Glecker et al., 2012). The basic laws of physics dictate that simultaneous warming of the world's oceans could only occur if there was external forcing, as no internal source of so much energy exists within the climate system (Hansen, Nazarenko et al., 2005). Observations show that the oceans have been warming from the surface downward (red dots), which requires heat transfer from the atmosphere to the oceans.

The vertical pattern of heat penetration with depth varies from one ocean to another as a result of the internal variability discussed above. Combined natural and human-induced forcing reproduced the pattern of heat penetration for each ocean. Man-made greenhouse gases strongly dominated the overall forcing. A more recent peer-reviewed study used three different observational data sets and combined the results of seven climate models to perform a more stringent fingerprinting analysis (Glecker et al., 2012).

Deforestation and green house gas

Deforestation is responsible not only for significant ecosystem and species loss, but importantly also for 20 percent of global greenhouse gas emissions. Ten countries account for 87 percent of global deforestation, with Brazil and Indonesia alone accounting for 54 percent of these emissions. Rates of deforestation have remained constant over the last two decades and without significant, concerted action these could result in missions of 10Gt of carbon dioxide per year for 50-100 years. Forests also absorb carbon dioxide, so increasing forest cover can increase carbon sequestration, but the positive impact of this is far out weighed by the negative impact of deforestation8 on atmospheric carbon dioxide, let alone wider ecosystem impacts. So, while restoring forest cover is a benefit, the primary focus should be to reduce deforestation (Glecker et al., 2012).

Global impact of climate change

All nations and all people share the same atmosphere. And we only have one. Global warming is evidence that we are overloading the carrying capacity of the Earth's atmosphere. Stocks of green house gases that trap heat in the atmosphere are accumulating at an unprecedented rate. Current concentrations have reached 380 Climate change provides a potent reminder of the one thing that we share in common. It is called planet earth. All nations and all people share the same atmosphere parts per million (ppm) of carbon dioxide equivalent (CO2e) exceeding the natural range of the last 650,000 years. In the course of the 21st Century, average global temperatures could increase by more than 5°C. To put that figure in context, context, it is equivalent to the change in temperature since the last ice age-an era in which much of Europe and North America was under more than one kilometer of ice. The threshold for dangerous climate change is an increase of around 2°C (Glecker et al., 2012).

This threshold broadly defines the point at which rapid reversals in human development and a drift towards irreversible ecological damage while the world's poor walk the Earth with a light carbon footprint they are bearing the brunt of unsustainable management of our ecological interdependence In rich countries, coping with climate change to date has largely been a matter of adjusting thermostats, dealing with longer, hotter summers, and observing seasonal shifts.

Cities like London and Los Angeles may face flooding risks as sea levels rise, but their inhabitants are protected by elaborate flood defense systems. By contrast, when global warming changes weather patterns in the Horn of Africa, it means that crops fail and people go hungry, or that women and young girls spend more hours collecting water. And, whatever the future risks facing cities in the rich world, today the real climate change vulnerabilities linked to storms and floods are to be found in rural communities in the great river deltas of the Ganges, the Mekong and the Nile, and in sprawling urban slums across the developing world.

The emerging risks and vulnerabilities associated with climate change are the outcomes of physical processes. But they are also a consequence of human actions

and choices. This is another aspect of ecological interdependence that is sometimes forgotten. When people in an American city turn on the air conditioning or people in Europe drive their cars, their actions have consequences.

Those consequences link them to rural communities in Bangladesh, farmers in Ethiopia and slum dwellers in Haiti. With these human connections come moral responsibilities, including a responsibility to reflect upon-and change-energy policies that inflict harm on other people or future generations. Recent evidence on the accelerated collapse of ice sheets in the Antarctic and Greenland, acidification of the oceans, the retreat of rainforest systems and melting of Arctic permafrost all have the potential-separately or in interaction-to lead to 'tipping points'. Countries vary widely in their contribution to the emissions that are driving up atmospheric stocks of greenhouse gases. With 15 percent of world population, rich countries account for almost half of emissions of CO2. High growth in China and India is leading to a gradual convergence in 'aggregate' emissions. However, per capita carbon footprint convergence is more limited.

Climate change status in United States

The carbon footprint of the United States is five times that of China and over 15 times that of India. In Ethiopia, the average per capita carbon footprint is 0.1 tonnes of CO2 compared with 20 tonnes in Canada. What does the world have to do to get on an emissions trajectory that avoids dangerous climate change? We address that question by drawing upon climate modeling simulations. These simulations define a carbon budget for the 21st Century. If everything else were equal, the global carbon budget for energy-related emissions would amount to around 14.5 Gt CO2 annually. Current emissions are running at twice this level.

The bad news is that emissions are on a rising trend. The upshot: the carbon budget for the entire 21st Century could expire as early as 2032. In effect, we are running up unsustainable ecological debts that will lock future generations into dangerous climate change. Carbon budget analysis casts a new light on concerns over the share of developing countries in global greenhouse gas emissions. While that

share is set to rise, it should not divert attention from the underlying responsibilities of rich nations. If every person in the developing world had the same carbon footprint as the average person in Germany or the United Kingdom, current global emissions would be four times the limit defined by our sustainable emissions pathway, rising to nine times if the developing country per capita footprint were raised to Canadian or United States levels. Changing this picture will require deep adjustments.

If the world were a single country it would have to cut emissions of greenhouse gases by half to 2050 relative to 1990 levels, with sustained reductions to the end of the21st Century. However, the world is not a single country. Using plausible assumptions, we estimate that avoiding dangerous climate change will require rich nations to cut emissions by at least 80 percent, with cuts of 30 percent by 2020. Emissions from developing countries would peak around 2020, with cuts of 20 percent by 2050. Our stabilization target is stringent but affordable. Between now and 2030, the average annual cost would amount to 1.6 percent of Gross Domestic Production (GDP).

Our common journey

It can be found in the advance integrated assessment and scenario models that have extended their reach to embrace the driving forces of change from both nature and society. And it can be found here in Tokyo, as we members of the world academies join together on our common journey.

The study about climate change on Tundra

The following paragraph has been explained about the climate change impact of Tundra area.

General introduction

Dwarf shrub heath, or tundra, is one of the most widespread ecosystem types on the globe. It covers large regions at high latitudes and at high altitudes, accounting for 5 to 10 percent of the world's land surface (Koerner, 1999; Post et al.,1982).

Studying the ecology of tundra ecosystems is of particular relevance in our world subject to rapid changes in climate: (1) The climate is changing fastest at high latitudes and altitudes, thus, these ecosystems are currently experiencing rapid changes in their natural environment (ACIA, 2004; IPCC, 2001). (2) Tundra soil store more than 90 percent of the carbon present in this ecosystem (IPCC, 2001), thus they have been a carbon sink for many centuries. Plant growth and litter decomposition are the two main Processes driving carbon accumulation or release rates, and they both are highly sensitive to climate change. Current climate warming, although often expressed as the rise in the global annual mean temperature, is not uniform in space and time. Warming rates have not only been greater at high latitudes and high altitudes than in other areas of the world, but temperatures in these regions have also increased more in winter than in summer (ACIA, 2004; IPCC, 2001).

Latin America and Coastal area

Here is given description about the Latin America and coastal area, the impact of climate change.

Brazil

Brazil's economy and land mass dominate Latin America and its regional and international influence cannot be underestimated. Among the ten biggest economies in the world, Brazil is the third largest user of energy and the biggest producer of ethanol. Although economic growth has been modest in recent years, Brazil is heavily present in the international political and economic arenas owing, among other things, to its trade surplus, competitive industries, energy abundance and an enormous environmental wealth; it is the steward of the world's largest remnant tropical rainforest and of almost 14 percent of the world's superficial freshwater.

Energy in Brazil

Balanço Energético Nacional, 2005 Electricity represents the second biggest source of energy for the Brazilian people (18 percent) behind petroleum and its sub-products (39 percent). Hydropower still dominates the electricity matrix, providing 75

percent of total electricity, although in recent years thermoelectricity has gained a stronger foothold, moving from 7.5 percent of market share in 1980 to 17.2 percent in 2004. The part played by unconventional renewable energy is still modest, notwithstanding the country's enormous potential.

Emissions

In 2000, Brazil's greenhouse gas emissions totaled about two billion tons of CO2 equivalents. In contrast to most developed countries, it is land-use change such as deforestation which represents the biggest emitting sector, with 62 percent of total emissions, followed by the agricultural sector with 20 percent and the transport sector with 6 percent (WRI, 2006). Nonetheless, yearly emissions are highly volatile given changes in deforestation rates. In 2002, for example, 70 percent of emissions came from land-use change. To put this into an international perspective, Brazil ranks eighteenth in the world for carbon dioxide emissions from the energy sector, but fourth if total emissions are considered. Given the uncertainties about the Green house gas (GHG) emissions from land-use changes, it is very difficult to make forecasts about future emissions.

While 2006 saw a 30 percent reduction (possibly due to lower beef and soy prices, but also to policy interventions; Ângelo, 2006), the second year of consecutive reduction, there is no evidence of a long term declining trend in land-use change. On the contrary, in the absence of large-scale incentives and support for effective national Initiatives to reduce deforestation, rates will increase as the Brazilian government struggles to contain illegal logging pressures and provide growth for the Amazon region and the country as a whole (building and paving highways into the core of the Amazon and large infrastructure projects. As for the energy sector, WWF-Brazil projects emissions to increase by almost 200 percent between 2000 and 2020, up to 72Mt carbon dioxide per annum in a business-as-usual scenario (IPM, 2005 and Brazil Government, 2007).

Climate change impacts on sub Saharan Africa

Climate Change Impacts on Sub-Saharan Africa is the most vulnerable region to climate change, as a result of the low adaptive capacity of the African population. This low capacity is due to the extreme poverty of many Africans, frequent natural disasters such as droughts and floods and agriculture heavily dependent on rainfall. The main impacts of climate change will be on the water resources, food security and agriculture, natural resource management and biodiversity, and human health (Dieudonne, 2001).

Water resources

The predictions for climate change in sub-Saharan Africa seem to show a trend of decreased precipitation in current semi-arid to arid parts of Africa. One of the main impacts of climate change will be a reduction in soil moisture in the sub-humid zones and a reduction in runoff. This could be a problem for the future water resources of these sub-humid regions. However, precipitation scenarios are not the same everywhere in Africa, as simulations seem to indicate a possible increase in precipitation in east Africa but a decrease in rainfall in southern Africa for the next 100 years.

These changes in precipitation will affect the levels of water storage in lakes and reservoirs, as these respond to climate variability. This could cause major problems for lakes, such as lake Chad, which has already decreased in size by about 50 percent in the last 40 years. For the Niger River Basin there is a predicted possible 10 percent change in precipitation, potential evaporation and runoff.

The Zambezi River, however, has the worst scenario of decreased rainfall (about 15%), increased potential evaporative losses (about 15–25%) and diminished runoff (about 30-40%). The Gambia River is also very sensitive to climate change. Climate change alone could cause a 50 percent change in runoff in the Gambia River catchment. A 1percent change in rainfall can cause a 3percent change in runoff for the

Gambia River, and this could have serious impacts, such as increased salt-water intrusion (IPCC, 2001).

Food security

Over the last 30 years, food production in most of the sub-Saharan African countries has not kept pace with population increases. Many of these countries rely on food aid from the developed countries. If climate change adversely affects food production, then these countries will become increasingly dependent on external aid, food insecurity will increase and their development goals will be adversely affected.

It is likely that global warming will affect the production of certain crops, such as rice, wheat, corn, beans and potatoes, which are major food crops for many people in Africa (IPCC, 2001). Other crops, such as millet, are resistant to high temperatures and low levels of water, and so may be less affected by future climate change. An experiment in Zimbabwe showed that a 2°C to 4°C increase in temperature caused a reduction of maize yield at all experimental sites. Changes in farming systems may compensate for some yield reductions although additional inputs such as fertilizers and increased irrigation may be needed, involving extra costs to the farmers. Food-importing countries will be at greater risk, although the impacts may have more to do with changes in world in world markets than with changes in the local climate and agricultural production (IPCC, 2001).

Global warming will also affect the fishing sector. In some cases, temperature increases will increase productivity. It is projected that a warming of 3°C to 5°C will increase the productivity of the Gambia River by about 13–21 percent. However, some fish species might be more sensitive to temperatures, and increases of 3°C to 4°C could negatively affect catfish and herring populations, whereas shrimp yields are estimated to increase significantly (IPCC, 2001).

A reduction in annual precipitation will affect range-fed livestock numbers in many African regions. Pastoral livelihoods in the semi-arid zones of Africa are likely to be adversely affected by climate change, as several Global Climate Models

(GCMs) predict a decrease in mean annual precipitation of about 10–20 percent and this will affect pastoralists' animal herds.

Human health

Climate change will probably have an impact on vector-borne diseases. Small changes in temperature and precipitation may support malaria epidemics in the current transmission zones. Flooding would also facilitate the breeding of the malaria vectors and so would increase transmission in the arid zones. The Sahel, for example, could be at risk of epidemics if climate change increases flooding in that area. After the El Niño event in 1997-98, malaria, Rift Valley fever and cholera outbreaks were recorded in many east African countries. It is also possible that with global warming, cholera will increase in the lake regions. Increased precipitation may increase the risk of Rift Valley Fever in livestock and people.

These risks could cause major economic and health problems for herding communities in Africa. Meningitis transmission appears to be affected by warming and reduced precipitation as meningitis infections and epidemics are prevalent in areas of low humidity. Regions where climate change will reduce rainfall levels could become at risk of a meningitis epidemic. Flooding could also cause the pollution of streams, wells and other water sources in rural areas, and this could introduce parasites such as giardia, amoeba and cryptosporidium into these sources (IPCC, 2001).

Climate change impacts in Asia

Water resources

Water availability is expected to be highly vulnerable to future climate change. Significant changes in runoff regimes (increases in the high latitudes and near the equator, and decreases in the mid-latitudes) are predicted for Asia. In general most of the climate models project an enhanced hydrological cycle and an increase in annual mean rainfall over most of Asia. Over Asia, as a whole, the models predict an annual mean increase in precipitation of about 3 percent by 2020 and 7 percent by 2050.

Over central Asia, an increase in winter precipitation and a decrease in summer precipitation are expected.

However, as precipitation levels over this area are already low, some countries can expect severe water stress and droughts. Surface runoff is also predicted to decline in the arid and semi-arid zones of Asia and this would have a detrimental effect on the availability of water for irrigation. The average annual runoff in certain basins could decline by as much as 27 percent (projection for the Indus) by 2050 (IPCC, 2001).

The perennial rivers in the High Himalayas receive water from the melting of snow and glaciers. The melting season of snow occurs at the same time as the summer monsoon season, so any intensification of the monsoon would cause flood disasters in Himalayan catchments. Countries such as Nepal and Bangladesh would be at risk of increasing flood disasters in the wet season. The intensity of extreme events may be higher in a warmer climate, which would also increase the risk of flash floods in parts of Nepal and Bangladesh (IPCC, 2001).

New water management strategies and increased investments will be required to help Asia cope with future water problems. The effects of climate change on the hydrological regimes and public water supply in the arid and semi-arid regions of Asia will require priority attention to avoid any inter-sect oral and international water conflicts and to secure sustainable development.

Many of the watersheds in Asia are already stressed by intensive land use and unfavorable climates, so they will become highly vulnerable to climate change if no appropriate adaptation strategies are developed (IPCC, 2001).

Food security and agriculture

Climate change impacts on agriculture in Asia will be crucial as agriculture plays a major role in the provision of food and fibre to the Asian population. If climate change negatively affects crop growth, this will have serious consequences on the level of food production and food security in Asia. Climate change may cause a

decrease in the supply of water and soil moisture during the dry season, which would exacerbate stress on the available water supplies and increase the need for irrigation. Rice growing areas may be affected by climate change, and resultant declines in yield would have a significant effect on agricultural trade, economic growth and development goals of certain Asian countries.

The level of vulnerability of Bangladesh is likely to increase as a result of severe land degradation, soil erosion, lack of appropriate technology and sea-level rise. Changes in precipitation and temperature caused by climate change will impair the efficiency of externally applied inputs, such as fertilizers, and this will have a negative imp act on food production. The results from several studies made on the impact of climate change on agriculture in Asia seem to suggest that, in general, mid and high-latitude areas will experience an increase in crop yields, whereas the lower latitude areas will experience declining yields. It appears that climatic variability and change will seriously endanger sustained agricultural production in Asia in the next decades. Both the duration of the growing period of the crop and the agricultural calendar will be affected by climate change. The gap between the supply and demand of crops, which might arise in certain Asian countries due to climate change, will increase those countries' reliance on food imp orts (IPCC, 2001).

Ecosystems and biodiversity

Climate change is likely to have an effect on the ecosystems and biodiversity of Asia. Climate change may accelerate damage to freshwater ecosystems such as lakes, marshes and rivers. More than 50,000 ha of coastal land has been damaged by floods in the past few years, and as precipitation is likely to increase with global warming, there may be increased flooding in the future, and this will increase the threat to coastal zones. The majority of semi-arid lands in Asia are rangelands, composed mainly of grasses or scrubs. Climate change will have a negative impact on desert vegetation, especially on the plants with surface root systems, which utilize precipitation moisture, and will therefore become more vulnerable due to reduced water availability. Climate change may also cause a shift in the dry land types in Asia, with semi-arid dry lands becoming not only drier but also decertified (IPCC, 2001).

Human health

Climate change will have a wide range of impacts on human health in Asia. With increased temperatures, an increase in the frequency and duration of heat waves can be expected. This will increase the risk of mortality in the older age groups and in Asia's urban poor population. An increases in respiratory and cardiovascular diseases in arid, semi-arid and tropical Asia can also be expected as a result of global warming (IPCC, 2001).Global warming will alter the occurrence of vector-borne diseases, such as malaria and dengue fever. With an increase in temperatures and changes in rainfall patterns, the distribution of vectors, such as mosquitoes may change. It is possible that these temperature and rainfall changes will expand vector-borne disease ranges into temperate and arid Asia, which would have serious human health implications.

Water-borne diseases, such as cholera and the diarrhea diseases caused by organisms such as giardia, salmonella and cryptosporidium, could become more prevalent in many south Asian countries as a result of global warming (IPCC, 2001). Climate Change Impacts on the Small Island States.

Water resources and water-level changes

Climate change will present water management challenges for the small island states. The most significant and immediate consequences will be related to changes in sea levels, rainfall regimes, soil moisture budgets and short-term variations in the regional and local patterns of wave action. Short-term variations are likely to be strengthened by the ENSO (El Niño Southern Oscillation) phenomenon. An increase in the frequency and magnitude of tropical cyclones would be a major threat to the small island states, as it would increase the risk of flooding, accelerate rates of beach and coastal erosion and cause displacements of settlements and infrastructure. Some small island states, such as Kiribati and the Maldives, are only three to four meters above mean sea level, so they are extremely vulnerable to higher sea levels.

Biodiversity

Climate change will affect the biodiversity of the small island states, increased temperatures and CO2 levels will affect mangroves, sea grasses and coral reefs. High CO2 levels will also affect the productivity of communities, which will have the effect of eliminating some species and introducing new species in their place. The impact of climate change on bird species will be linked to increased physiological stress in the birds and to the impacts on the forest ecosystems in which these birds live. Climate change may result in changes and loss in habitat, especially from fires and cyclones. In Samoa, flying foxes do nearly 100% of seed dispersal in the dry season. If climate change threatens or alters the flying foxes' habitats, this could result in the loss of many plant species (IPCC, 2001).

Nine vulnerable countries (South Asia)

Researchers in Bangladesh, Bhutan, Burkina Faso, Ethiopia, the Gambia, Kenya, Micronesia, Mozambique and Nepal conducted household surveys (n=3,269) and more than a hundred focus group discussions and open interviews about loss and damage (Warner, K. and van der Geest, K. (2013). Science points to widespread current and future biophysical impacts of anthropogenic climate change (IPCC, 2007a, 2007b, 2012; Fung et al., 2011; Thornton et al., 2011). Understanding loss and damage around constraints and limits to adaptation for the community-based field research introduced in this article the following working definition of loss and damage was used.

Loss and damage refers to negative effects of climate variability and climate change that people have not been able to cope with or adapt to. This includes the inability to respond adequately to climate stressors and the costs and adverse effects associated with the adaptation and coping measures themselves. Such costs and adverse effects can be both economic and non-economic. Loss and damage is also related to mitigation, as the potential costs of future climate change depend to a large extent on the intensity of climatic disruptions, which in turn depend on mitigation efforts globally.

The empirical research on loss and damage aimed to enhance understanding of how the interaction of climatic variability and climate change with livelihoods and social vulnerability creates particular patterns of loss and damage today in least developed and developing countries. To understand patterns of loss and damage in nuanced social-ecological contexts across the world, the case studies gathered data in four research domains (IPCC, 2007a, 2007b, 2012; Fung et al., 2011; Thornton et al., 2011).

Climate stressor

Manifestations of climate variability and climate change in specific ecosystems (for example, rainfall variability, droughts, floods, cyclones and tropical storms, glacial melt, sea-level rise, etc.). This could involve extreme weather-related events and more gradual changes. Some impacts -like coastal erosion and salinity intrusion - result from both social and physical/climatic factors and their interactions.

Responses

What is done to adapt to changes in the frequency and severity of extreme weather-related events and slow-onset climate changes? And what is done to cope with societal impacts? The terms ‘coping’ and ‘adaptation’ are often used synonymously. This is problematic because they involve different types of responses to different types of stressors (van der Geest, 2004; Birkmann, 2011).

(Residual) loss and damage

What are the effects of climate variability and climate change that people have not (yet) been able to avoid? What are the limits and costs of adaptation to climatic changes? What happens to a household when its coping strategies are not effective enough to avoid or manage the impacts of extreme events? Loss and damage can result from an inability to respond to climate stressors, insufficient coping and adaptation measures, the costs associated with coping and adaptation strategies, and adverse long-term effects of adopted measures. These costs and consequences often elude quantification but cause severe harm and impede sustainable development.1

In drought-affected areas, many households also reported severe impacts on livestock; and in study sites with frequent flooding, damage to physical assets, particularly house was common. Adaptation measures adopted in response to slow-onset climatic changes (% of households) Country Climate-related stressor Adaptation strategies adopted to reduce future impacts or to deal with current impacts. Bangladesh Salinity intrusion Reduce dependence on crop cultivation (60%), plant salt-resistant rice cultivars (39%), on-farm measures to reduce salinity (27%) Bhutan Changing monsoon Water-sharing arrangements (48%), more intensive maintenance of irrigation channels (37%), shift from rice to other crops (31%) Micronesia Coastal erosion Build sea walls (29%), land filling to protect coastline (29%), plant trees along coastline (15%), raise houses (11%). Among the people who adopted coping and adaptation measures, most were not fully successful in avoiding residual impacts. For example, in the Bhutan study area, 87 percent of households that adopted measures to deal with changing monsoon patterns and reduced availability of water for rice cultivation reported that they were still experiencing adverse effects despite the adaptation measures (Kusters & Wangdi, 2013).

The findings from Rabbani et al. (2013) in Sathkira, *Bangladesh* exemplify a case where seemingly successful measures to adapt to slow-onset processes are insufficient to avoid loss and damage when the situation is aggravated by an extreme weather event. Sathkira is a coastal district facing sea-level rise and frequent cyclones. Both result in saltwater intrusion, which has a severe impact on rice cultivation, the mainstay of the local economy and the principal source of food for the majority of the population. Eighty one percent of the survey respondents reported sharp increases in soil salinity levels, compared to just 2 percent in 20 years ago. To adapt, many farmers have planted new, saline tolerant-rice varieties.

This strategy worked reasonably well until 2009, when cyclone Aila hit the area and caused a drastic increase of soil salinity. Almost all farmers in the area lost their complete harvest that year. In the two subsequent years, salinity levels remained high and rice yields were miniscule. Between 2009 and 2011, the total loss of rice harvest was US$1.9 million for the four villages' surveyed (Rabbani et al., 2013).

The measures that households adopt to cope with impacts of extreme weather events and to adapt to slow-onset climatic changes often have costs themselves. These costs can be both monetary and non-monetary. In *Bhutan*, Kusters and Wangdi (2013) looked at the impact of changing monsoon patterns on rice cultivation. The monsoon rains are starting later and the total amount of rain has reduced sharply over the past two decades. Rice farmers in the study area (Punakha District) have tried to adapt by modifying water sharing arrangements between Villages and by intensifying irrigation canal maintenance in drier years. Crop yields and income from maize are 2.5 to 8 times lower than for rice and 87eighty seven percent of the respondents using such measures said these involved extra monetary and non-monetary costs.

In our study areas in *Mozambique*, households had to deal with the double threat of droughts and floods (Brida et al., 2013). If adverse effects cannot be avoided through preventive action, but the impact is not very severe, people first employ 'non-erosive' coping measures, such as drawing on any buffers they have created. If the crisis is more severe, for example when an area is hit by drought in several consecutive years, or when several hazards strike simultaneously, the set of non-erosive coping strategies may become exhausted and people will have to take more drastic action. For instance, they may need to sell productive assets, eat into their seed stock, or take children out of school so they can seek work to support the household. These measures are 'erosive' because they can seriously jeopardize people's future livelihoods and food security (de Waal,1989; van der Geest & Dietz, 2004).

These strategies allow them to survive in the short term but weaken household resilience in the longer term. Opondo (2013) examined the coping strategies that households adopted after River Nzoia in Western *Kenya* broke its dykes in December 2011 and caused havoc in Budalangi Division (a low-lying area on the shores of Lake Victoria). Floods have become more frequent and intense in recent decades. The December 2011 flood drowned people and livestock, washed away crops, severely damaged houses and spawned an outbreak of water-borne diseases. Some of the coping strategies that people adopted to gain access to food or reconstruct housing have severe implications for future livelihood security. For example, some households

were forced to sell their bullocks to buy food after the flood had washed away their crops.

The following season, the bullocks were not available to plough the fields and the households' situation became even more precarious. Also, able-bodied household members had to invest much of their time in non-farm activities or migration to urban centre to solve their households' urgent food needs. This meant that they had much less time to spend on the household farm, which undermined food security in the next cultivation cycle.

Lack of knowledge or skills was the most common reason, followed by lack of financial means or other resources. These households did not know what do or were not able to do anything. Very few households indicated that it was not their task to do anything or that it was not a priority. This is because the most common adaptation options they have are too expensive or seem inefficient. For example, people may refrain from building a sea wall to protect their house, land and other property because they lack resources and because they have seen from neighbours building a sea wall is no guarantee that impacts are avoided. When faced with such adaptations limits or constraints, households and communities have to make difficult choices: changing their objectives, accepting loss and damage, or undertaking more significant transformation. Changing objectives often involves a deteriorating standard of living, the loss of cultural values, and the disintegration of commonly held values and practices in the community. Accepting loss and damage often means falling incomes, assets, education levels and social status, along with greater poverty, lower food consumption, and diminished future prospects. Undertaking more significant transformation can involve more permanent migration out of one's home area, leading to other significant changes in livelihood and social systems. (Preston et al., 2013; Kates et al., 2012).

Climate change impacts and adaptation

China

According to the IPCC third assessment report, global average temperature has increased by (0.6^{o}–0.2^{o}C) during the 20^{th} century. In China, the observed data show that the nationwide mean surface temperature has markedly increased over the past 100 years and the change ranged between 0.5J 0.8. Climate change characterized by warming will impact on various aspects of Chinese social and economic life. Since the early 1990s, Chinese scientists have studied climate change impacts, vulnerability and adaptation strategies and obtained many good results January 19, 2007; revised: April 6, 2007. There are three types of climate change scenarios used by Chinese scientists in the past: incremental increase scenario, equilibrium double CO2 scenario, and transient GHG emissions scenario. Climate change impact assessment on vulnerable sectors and regions.

Observed impacts

In recent years, coral bleaching occurred in the coastal of Hainan and Guangxi Provinces. Drought-stricken areas have widened in northern China and flooding has gotten more serious in southern China. Since the 1980s, agricultural production has become more unstable. In some places, droughts and heat waves have become more severe.

Crop damage from spring frost has increased due to mild winters that lead to earlier onset of budding and flowering in winter wheat, trees and fruits, making them more vulnerable to cold. However, climate warming over the past two decades has caused winter wheat plantation in Northeast China moved northward and extended westward. Certain varieties of maize that have a relatively long growth period and high yield have been grown more widely, resulting in productivity increase. Since the 1950s, the runoffs to six large rivers in China have all been observed experiencing a decreasing trend, with the largest decrease occurred along the Haihe River. Some rivers in northern China faced intermittent flow. While large flooding events occurred

along the Yangtze, Pearl, Songhua, Huaihe, and Yellow Rivers as well as the Taihu Lake in the 1990s resulting in increasingly heavy losses.

Climate change and sea level rise have already affected China's coastal areas, where the economic losses from storm surges, flooding, heavy rains, drought and other serious climatic events were most significant. The Yellow River Delta, Yangtze River Delta and Pearl River Delta are more available at online. The areas of wetland in southwest China, the Sanjiang (Three-River) Plain and the wetland of Qinghai Province have also shrunk and their functions declined. Since the 1950s, the fluctuation cycle of mountain disasters in the Southwest China has shortened, and the frequency of disaster events and the losses they caused have increased.

Climate change has raised the possibility of disease incidence and transmission, greatly influencing the distribution and the potential danger of vector-borne infectious diseases. After a flood disaster, the incidents of infectious diarrhea diseases, such as cholera, dysentery, typhoid and paratyphoid, often increased. In the past 40 years, although the Qinghai-Xizang Plateau experienced a warming trend, the coverage of dry grassland has actually increased due to increased rainfalls at online.

Impacts on agriculture

Climate change would decrease the stability of agricultural production causing larger variations in crop productivity. The most recent studies show that climate change will greatly influence China's agricultural output. By 2030, the overall crop productivity in China could decrease by 5 percentJ10 percent if no action is taken. By the second half of the twenty first century, climate change could cause yield reduction in rice, maize and wheat up to 37 percent.

In the next years, agricultural production may be seriously affected, compromising long-term food security in China. Water demand for irrigation would grow in most regions of China due to increased evaporation, and in some regions, decreased precipitation as the climate gets warmer. Coupled with intensified water stress, this situation will significantly affect the costs of food production and

investments demanded. The carrying capacity of grasslands and the number and distribution of grazing animals will undergo large changes as well.

Impacts on forests and other ecosystems

Climate change would not have a significant impact on the geographical pattern of net primary production of forests in China. However, through 2030, the productivity of forests is projected to increase by 1 percent J10 percent with the southeastern region realizing less increases and the northwestern region more. The structure and composition of forests in Northeast China would experience great changes, with defoliate and broadleaf trees becoming dominant species. In semi-arid areas, desertification would gain more momentum.

Impacts on coastal environment

The response of China's coastal regions to climate change and sea level rise would be different from that of Europe and America. Storm surges, droughts and other extreme climate events are the main coastal disasters. Currently, the Yellow River Delta, the Yangtze River Delta and the Pearl River Delta are the most vulnerable coastal regions in China.

Impacts on other sectors

Climate change could increase the frequency of heat waves and their intensity, resulting in higher mortality and morbidity of serious diseases. It would endanger human health by increasing the occurrence of diseases and the transmission of infectious diseases. Climate change would increase the degree and range of cardiovascular diseases, malaria, dengue fever and heatstroke. Climate change may cause the melting of mountain snow and the rising of sea levels, so that mountain, coastal and island landscapes would change, affecting nature conservation areas and national forest parks characterized with excellent environmental quality and biodiversity.

Climate change could thus affect tourism and the safety of tourists. Climate change would further challenge power supplies in China because of people's increasing reliance on air conditioners. The Qinghai-Tibet Railway and other large projects could also be adversely affected by the thaw of permafrost, and/or rainfall changes at online.

Why India is a key country

India will undergo enormous change over the coming half century as its population (already a sixth of the world total) grows to eclipse that of China, and as it seeks to eradicate poverty through economic development and the widespread provision of commercial energy. The challenges are huge, especially in a climate-constrained world, in supplying adequate energy to support the growth of industrial and commercial sectors, and the exploding demand for transportation, while also meeting the needs of the 650 million people living in rural areas, roughly 350 million of whom currently have no commercial energy supplies.

India is highly vulnerable to climate change, its rural population largely reliant on rain- and melt water-fed agriculture. Probable impacts range from food security and freshwater availability to flooding and cyclones as well as heat waves and droughts. (", KPMG, 2006 / RET Outlook"Based on MNES website). India Energy Outlook Follow format

Energy

In India, a land of extreme contrasts, the very low values of per capita energy consumption, electricity generation and emissions (of both GHGs and other pollutants) KPMG, 2006") India Energy Outlook, website. hide the high demand from urban, industrial and largely coal based power sectors, and of the growing sector of affluent and upper middle class consumers. A third of the population without access to commercial energy do not contribute to emissions but do contribute to, and suffer from CO2 pollution, smoke and particulate emissions from inefficient energy sources.

Climate change

This engagement also brings with it responsibility and a high degree of interest towards ensuring that there is no gap between the two commitment periods of the Kyoto Protocol. There is an increasing interest within the Industry with regards to the Carbon Markets and opportunities to engage in it.

Renewable and alternative sources of low carbon energy

India will be an especially attractive partner for other developing countries as technology provider, equipment supplier and capacity builder. Indeed, South-South-North partnerships, which utilize innovative new solutions and the financial and marketing strengths of industrialized countries, may be an effective instrument.

Decades of sustained support to R&D in the renewable energy sector, India is today in a position to play a major role in the large scale commercialization RETs such as large and small biomass and biogas technologies, wind generators, small hydro, solar thermal, solar PV, energy efficient lighting systems, and much more ("India Energy Outlook, KPMG, 2006 / RET Outlook"Based on MNES website).

Nuclear energy

Increasingly Nuclear power is being labeled as a carbon neutral option towards managing increasing carbon emissions from developing countries. Unfortunately in India civilian nuclear power generation units have been shown to be the most expensive option upon comparison with the time and capital invested in other fuel choices. Further the risks attached with the nuclear sector raise critical questions about the safety of local populations and eco-systems in case of an accident.

The threat from potential leakages is an issue of concern in a densely populated country like India. A similar level of efforts and money if invested in renewable or decentralized systems such as solar, wind and bio-mass based projects will channelize limited financial resources for an alternative option to develop a low-

cost and eco- friendly energy paradigm for solving the country's energy security problems.

Carbon capture and storage

While India is not yet in the forefront of carbon capture and storage technology development, its current dependence on coal and large reserves makes it important that CCS is proven, and if successful, made intrinsic to future coal use in India. Several national programmes are being undertaken to develop and commercialize clean coal technologies, backed by international co- operation programs both in the public and private sectors. However, Bangladesh The 'flood of the century' is a normal part of the ecology of Bangladesh, with climate change, 'abnormal' flooding is likely to become a standing feature of the future ecology. Experience following the flood event of 1998-dubbed the 'flood of the century'- highlights the danger that increased flooding will give rise to long term human development setbacks.

The 1998 flood was an extreme event. In a normal year, around a quarter of the country experiences inundation. At its peak, the 1998 flood covered two-thirds of the country. Over 1,000 people died and 30 million were made homeless. Around 10 percent of the country's total rice crop was lost. With the duration of the flood preventing replanting, tens of millions of households faced a food security crisis. Large-scale food imports and government food aid transfers averted a humanitarian catastrophe. However, they failed to avert some major human development setbacks. (India Energy Outlook, KPMG, 2006)

Primary physical impacts of climate change

The impact of climate change has been assessed under different climate change scenarios for different sectors, and the following areas have been identified as critical for development policy makers to consider measures to combat the adverse impacts of climate change in a warmer Bangladesh.

Drainage congestion

The combined effect of higher sea levels, subsidence and siltation of estuary branches, higher riverbed levels and reduced sedimentation in flood-protected areas will gradually increase water logging problems, and impede drainage. Drainage congestion will increase the period of inundation and expand wetland areas. This may hamper agricultural productivity and threaten human health by increasing the potential for water borne diseases.

Reduced freshwater availability

Reduced freshwater availability will become a serious problem in the dry season due to low river flows and increased evapo-transpiration in the dry period. In the coastal zone, the additional effect of saline water intrusion in the estuaries and into the groundwater stimulated by low river flow and sea level rise will be significant. Pressure from growing populations and economic development will further reduce fresh water availability.

Increased intensity of disasters

Increased intensity of disasters (extreme events) including cyclones/storm surges, floods and droughts will become evident with climate change. Bangladesh is particularly vulnerable to climate change in its coastal zone, covering about 30% of the country. Private sector investment in this area is likely to be affected by the increased risks of cyclones and flooding.

Population at risk

Under climate change scenarios, high percentages of the population will be affected by inundations, the maximum being 94 percent for both the Business-As-Usual (BAU) and High Development Option (HDO) under non-water sharing conditions.

The following observations merit mention.

- For the HDO in Bangladesh and 100 cm sea level rise, 94 percent of the population will be affected if moderate or high levels of climate change occur. Without climate change, 55 percent of the population will already be affected by inundations under this scenario, so the additional effects of sea level rise are relatively small.
- Under moderate or high levels of climate change, if the sea level rise is 30 cm, the percentage number of people affected by inundations is about one third of that predicted for a 100 cm rise. About 8.5 million people lived in the severe and very severe drought prone areas in 1990. This number increases to about 25 million people under the high climate change scenario. For the rainy season under the low and high climate change scenarios, these numbers are 19 and 29 million people, respectively.

Human health

The safe drinking water supply programme undertaken in the context of the government's commitment to universal coverage has resulted in unprecedented gains. Although only 1.17 percent of the GDP was spent on the health sector in 1996, 97 percent of the population had access to drinking water from a safe source (tubewell, ringwell or tap) by 1997. This comprised of 97 percent and 99 percent of those in rural and urban areas respectively, but only 68 percent in tribal areas. This achievement has already exceeded the goal of 80 percent coverage set for the year 2000. However, the success rate in use of safe water for all domestic purposes has lagged far behind at 56 percent Surprisingly this rate was 98 percent in urban slums, despite the fact that slum dwellers spent more time (30 minutes to two hours) fetching the water. Others (5.6%) use water from ponds, marshes, rivers and springs.

In 1996, 83 percent of the urban population had access to sanitation services compared to 38 percent of the rural population and 50 percent of those in tribal areas. The total percentage increased from 11 percent in 1990 to 44 percent in 1996 against a goal of 80 percent for the year 2000. Piped water supply systems and on-site sanitation facilities are operational in the four city corporations and 60 district towns. In Dhaka city, the percentage population covered by sewerage facilities grew from 25

percent in 1990 to only 35 percent in 1997. Only 25 percent of the population benefited from storm sewer facilities in 1995.

Infrastructure

The country has about 2,858 kilometres of railroad, 15,053 kilometres of paved road and roughly 5,896 kilometres of perennial and seasonal waterways. Efforts are underway to develop the water transport system. In fact, rivers are the lifelines of the nation, and provide the cheapest means of transport, water for agriculture, and fish supplies. Results reveal that the costs of losing immobile infrastructure due to inundation following a one meter sea level rise will be greater than US$5 billion, which is equivalent to 10 percent of country's GDP. Such infrastructure includes water works, housing and settlements, transport infrastructure, utilities, and industry.

Food security and crop agriculture

The simulation study conducted under the Climate change country study assessed the vulnerability of food grain production due to climate change in Bangladesh. The experiments considered impact on three high yielding rice varieties and a high yielding wheat variety. Sensitivity to changes in temperature, moisture regime and CO2 fertilization was analyzed against the baseline climate condition. The GFDL model predicted about 17 percent decline in overall rice production and a decline as high as 61 percent in wheat production compared to the baseline situation. The highest impact would be on wheat. The CCCM model predicted a significant, but much reduced shortfall in food grain production.

It was noticed that a 4°C increase in temperature would have severe impacts on food grain production, especially wheat. A rise in temperature would reduce production of rice and wheat by 28 percent and 68 percent respectively. However, a doubling of atmospheric CO2 levels in combination with temperature rises would result in an overall 20 percent rise in rice production and 31% decline in wheat

production. It was found that Boro rice would enjoy a good harvest under severe climate change scenarios.

It is feared that moisture stress would be more intense during the dry season, which might force. The Bangladeshi farmers reduce the area for Boro cultivation. A shortfall in food grain production could therefore severely threaten national food security. They diminish the suitability of a number of seasonal crops that are usually preferred by farmers.

Water resources

The Vulnerability Assessment of the SAARC Coastal Region to Sea Level Rise project has carried out a rigorous analysis of water resources vulnerability to climate change and sea level rise. River water levels are affected by the sea level and upstream river discharges. Moreover, Bangladesh is located on a geo tectonically active sedimentary basin and thus experiences subsidence over almost the entire delta. Changes in river water levels may cause changes in bed levels as the sediment carrying capacity of rivers is affected. Rivers in Bangladesh are morphologically highly dynamic and are expected to adapt to such changes over time.

Bed level changes will cause additional river level changes, which in effect will propagate the impact of sea level rise in an upstream direction. The discharge distribution at the tributaries of the Ganges and the Padma Rivers (Gorai and Arial Kahn Rivers) will change due to sedimentation. These changes might have important consequences for the course of the main river channels in Bangladesh.

Coastal zone

Climate change is only one aspect of the vulnerability of those relying on coastal livelihoods. Vulnerability to climate change means that climate change adversely affects the capability of People to cope with other ‘normal’ vulnerabilities such as food and income security and safety of properties. The selection of the key primary physical effects of these ‘agents of change’ comprising saltwater intrusion,

drainage congestion, disasters (extreme events) and coastal morphology) is based on a full recognition of possible accumulative effects.

Forestry and biodiversity

An attempt was made to qualitatively analyse the impact of climate change on forest resources of Bangladesh. It was found that increased rainfall during monsoon would cause increased runoff on the forest floor instead of infiltration into the soil. As a result there would be enhanced forest floor soil erosion, particularly in dense hill forest areas. Tea plantations in the northeast would also suffer due to moisture stress. The growth of freshwater-loving species would therefore be severely affected. Eventually non-woody shrubs and bushes would replace species offering dense canopy cover, while overall forest productivity would significantly decline. The degradation of forest quality might cause a gradual depletion of the rich diversity of the forest flora and fauna currently found in the Sundarbans ecosystem.

Climate change and Nepal

Nepal's contribution for causing climate change is negligibly small. Today Nepali citizens comprise less than 0.4 percent of the word population and are responsible for only about 0.025 percent of annual greenhouse emissions. Nepal's vulnerability to damage from climate change, however, is large. Temperature is likely to increase more in high mountain areas than elsewhere. Glaciers and snowfields will reduce and may even disappear, reducing Nepal's dry season river water source. This will impact irrigation and drinking water supply and as well as the reliability of hydroelectricity. Global climate change will also likely shift monsoon rainfall patterns in ways that threatens Nepal's current agricultural practices, as well as threaten infrastructure. Changing temperature and moisture pattern will threaten biodiversity, especially in mountain areas where migration of species is physically restricted (GON, 2003).

According to the study carried out by Metrological Department of Nepal, there is increasing phenomenon of melting of glacier and Glacier Lake may cause outburst

and increases flooding. According to the report 0.120C in Himalaya, 0.030C in Hill and 0.060C in Terai temperature is increasing annually (Sapkota, 2007). Shows the increasing trend of temperature in Nepal. Climate change is contemporary issue for Nepal.

Impact of climate change

The following impact will be seen from climate change (Sedhai, 2007).

- Increase in temperature causes the spread of tropical insect mosquitoes, flies and other diseases in upper part that will cause epidemics.
- The pasture land of Himalayas will be cover of bushes that lead to scarcity of pasture land and negative impacts on livestock rearing.
- Scarcity of water, poverty, decrease in agricultural productivity, effects negatively on sustainable tourism development strange climate is being observed in Himalayan area of Nepal due to global climate change. Opposite character of the climate is seen in some topographical areas of Manang and Mustang. Rainfall pattern is changing, the area where minimum rainfall occurred during same season last year's maximum rainfall occurred this year and vice versa. 17ml of rainfall was recorded on May at Mustang in 2008. Three fold quantity of rainfall (53.5 ml) is recorded in the same period this year.

In the same period, in Manang last year 356.6 ml of rainfall was recorded this year only 7ml was recorded. Dramatic change in temperature also recorded in these districts during that season. 40 □C temperature rises is recorded in Manang in one year (Nagarik, Shrawn 8th 2009 follow format). Because of increase in rainfall and decrease in snow fall traditional mud house structure is being damaged, local dwellers of Mustang have started to house roof with corrugated sheet. (Dahal, 2008). Periodic monsoon pattern has been changing and monsoon period shortened. Thousands hector of land is being barren due to lack of irrigation, which are depending upon rainfall. Epidemics and tropical disease outburst is taking place due to lack of monsoon in season (Kantipur, Daily newspaper, 2009).

Migration and globalization: Nepal

In Nepal, migration, whether seasonal or long-term, is a key strategy of adaptation for many households. While it does reduce risk and in the short term can contribute financial resilience through remittances and reduced reliance on land-based livelihoods, it also alters community relationships and local resource management dynamics. The long-term implications of such a strategy could debilitate the social and economic health of the country as domestic skill and expertise declines. At the same time, increased income from remittances can fuel an increase in consumer spending that makes little contribution to the national economy with the end result that the Gross National Production (GNP) depends on a fragile and consumerist remittance economy.

A study by the National Planning Commission (NPC, 2010) suggests that the financial benefit from short-term seasonal migration. Nepal already transfer huge amounts of sediment derived from natural and geological processes such as landslides and other mass movements and the erosion of riverbeds and banks. Rainfall events, particularly cloudbursts, accentuate these processes thereby increasing regional sedimentation. Coarse sediment deposition is particularly intense at the base of hills, where river gradients decline dramatically as they enter the plains. In this zone, rivers shift their channels frequently.

How climate change will affect the migration: Future prediction

This chapter aims to combine the analysis of migration patterns with that of climate impacts. As said earlier, in the current state of science and given the wide range of uncertainties about how populations will respond to climate impacts, it does not seem possible to make accurate predictions or estimates of the number of climate-induced migrants. Thanks to local assessments of migration patterns, climate impacts, and vulnerability, it is, however, possible to identify areas where climate-induced migration could occur, and the processes through which these migration flows would occur (UN, 2013). When assessing the climate change–migration nexus, it is also important to consider how climate change will interact with other migration drivers,

and not only the population movements that will directly result from the impacts of climate change.

Climate change impact on populations in the South Asia.

The following paragraphs look at how climate change is likely to affect populations in the South Asia. With around one-quarter of the world's population and continuing high levels of poverty, South Asia is also an area at great risk of climate change impacts. Unlike many areas of East and Southeast Asia, however, population growth will continue at a substantial pace because fertility levels remain relatively high. A substantial proportion of the region's population lives in vulnerable areas. Show that climate change could lead to a decline of around 20 million tons (25%) in rice production and over 30 million tons in wheat (30%) in India over 2000–2050.

Large populations in India live in areas likely to experience greater riparian flooding and water stress as a result of climate change-major factors that will lead to lower agricultural productivity. A significant number will also be affected by coastal flooding. Substantial parts of Mumbai, a city with a metropolitan population of around 20 million people, are below sea level and already subject to flooding.

In January 2011, flash floods ravaged Sri Lanka, affecting more than one million people, including more than 3,00, 000 forced out of their homes. By 2050 it is anticipated that 1.4 billion Indians will be living in areas experiencing negative climate change impacts. Moreover, there will be more than 250 million people living in hot spots at multiple risk of climate change in both Bangladesh and Pakistan. While most people will adapt in situ, the potential for redistribution of population through migration is substantial.

Climate change represents an important potential brake on recent rapid economic growth in India. India is a vast nation with complex patterns of internal mobility (both permanent and temporary), and recent rapid economic growth has been accompanied by a significant redistribution of population, especially from rural to urban areas. This situation will be exacerbated by the impact of climate change on

agriculture. India is also one of the world's major origin nations for international migrants, with a diaspora of around 20 million. There are high levels of unskilled migration to the Middle East and rapidly growing skilled migration to Organization for Economic Co-operation and Development (OECD) member countries and richer economies in Asia.

Some of the recurrent environmental patterns that can be expected in India include increasing intensity and frequency of cyclones and floods along important rivers such as the Ganges and Brahmaputra in the north; the Mahanadi, Godavari, and Krishna rivers in the south; the Indus in the west; and in the northeastern and eastern regions from Assam and West Bengal to Andhra Pradesh and Tamil Nadu (Revi,2008).

Northern India, including the states of Bihar and West Bengal-and large cities such as Chennai, Kolkata, and Mumbai-have already been exposed to frequent floods and to tsunamis (De, Dube, and Prakasa Rao 2005). Longer and more frequent droughts and water stress have been recorded in several states, particularly those in western and central India (Mall et al. 2006). Chennai and Mumbai are arguably the areas most vulnerable to sea-level rise (Kelkar &Bhadwal, 2007).

Most of India's population is employed in the agriculture sector and is heavily dependent on water for irrigation purposes. It is predicted that, by 2050, annual runoff in the Brahmaputra and Indus basins will decline substantially (Kelkar & Bhadwal, 2007). In light of the dependence on agriculture for daily subsistence and livelihoods, more floods, landslides, droughts, and cyclones will increase vulnerability and lead to displacement.

Bangladesh figures prominently in global discussions of climate change because of the millions of poor living in its low-lying deltaic region who are already subject to severe environmental hazards. The country is already at high risk of flooding due to sea surges, river flow, and local rainfall events, and interactions between all three. Migration, both internal and international labor migration of unskilled workers, is increasingly being used within Bangladesh as a coping

mechanism in the face of environmental and economic challenges (Afsar, 2005; Siddiqui, 2005).

Forty percent of migrant workers originate from just 5 of 64 districts (Brahmanbaria, Chittagong, Comilla, Dhaka, and Tangail), all in the south of the country (Siddiqui 2005). These areas are especially prone to flooding and environmental events. It is clear that environmental factors are working together with economic forces in causing migration. Environmental processes and events have played an important role in shaping migration, although usually in combination with economic, social, and conflict-related factors. Nevertheless, it seems inevitable that climate change will strengthen those environmental forces so that pressure for permanent and temporary migration out of the areas affected will continue.

Temporary and permanent internal migration due to environmental displacement has a long history in Bangladesh, but it is arguably still the socioeconomic vulnerability of the rural population that has been the primary driver. And it is times of famine, rather than extreme natural hazards, that have led to the greatest movements of people in recent history (Faisal & Parveen, 2004; Dowlah, 2006). Projected climate change would significantly increase the numbers and the permanency of those movements.

As elsewhere, a high proportion of internal migration in Bangladesh is associated with a shift from rural to urban regions. Greater congestion of urban areas has already led to severe health, security, and resource issues for a large number of the urban poor. Metropolitan Dhaka is an important destination, but with more than 16 million residents it is itself highly vulnerable to socio ecological degradation and to the impacts of climate change (Alam & Rabbani, 2007).

Indeed, Dhaka's vulnerability to flooding and cyclonic events brings into doubt its role as a destination for the displaced-temporary or permanent. Dhaka is 2-13 meters above mean sea level, with most of the urbanized areas at elevations of 6–8 meters (Alam & Rabbani, 2007). Nonetheless, Dhaka continues to attract large numbers of migrants.

Elsewhere in South Asia, landlocked Nepal is a country that has experienced substantial environmental degradation and could see much more due to climate change impacts. More extreme monsoonal rainfall and associated landslides and floods would impoverish many rural Nepalese in the hill and mountain valley regions. Nepal has experienced considerable rural–urban migration, primarily to Kathmandu and environs. A long-standing open border policy with India has facilitated movement across the country's southern frontier and swelled the ranks of a substantial Nepali émigré population.

A major threshold for a nonlinear increase in migration could originate from increasing flood risk in the relatively low-lying Terai region, which is comparatively densely populated and already experiences regular flooding. More flooding could boost outward migration from this southern region as residents escape regular inundation, which leads to crop and stock losses, impoverishment, and malnourishment. Climate change could reduce effective agricultural territory within the Terai region and provide less of a buffer within the country to absorb those people moving down from high hill and mountain valley regions.

What are the major issues of climate change in the world?

Climate shocks already figure prominently in the lives of the poor. Events such as droughts, floods and storms are oft en terrible experiences for those affected: they threaten lives and leave people feeling insecure. But climate shocks also erode long-term opportunities for human development, undermining productivity and eroding human capabilities. No single climate shock can be attributed to climate change. However, climate change is ratcheting up the risks and vulnerabilities facing the poor. It is placing further stress on already over-stretched coping mechanisms and trapping people in downward spirals of deprivation. Vulnerability to climate shocks is unequally distributed. Hurricane Katrina provided a potent reminder of human frailty in the face of climate change even in the richest countries-especially when the impacts interact with institutionalized inequality.

Across the developed world, public concern over exposure to extreme climate risks is mounting. With every flood, storm and heat wave, that concerns is increasing. Yet climate disasters are heavily concentrated in poor countries. Some 262 million people were affected by climate disasters annually from 2000 to 2004, over 98 percent of them in the developing world.

In the Organization for OECD countries one in 1,500 people was affected by climate disaster. The comparable figure for developing countries is one in 19-a risk differential of 79. High levels of poverty and low levels of human development limit the capacity of poor households to manage climate risks. With limited access to formal insurance, low incomes and meagre assets, poor households have to deal with climate-related shocks under highly constrained conditions. Strategies for coping with climate risks can reinforce deprivation. Producers in drought prone areas often forego production of crops that could raise income in order to minimize risk, preferring to produce crops with lower economic returns but resistant to drought.

When climate disasters strike, the poor are oft en forced to sell productive assets, with attend at implications for recovery, in order to protect consumption. And when that is not enough households cope in other ways: for example, by cutting meals, reducing spending on health and taking children out of school. These are desperation measures that can create life-long cycles of disadvantage, locking vulnerable households into low human development traps. Research carried out for this report underlines just how potent these traps can be. Using micro level household data we examined some of the long-term impacts of climate-shocks in the lives of the poor.

In Ethiopia and Kenya, two of the world's most drought-prone countries, children aged five or less are respectively 36 and 50 percent more likely to be malnourished if they were born during a drought. For Ethiopia, that translates into some 2 million additional malnourished children in 2005. In Niger, children aged two or less born in a drought year were 72 percent more likely to be stunted. And Indian women born during a flood in the 1970s were 19 percent less likely to have attended primary school.

The long-run damage to human development generated through climate shocks is insufficiently appreciated. Media reporting of climate-related disasters oft en plays an important role in informing opinion-and in capturing the human suffering that comes with climate shocks. However, it also gives rise to a perception that these are 'here-today-gone-tomorrow' experiences, diverting attention from the long-run human consequences of droughts and floods.

Climate change will not announce itself as an apocalyptic event in the lives of the poor. Direct attribution of any specific event to climate change will remain impossible. However, climate change will steadily increase the exposure of poor and vulnerable households to climate-shocks and place increased pressure on coping strategies, which, over time, could steadily erode human capabilities. We identify five key transmission mechanisms through which climate change could stall and then reverse human development and some others are mentioned below (WDR, 2008).

Impact of climate change on agriculture

Climate change threat to agriculture is now unambiguous, but the exact magnitude is uncertain because of complex interactions and feedback process in the ecosystem and the economy. Greater risk of crops and livestock death are already imposing economic losses and undermining food security and they are likely to get far more severe as global warming continues. Five main factors will affect agricultural productivity: change in temperature, precipitation, carbon dioxide fertilization, climate variability, and surface water runoff.

For temperature increase above 30º C, yield losses are expected to occur everywhere and be particularly severe in tropical regions. In parts of Africa, Asia and Central America yields of wheat and maize could decline by around 20 to 40 percent as temperature rises by 3 to 40º C, even assuming from-level adjustment to higher temperature. With full CO2 fertilization the losses would be about half as large. Rice yields would also decline, though less than wheat and maize yields (WDR, 2008).

More than 70 percent of the population relies on traditional and subsistence agriculture, the majority of which are dependent on rain-fed agriculture and pastures. This all makes our economy extremely vulnerable to any slight changes in the weather. These changes are happening now and many people's livelihood is under threat (Abdalla, 2009).

Increasing atmospheric CO2 levels, driven by emissions from human activities, can act as a fertilizer and enhance the growth of some crops such as wheat, rice and soybeans. CO2 can be one of a number of limiting factors that, when increased, can enhance crop growth. Other limiting factors include water and nutrient availability. While it is expected that CO2 fertilization will have a positive impact on some crops, other aspects of climate change (e.g., temperature and precipitation changes) may temper any beneficial CO2 fertilization effect (IPCC, 2007).

Change in climatic variability and extreme events

Changes in the frequency and severity of heat waves, drought, floods and hurricanes, remain a key uncertainty in future climate change. Such changes are anticipated by global climate models, but regional changes and the potential effects on agriculture are more difficult to forecast. Experience of Nepali farmers is similar to Uganda, Malawi, Haiti, Bolivia, Vietnam and South Africa. Farmers are in the trap of decreasing production and productivity of crops. Farmers of Baitadi and Roshi have not seen any drop of water in monsoon season and say "In this year production of Barley is reduced, and production of other crops is also decreasing. Local farmers' ability to prediction of weather system is distorted because of uncertainty in season and rainfall.

Rainfall pattern is opposite in comparison with past years (Tandan, 2066). Over two-thirds of Nepal's population depends on agriculture for their livelihood. Farmers follow traditional agricultural patterns, relying on rainwater and seasons. Changes in local and regional temperatures, the form and amount of precipitation, rainfall patterns, soil moisture content, and sunshine and cloudiness threaten traditional agriculture in Nepal. Moreover, climate change will increase the

occurrence of extreme events like floods, droughts and hailstorms, which can also have a drastic effect on agriculture. Rising temperatures and increased rainfall may also lead to more pests and weeds, which will reduce agricultural productivity. 4

Reduced agricultural productivity

Around three-quarters of the world's population living on less than US$1 a day depend directly on agriculture. Climate change scenarios point to large losses in productivity for food staples linked to drought and rainfall variation in parts of sub-Saharan Africa and South and East Asia. Projected revenue losses for dry land areas in sub-Saharan Africa amount to 26 percent by 2060, with total revenue losses of US$26 billion (in constant 2003 terms)-in excess of bilateral aid transfers to the region. Through its impact on agriculture and food security, climate change could leave an additional 600 million facing acute malnutrition by the 2080s over and above the level in a no-climate change scenario.

Impact of climate change on overall economy

Developing countries are most vulnerable to the economic impacts of climate change. The increased frequency and severity of extreme weather events can have serious economic consequences. The impact of climate change on agriculture and the fragile ecosystems in Nepal will have a direct impact on agricultural productivity and tourism, and consequently on the country's economy.

Climate affects the livelihood of the people

According to UN climate change impact report the following impacts of climate will appear on climate and affects the livelihood of the people. About 20 to 30 percent of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global average temperature exceed 1.5º to 2.5º degrees C (2.7º to 4.5º degrees F).

The mountainous areas of Europe will face much greater species losses, in some areas up to 60 percent under high emission scenarios by 2080. By 2020,

between 75 and 250 million people in Africa are projected to be exposed to an increase of water stress due to climate change. By mid-century, annual average river runoff and water availability are projected to increase by 10-40 percent at high altitudes and in some wet tropical areas, and decrease by 10-30 percent over some dry regions at mid-latitudes and in the dry tropics, some of which are presently water stressed areas.

- Over the course of the century, water supplies stored in glaciers and snow cover are projected to decline, reducing water availability in regions supplied by melt water from major mountain ranges, where more than one-sixth of the world population currently lives.
- By the 2080s, millions of people are projected to be flooded every year due to sea-level rise, the report predicts. The numbers affected will be largest in the mega-deltas of Asia and Africa while small islands are especially vulnerable.
- Glacier melt in the Himalayas is projected to increase flooding and avalanches and affect water resources within the next two to three decades. This will be followed by decreased river flows as the glaciers recede.
- Poor countries that bear least responsibility will suffer most - and they have no money to respond - but people should also be aware that even the richer countries risk enormous damage.

Impact of climate change on biodiversity

About 20 to 30 percent of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global average temperature exceed 1.5º to 2.5º C (2.7º to 4.5º F) (UN, 2008). A recent study projected that doubling of atmospheric carbon dioxide (CO2) concentration will reduce Nepal's forest types from 15 to 12, and habitats and ecosystem will be destroyed. Climate change will also affect the productivity of natural ecosystems, particularly provision of environmental services such as clean air, water, food and aesthetic values. Communities of various parts of Nepal have already experienced loss of native plants and species. Climate change will alter the world's habitats and ecosystems. Climate change will alter the fragile ecosystems of the Himalayas. (Gaire et al., 2008).

The collapse of ecosystem

All predicted species extinction rates accelerate beyond the 2°C threshold, with 3°C marking the point at which 20–30 percent of species would be at ‘high risk’ of extinction. Coral reef systems, already in decline, would suffer extensive ‘bleaching’ leading to the transformation of marine ecologies, with large losses of biodiversity and ecosystem services. This would adversely affect hundreds of millions of people dependent upon fish for their livelihoods and nutrition.

Water stress and water insecurity

Changed run-off patterns and glacial melt will add to ecological stress, compromising flows of water for irrigation and human settlements in the process. An additional 1.8 billion people by 2080.Central Asia, Northern China and the northern part of South Asia face immense vulnerabilities associated with the retreat of glaciers-at a rate of 10–15 meters a year in the Himalayas. Seven of Asia’s great river systems will experience an increase in flows over the short term, followed by a decline as glaciers melt. The Andean region also faces imminent water security threats with the collapse of tropical glaciers. Several countries in already highly water-stressed regions such as the Middle East could experience deep losses in water availability could be living in a water scarce environment.

Climate change will affect rainfall, temperature and water availability for agriculture in vulnerable areas. For example, drought affected areas in sub-Saharan Africa could expand by 60–90 million hectares, with dry land zones suffering losses of US$ 26 billion by 2060 (2003 prices), a figure in excess of bilateral aid to the region in 2005. Other developing regions-including Latin America and South Asia-will also experience losses in agricultural production, undermining efforts to cut rural poverty. The additional number affected by malnutrition could rise to 600 million by 2080.

Impact of climate change on human health

Rich countries are already preparing public health systems to deal with future climate shocks, such as the 2003 European heat wave and more extreme summer and winter conditions. However, the greatest health impacts will be felt in developing countries because of high levels of poverty and the limited capacity of public health systems to respond. Major killer diseases could expand their coverage. For example, an additional 220-400 million people could be exposed to malaria-a disease that already claims around 1 million lives annually. Dengue fever is already in evidence at higher levels of elevation than has previously been the case, especially in Latin America and parts of East Asia.

They will interact with wider social, economic and ecological processes that shape opportunities for human development. Inevitably, the precise mix of transmission mechanisms from climate change to human development will vary across and within countries. Large areas of uncertainty remain. What is certain is that dangerous climate change has the potential to deliver powerful systemic shocks to human development across a large group of countries.

Diseases such as malaria and Japanese encephalitis have spread to new areas. Temperature 22º- 23ºC favors development of mosquitoes and completion of its cycle, children. Projected climate change-related exposures are likely to affect the health status of millions of people through increases in malnutrition, heat waves, floods, storms, fires and droughts; the increased frequency of cardio-respiratory diseases due to higher concentrations of ground level ozone related to climate change; and, the migration of some infectious diseases.

Climate change may directly affect human health through increase in average temperature. Such increase may lead to more extreme heat waves during the summer while producing less extreme cold spells during the winter. Rising average temperature is predicted to increase the incidence of heat waves and hot extremes. In the United States, Chicago is projected to experience 25 percent more frequent heat waves and Los Angeles a four-to-eight-fold increase in heat wave days by the end of

the century Particular segments of the population such as those with heart problems, asthma, the elderly, the very young and the homeless can be especially vulnerable to extreme heat (IPCC, 2007).

Developing countries are at a double disadvantage in this area: they are located in tropical areas that stand to experience some of the most severe early impacts from climate change; and agriculture-the sector most immediately affected-plays a far greater social and economic role. Above all, they are characterized by high levels of poverty, malnutrition and disadvantage in health. The combination of acute deprivation on the one side, with weak social insurance provision and limited infrastructural capacity to contain climate risks on the other, points to a high potential for human development reversals.

Child death

Indoor air pollution resulting from the use of solid fuels is a major killer. It claims the lives of 1.5 million people each year, more than half of them below the age of five: that is 4000 deaths a day. To put this number in context, it exceeds total deaths from malaria and rivals the number of deaths from tuberculosis. Most of the victims are women, children and the rural poor. Indoor air pollution is also one of the main causes of lower respiratory tract infections and pneumonia in children. In Uganda, children under the age of five are reported to suffer 1-3 episodes of acute respiratory tract infection annually.

In India, where three in every four households in rural areas depend on firewood and dung for cooking and heat, pollution from unprocessed bio-fuels accounts for some 17 percent of child deaths. Electrification is often associated with wider advances in health status. For example, in Bangladesh, rural electrification is estimated to increase income by 11 percent- and to avert 25 child deaths for every 1000 households connected.

Climate change and future challenge

Understanding the scientific evidence on climate change is a starting point for understanding the human development challenges of the 21st Century. There is a vast amount of scientific literature on the subject. Here we focus on the consensus set out by the IPCC, while drawing attention to the large areas of uncertainty over future outcomes. In looking at the future under climate change there are many 'known unknowns'-events that can be predicted but without any certainty as to their timing or magnitude. It should come as no surprise that scientists cannot be certain about precisely how the Earth's ecological systems will respond to human-induced greenhouse gas emissions: we are living with an experiment that has never been conducted before. One of the 'knowns' is that we are on a trajectory that, if uncorrected, will lead to a very high probability of dangerous climate change outcomes. Those outcomes would provide a continuum from near-term human development setbacks to long term ecological disaster.

Differences in the depth of carbon footprints are linked to the history of industrial development. But, they also reflect the large 'carbon debt' accumulated by rich countries-a debt rooted in the over-exploitation of the Earth's atmosphere. People in the rich world are increasingly concerned about emissions of greenhouse gases from developing countries. They tend to be less aware of their own place in the global distribution of CO2 emissions. Consider the following examples, The United Kingdom (population 60million) emits more CO2 than Egypt, Nigeria, Pakistan, and Viet Nam combined (total population 472 million).The Netherlands emits more CO2 than Bolivia, Colombia, Peru, Uruguay and the seven countries of Central America combined.

The state of Texas (population 23 million) in the United States registers CO2 emissions of around 700 Mt CO2 or 12 percent of the United States' total emissions. That figure is greater than the total CO2 footprint left by sub-Saharan Africa-a region of 720 million people. The state of New South Wales in Australia (population 6.9 million) has a carbon footprint of 116 Mt CO2. This figure is comparable to the combined total for Bangladesh, Cambodia, Ethiopia, Kenya, Morocco, Nepal and Sri

Lanka. The 19 million people living in New York State have a higher carbon footprint than the 146 Mt CO2 left by the 766 million people living in the 50 least developed countries.

Currently some 2.5 billion people depend on biomass. Changing this picture is vital for human development.

The challenge is to expand access to basic energy services while limiting increases in the depth of the developing world's per capita carbon footprint. Enhanced efficiency in energy use and the development of low-carbon technologies hold the keys. Lack access to such services. Most some contribution: How does human development relate to our environmental concerns in general and to climate change in particular? There are well established traditions in policy discussions to make us think of the demands of development and the preservation of the environment in rather antagonistic terms.

Attention is often concentrated on the fact that many of the deteriorating environmental trends in the world, including global warming and other disturbing evidence of climate change, are linked with heightened economic activity, such as industrial growth, increased energy consumption, more intensive irrigation, commercial felling of trees, and other activities that tend to correlate with economic expansion. There is a huge contribution that the human development approach can make by invoking the central perspective of seeing development as the expansion of substantive human freedom, which is indeed the point of departure of the human development approach. In this broader perspective, assessment of development cannot be divorced from considering the lives that people can lead and the real freedoms that they can enjoy. Development cannot be seen merely in terms of enhancement of inanimate objects of convenience, such as a rise in the GNP (or in personal incomes).

This is the basic insight that the human development approach brought to the development literature right from the outset of that approach, and this insight is critically important today for clarity regarding environmental sustainability. People have reason to satisfy their needs, of course, and the elementary applications of the

human development approach (for example what we get from the simple Human Development Index, the HDI) do indeed focus exactly on that. But the domain of freedom can go well beyond that, and the use of the fuller human development perspective can take into account the freedom of people to do things that are not governed exclusively by their own needs. Human beings may not, for example, 'need' spotted owls in any obvious sense, and yet if they have reason to object to the extinction of such species, then the value of their freedom to achieve this deliberated goal can be the basis of a reasoned judgment.

Prevention of the extinction of animal species that we human beings want to preserve (not so much because we 'need' these animals in any specific way, but because we judge that it is a bad idea to let existing species disappear forever) can be an integral part of the human development approach. In fact, the preservation of biodiversity is likely to be among the concerns in our responsible thinking about climate change.

Second, the environment is not only a matter of passive preservation, but also one of active pursuit. We must not think of the environment exclusively in terms of pre-existing natural conditions, since the environment can also include the results of human creation. For example, purification of water is a part of improving the environment in which we live. The elimination of epidemics, such as smallpox (which has already occurred) and malaria (which ought to occur very soon if we can get our acts together), is a good illustration of an environmental improvement that we can bring about.

This positive recognition does not, of course, change the significant fact that the process of economic and social development can, in many circumstances, also have strongly destructive consequences. Those unfavorable effects have to be clearly identified and firmly resisted, along with strengthening the positive and constructive contributions of development. Even though many human activities that accompany the process of development may have destructive consequences, it is also within human power to resist and reverse many of these bad consequences if timely action is taken activity.

It takes 2 to 3 hours a day. When she is unable to collect wood, she has no choice but to use animal dung for cooking-a serious health hazard. In developing countries there are some 2.5 billion people like Elisabeth Faye who are forced to rely on biomass-fuel wood, charcoal and animal dung-to meet their energy needs for cooking. In sub-Saharan Africa, over 80 percent of the population depends on traditional biomass for cooking, as do over half of the populations of India and China. Unequal access to modern energy is closely correlated with wider inequalities in opportunities for human development. Within countries, inequalities in access to modern energy services between rich and poor and urban and rural areas interact with wider inequalities in opportunity. Poor people and poor countries pay a high price for deficits in modern energy provision (UNDP, 2008).

Gender and climate change

Women and young girls have to allocate large amounts of time to the collection of Fire wood compounding gender inequalities in livelihood opportunities and education. Collecting fuel wood and animal dung is a time-consuming and exhausting task, with average loads often in excess of 20kg. Research in rural Tanzania has found that women in some areas walk 5-10 kilometers a day collecting and carrying firewood, with loads averaging 20kg to 38kg. In rural India, average collection times can amount to over 3 hours a day. Beyond the immediate burden on time and body, fuel wood collection often results in young girls being kept out of school.

Poor households often spend a large share of their income on fuel wood or charcoal. In Guatemala and Nepal, wood expenditure represents 10-15 percent of total household expenditure in the poorest quintile. Collection time for fuel wood has significant opportunity costs, limiting opportunities for women to engage in income generating activities. More broadly, inadequate access to modern energy services restricts productivity and helps keep people poor.

Climate change and environment

Deficits in access to modern energy can create a vicious circle of environmental, economic and social reversal. Unsustainable production of charcoal in response to rising urban demand has placed a huge strain on areas surrounding major cities such as Luanda in Angola and Addis Ababa in Ethiopia. In some cases, charcoal production and wood collection has on tribute to local deforestation.

As resources shrink, dung and residues are diverted to fuel use instead of being ploughed back into fields, undermining soil productivity. Expanded access to affordable electricity for the poor remains an overarching development priority. Current projections show that the number of people relying on biomass will increase over the next decade and beyond, especially in sub-Saharan Africa. This will compromise progress towards several Millinium Development Goals (MDGs), including those relating to child and maternal survival, education, poverty reduction and environmental sustainability.

Human development projection

Major losses in agricultural production leading to increased malnutrition and reduced opportunities for poverty reduction. Overall, climate change will lower the incomes and reduce the opportunities of vulnerable populations. By 2080, the number of additional people at risk of hunger could reach 600 million-twice the number of people living in poverty in sub-Saharan Africa today (UNDP, 2013).

Global assessments of the impact of climate change on agriculture obscure very large variations across and even within countries. In broad terms, climate change will increase the risks to and reduce the productivity of developing country agriculture.

In contrast, production could be boosted in developed countries, so that the distribution of world food production may shift. Developing countries are likely to become more dependent on imports from the rich world, with their farmers losing market shares in agricultural trade.48 Emerging patterns of climate change risk in

agriculture will have important implications for human development. Around three in every four people in the world living on less than US$1 a day reside in rural areas. Their livelihoods depend on smallholder agriculture, farm employment, or pastoralism.

The same constituency also accounts for most of the 800 million people in the world who are malnourished. Climate change impacts on agriculture will thus have important multiplier effects. Agricultural production and employment underpin many national economies. The agricultural sector accounts for over one third Rising sea levels and exposure to climate disasters. Sea levels could rise rapidly with accelerated ice sheet disintegration.

Global temperature increases of 3-4°C could result in 330 million people being permanently or temporarily displaced through flooding. Over 70 million people in Bangladesh, 6 million in Lower Egypt and 22 million in Viet Nam could be affected. Small island states in the Caribbean and Pacific could suffer catastrophic damage. Warming seas will also fuel more intense tropical storms. With over 344 million people currently exposed to tropical cyclones, more intensive storms could have devastating consequences for a large group of countries. The 1 billion people currently living in urban slums on fragile hillsides or flood-prone river banks face acute vulnerabilities. (UNDP, 2013).

Income and poverty

There are still around 1 billion people living at the margins of survival on less than US$1 a day, with 2.6 billion-40 percent of the world's population-living on less than US$2 a day. Outside East Asia, most developing regions are reducing poverty at a slow pace-too slowly to achieve the MDG target of halving extreme poverty by 2015. Unless there is an acceleration of poverty reduction from 2008 onwards, the target looks likely to be missed by around 380 million people.

Nutrition

Around 28 percent of all children in developing countries are estimated to be underweight or stunted. The two regions that account for the bulk of the deficit are South Asia and sub-Saharan Africaand both are off track in terms of achieving the MDG target of halving under-nutrition by 2015. If India's high economic growth is unequivocal good news, the bad news is that this has not been translated into accelerated progress in cutting under-nutrition. One-half of all rural children are underweight for their age-roughly the same proportion as in 1992.

Child mortality

Around 10 million children die each year before the age of 5, the vast majority from poverty and malnutrition. Only around 32 countries out of 147 monitored by the World Bank are on track to achieve the MDG of a two-thirds reduction in child mortality by 2015. South Asia and sub-Saharan Africa is comprehensively off track. On current trends the MDG target will be will be missed by a margin that will represent 4.4 million additional deaths in 2015.9

Health infectious diseases

Infectious diseases continue to blight the lives of the poor across the world. An estimated 40 million people are living with Human Immune Viral HIV/AIDS, with 3 million deaths in 2004. Every year there are 350–500 million cases of malaria, with 1 million fatalities: Africa accounts for 90 percent of malarial deaths and African children account for over 80 percent of malaria victims worldwide.10 These deficits in human development draw attention to deep inequalities across the world. The 40 percent of the world's population living on less than US$2 a day accounts for 5 percent of global income.

The richest 20 percent accounts for three-quarters of world income. In the case of sub-Saharan Africa, a whole region has been left behind: it will account for almost one-third of world poverty in 2015, up from one-fifth in 1990. Income

inequality is also rising within countries. More than 80 percent of the world's population lives in countries where income differentials are widening.

According to one analysis, developing countries have to grow at over three times the pre-1990 rate to achieve the same reduction in poverty incidence. Child death rates among the poorest are one-fifth in the developing world. In an increasingly urbanized world, disparities between rural and urban populations remain substantial. Rural areas account for three in every four people living on less than US$1 a day and a similar share of the world population suffering from malnutrition.13 The state of the world's environment is a vital link between climate change and human development. In 2005, the United Nations' Millennium Ecosystem Assessment drew attention to the global deterioration of vital ecosystems, including mangrove swamps, wetlands and forests. These ecosystems are highly vulnerable to climate change-as are the people who depend on the services they provide. At a time when climate change concerns are mounting across the world, it is important that complex future scenarios are considered in the context of initial human development conditions.(HD, 2008).

International panel on climate change (IPCC)

The IPCC's fourth assessment draws attention to a wide range of uncertainties linked to potentially catastrophic events. Two such events have figured prominently in debates on climate change. The first is a reversal of the meridional overturning circulation (MOC), the vast conveyor of warm water in the Atlantic Ocean. The heat transported by the Gulf Stream is equivalent to around 1 percent of humanity's current energy use. As a result of this heat transport, Europe is up to 8°C warmer, with the largest effects apparent in winter.

It is the threat to the comparatively mild European climate, as well as climate concerns elsewhere, that has given rise to worries about the future of the MOC. Additional fresh water fl owing into the North Atlantic as a result of glacial melting has been identified as a potential force for shutting down or slowing the MOC. Switching off the Gulf Stream would put northern Europe on course for an early ice age. While the IPCC concludes that a large abrupt transition is very unlikely in the

21st Century, it warns that "longer-term changes in the MOC cannot be assessed with confidence". Moreover, the likelihood range for an abrupt transition is still 5-10 percent. While this may be "very unlikely" in terms of the IPCC's statistical accounting, the magnitude of the threat and the considerable uncertainty that surrounds it make a powerful case for precautionary behavior in the interests of future generations. The same applies to rising sea levels. The IPCC scenarios point to rises of between 20 and 60 centimeters by the end of the 21st Century.

That is more than a marginal change. Moreover, the fourth assessment acknowledges that "larger values cannot be excluded." Outcomes will depend upon complex ice formation and melting processes, and on wider carbon cycle effects. The IPCC anticipates the continuing contraction of the great ice sheet in Greenland as a source of rising sea levels, with uncertainty over the future of the ice sheets of Antarctica. However, in the case of Antarctica the IPCC acknowledges that recent models provide evidence pointing to processes that could "increase the vulnerability of the ice-sheets to warming".45 these uncertainties are of more than passing academic concern. Consider first the evidence on the melting of ice sheets and rising sea levels. So far, the rise in sea level has been dominated by thermal expansion these uncertainties are of more than passing academic concern. Consider first the evidence on the melting of ice sheets and rising sea levels.

So far, the rise in sea level has been dominated by thermal expansion due to increased temperatures rather than glacial melt-but this could change. For humanity as a whole, the accelerated disintegration and eventual demise of the Greenland and West Antarctic ice sheets are perhaps the greatest of all the threats linked to climate change. Recent evidence suggests that warming ocean waters are now thinning some West Antarctic ice shelves by several metres in a year. The area of Greenland on which summer melting of ice took place has increased by more than 50 percent during the past 25 years. Concern over the fate of Antarctic ice shelves has been gathering since the enormous Larsen B ice shelf collapsed in 2002.

But research in this area necessarily encompasses insights from social as well as natural sciences and from policy analysts even outside the IPCC process that, by its

nature, cannot be all-encompassing. Participants at a meeting in London in October 2001, hosted by the Tyndall Centre and the International Institute for Environment and Development, including climate scientists, humanitarian relief and international development agencies, argued that new priorities for research and policy in this area are required, reflecting the lived experience of resource-dependent societies in the developing world in coping with climate variability, and even with observed climate change in the recent past. And these lessons, they argued, should feed upwards into the actions of international development agencies and to the whole notion of adaptation within the processes and mechanisms of the UN FCCC Cross & Barker, 1992; Mortimore, 1998; Huq et al., 1999; Huq, 200 Huq, 2001; Berkes & Jolly, 2001; Adger et al., 2001b; Roncoli et al., 2001).

United Nation on Framework for Climate Change Conference (UNFCCC)

The convention was adopted on 9 May 1992 in New York and signed at the 1992 Earth Summit in Rio de Janeiro by more than 150 countries and the European Community. Its ultimate objective is the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." It contains commitments for all Parties. Under the Convention, Parties included in Annex I aim to return greenhouse gas emissions not controlled by the Montreal Protocol to 1990 levels by the year 2000. The Convention entered into force in March 1994. See also Kyoto Protocol and conference of the Parties (COP).

Conference on parties (COP)

The supreme body of the United Nations Framework Convention on Climate Change (UNFCCC), comprising countries that have ratified or acceded to the UNFCCC is known as conference of parties. The first session of the Conference of the Parties (COP- 1) was held in Berlin, Germany in 1995, followed by COP-2 in Geneva, Switzerland 1996, COP-3 in Kyoto, Japan 1997, COP-4 in Buenos Aires, Argentina 1998, COP-5 in Bonn, Germany 1999,

COP-6 Part 1 in The Hague, Netherland 2000, and COP-6 Part 2 in Bonn, Germany 2001, COP-7 in Marrakech, Morocco 2001, COP-8 in New Delhi, India 2002, COP-9 in Milan, Italy 2003, COP-10 in Buenos Aires, Argentina 2004, COP-11 in Montreal, Canada 2005,COP-12 in Nairobi 2006, COP-13 in Bali, Indonesia 2007, COP-14 in Poznañ, Poland 2008, COP-15 in Copenhagen, Denmark 2009, COP-16 in Cancún, Mexico 2010 and COP-17 to be held in Durban, South Africa 2011.

Bali action plan

The Bali Action Plan represents an important step in this global effort by recognizing that all countries that contribute to atmospheric emissions must undertake measurable, reportable, and verifiable mitigation actions in order to cut greenhouse gas emissions. The United States is taking a leading role in addressing climate change by advancing an ever-expanding suite of measures. And have initiated a number of polices and partnerships that span a wide range of initiatives from reducing their emissions at home to developing transformational low-carbon technologies to improving observations systems that will help to better understand and address the possible impacts of climate change. The efforts emphasize the importance of results-driven action both internationally and domestically.

Kyoto protocol

The Kyoto protocol was adopted at COP-3 in Kyoto, Japan, on 11 December 1997. The Kyoto Protocol is intended to supplement and strengthen the Convention by creating binding targets on GHG emissions for Annex I Parties. It is founded on the same principles the Convention and shares its ultimate objective, as well as the way it groups counties into Annex I, Parties. It also shares the Convention's institutions.

The COP will also serve as the 'meeting of the Parties' (the CMP, formerly the COP/MOP) to the Protocol. The COP Secretariat will serve as the Secretariat to the Kyoto Protocol, and the IPCC will support the Protocol on scientific, technical and methodological matters. Only countries that are already Parties to the Convention

can ratify (or accept, approve, or accede to) the Protocol, and thereby become Parties to it. The rules for entry into force of the Kyoto Protocol require 55 Parties to the Convention to ratify (or approve, accept or accede to) the Protocol, including Annex I Parties accounting for 55 per cent of that group's carbon dioxide emissions in 1990.

These criteria ensured that no single Party could veto the Protocol's entry into force. Following ratification by Russia on 18 November 2004, the Protocol achieved its criteria for entry into force, and 90 days after this date, on 16 February 2005, the Kyoto Protocol entered into force. The entry into force of the Protocol shifted attention to the implementation of its legally-binding emissions targets.

The Global Environment Facility (GEF)

The GEF was established by developed countries in 1991 to fund the incremental costs to developing countries of their participation in international environmental treaties. GEF serves as the 'operating entity' of the Convention's financial mechanism. The COP provides policy guidance to the GEF on its climate change policies, programme priorities and eligibility criteria for funding based on advice from the SBI. Correspondingly, the GEF reports on its climate change work to the COP every year.

As part of the Marrakesh Accords (a 2001 set of agreements on implementation of both the UNFCCC and Kyoto Protocol) the COP gave additional guidance to the GEF that expanded the scope of activities eligible for funding, including in the areas of adaptation and capacity building. The Marrakesh Accords also established two new funds under the Convention. These are managed by the GEF, as the financial operating entity of the Convention.

Climate change: Resilience and mitigation process in the world

The global mitigation effort would be dramatically enhanced if a post 2012 Kyoto framework incorporated mechanisms for finance and technology obstacles to the rapid disbursement of the low carbon technologies needed to avoid dangerous

climate change. Cooperation to support the conservation and sustainable management of rainforests would also strengthen the mitigation effort.

Adaptation priorities transfer. These mechanisms could help remove must also be addressed. For too long, climate change adaptation has been treated as a peripheral concern, rather than as a core part of the international poverty reduction agenda. Mitigation is an imperative because it will define prospects for avoiding dangerous climate change in the future. But the world's poor cannot be left to sink or swim with their own resources while rich countries protect their citizens behind climate-defense for ratifications. Social justice and respect of human rights demand stronger international commitment on adaptation.

Mitigation and adaptation

To address climate change, two approaches have been identified that deal with the cause and effect of climate change. Mitigation focuses on the reduction of greenhouse gas emission and adaptation reduces the changes resulting from global warming. Setting international mitigation targets has been done by signing the Kyoto Protocol in 1997. The protocol mandated that by the period from 2008 to 2012, Annex I countries (developed countries and economics in transition) committed to reduce their greenhouse gas emissions by approximately 5percent compared to their 1990 levels. At the European level, the European Union set a 2 C target, aimed at limiting the global average temperature increase to less than 2C compared to pre-industrial levels (CEC, 2007). The 2009 UNFCCC Conference of the Parties in Copenhagen reached a non-binding Copenhagen.

The scientific view that the increase in global temperature should be below 2 degree Celsius (UNFCCC, 2010a). However, currently it is unclear whether the international climate negotiations concerning the follow-up of the Kyoto Protocol will reach consensus on reducing greenhouse gas emissions, and if the 2_C target of reducing emissions is sufficient to counter the most severe impacts of climate change resulting from temperature rise. Adaptation to climate change is defined by the IPCC as the adjustment in natural or human systems in response to actual or expected

climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (Parry et al., 2007).

Strategies for mitigation

Avoiding the unprecedented threats posed by dangerous climate change will require an unparalleled collective exercise in international cooperation. Negotiations on emission limits for the post 2012 Kyoto Protocol commitment period canand mustframe the global carbon budget. However, a sustainable global emissions pathway will only be meaningful if it is translated into practical national strategiesand national carbon budgets.

Climate change mitigation is about transforming the way that we produce and use energy. And it is about living within the bounds of ecological sustainability. Setting credible targets linked to global mitigation goals is the starting point for the transition to a sustainable emissions pathway. These targets can provide a basis for carbon budgeting exercises that provide a link from the present to the future through a series of rolling plans. However, credible targets have to be backed by clear policies. The record to date in this area is not encouraging. Most developed countries are falling short of the targets set under the Kyoto Protocol: Canada is an extreme case in point. In some cases, ambitious 'Kyoto-plus' targets have been adopted.

The European Union and the United Kingdom have both embraced such targets. For different reasons, they are both likely to fall far short of the goals set unless they move rapidly to put climate mitigation at the centre of energy policy reform. Two major OECD countries are not bound by Kyoto targets.

Australia has opted for a wide-ranging voluntary initiative, which has produced mixed results. The United States does not have a federal target for reducing emissions. Instead, it has a 'carbon-intensity' reduction goal which measures efficiency. The problem is that efficiency gains have failed to prevent large aggregate increases in emissions. In the absence of federal targets, several United States' states have set their own mitigation goals. California's Global Warming Solutions Act of

2006 is a bold attempt to align greenhouse gas reduction targets with reformed energy policies. Setting ambitious targets for mitigation is an important first step. Translating targets into policies is politically more challenging.

The starting point: putting a price on carbon missions. Changed incentive structures are a vital condition for an accelerated transition to low-carbon growth. In an optimal scenario, the avoiding the unprecedented threats posed by dangerous climate change will require an unparalleled collective exercise in international cooperation carbon price would be global. This is politically unrealistic in the short-run because the world lacks the required governance system. The more realistic option is for rich countries to develop carbon pricing structures. As these structures evolve, developing countries could be integrated over time as institutional conditions allow. There are two ways of putting a price on carbon. The first is to directly tax CO2 emissions. Importantly, carbon taxation does not imply an increase in the overall tax burden.

The revenues can be used in a fiscally neutral way to support wider environmental tax reforms,for example, cutting taxes on labour and investment. Marginal taxation levels would require adjustment in the light of greenhouse gas emission trends. One approach, broadly consistent with our sustainable emissions pathway, would entail the introduction of taxation at a level of US$10–20/t CO2 in 2010, rising in annual increments of US$5–10/t CO2 towards a level of US$60–100/t CO2. Such an approach would provide investors and markets with a clear and Predictable framework for planning future investments. And it would generate strong incentives for a low-carbon transition.

The second route to carbon pricing is cap and trade. Under a cap-and-trade system, the government sets an overall emissions cap and issues tradable allowances that grant business the right to emit a set amount. Those who can reduce emissions more cheaply are able to sell allowances. One potential disadvantage of cap-and-trade is energy price instability. The potential advantage is environmental certainty: the cap itself is a quantitative ceiling applied to emissions. Given the urgency of achieving

deep and early quantitative cuts in greenhouse gas emissions, well-designed cap-and-trade programmes have the potential to play a key role in mitigation.

The European Union's Emissions Trading Scheme (ETS), is the world's largest cap-and trade programme. While much has been achieved, there are serious problems to be addressed. The caps on emissions have been set far too high, primarily because of the failure of European Union member states to resist the lobbying efforts of powerful vested interests. And only a small fraction of ETS permits-less than 10 percent in the second phase-can be auctioned, depriving governments of revenue for tax reform and opening the door to political manipulation and generating inefficiencies. Restricting ETS quota allocations in line with the European Union's commitment to a 20–30 percent cut in emissions by 2020 would help to align carbon markets with mitigation goals.

Carbon markets are a necessary condition for the transition to a low-carbon economy. They are not a sufficient condition. Governments have a critical role to play in setting regulatory standards and in supporting low-carbon research development and deployment. There is no shortage of positive examples. Renewable energy provision is expanding in part because of the creation of incentives through regulation. In Germany, the 'feed-in' tariff has boosted the share of renewable suppliers in the national grid.

The United States has successfully used tax incentives to encourage the development of a vibrant wind power industry. However, while the rapid growth of renewable energy has been encouraging, overall progress falls far short of what is possible-and of what is required for climate change mitigation. Most OECD countries have the potential to raise the share of renewable energy in power generation to at least 20 percent. Enhanced energy efficiency has the potential to deliver a 'double dividend'. It can reduce CO2 emissions and cut energy costs. If all electrical appliances operating in OECD countries in 2005 had met the best efficiency standards, it would have saved some 322 Mt CO2 of emissions by 2010-equialent to taking over 100 million cars off the road. Household electricity consumption would

fall by one-quarter. Personal transportation is another area where regulatory standards can unlock doubledividends.

Brazil is more efficient than either the European Union or the United States in producing ethanol. Moreover, sugar-based ethanol is more efficient at cutting carbon emissions. The problem is that imports of Brazilian ethanol are restricted by high import tariffs. Removing these tariff s would generate gains not just for Brazil, but for climate change mitigation. The rapid development and deployment of low-carbon technologies is vital to climate change mitigation. Picking winners in technology is a hazardous affair. Governments have at best a mixed record. However, confronted with a national and global threat on the scale of climate change, governments cannot afford to stand back and wait for markets to deliver.

Energy policy is an area in which the scale of upfront investments, time horizon, and uncertainty combine to guarantee that markets alone will fail to deliver technological change at the pace required by mitigation. In earlier periods, major technological breakthroughs have followed decisive government action:

Low levels of energy efficiency in developing countries are currently a threat to climate change mitigation efforts. Raising efficiency levels through international cooperation could transform that threat into an opportunity, generating large gains for human development in the process. We demonstrate this by examining the impact on CO2 emissions of an accelerated technology transfer programme for the coal sector in China. For China alone, emissions in 2030 would be 1.8 Gt CO2 below the level projected by the International Energy Agency. That figure is equivalent to around one-half of current European Union emissions. Similar efficiency gains are attainable in other areas. Enhanced energy efficiency is a win–win scenario.

Developing countries stand to gain from improved energy efficiency and lower environmental pollution. All countries stand to gain from CO2 mitigation. Unfortunately, the world currently lacks a credible mechanism for unlocking this win–win scenario. We propose the development under the auspices of the post2012 Kyoto framework, of a Climate Change Mitigation Facility (CCMF) to fill this gap.

The CCMF would mobilize US$ 25–50 billion annually to finance low-carbon energy investments in developing countries. Financing provisions would be linked to the circumstances of individual countries, with a menu of grants, concessional support and risk guarantees available. Support would be programme based. It would cover the incremental costs of achieving defined emission reduction targets by scaling-up nationally-owned energy policies in areas such as renewable energy, clean coal and enhanced efficiency standards for transport and buildings. Deforestation is another key area for international cooperation.

Currently, the world is losing the carbon assets contained in rainforests at a fraction of the market value they would have even at low carbon prices. In Indonesia, every US$1 generated through deforestation to grow palm oil would translate into a US$ 50–100 loss if the reduced carbon capacity could be traded on the European Union's ETS. Beyond these market failures, the loss of rainforests represents the erosion of a resource that plays a vital role in the lives of the poor, in the provision of ecosystem services and in sustaining biodiversity. There is scope for exploring the potential of carbon markets in the creation of incentives to avoid deforestation. More broadly, carbon finance could be mobilized to support the restoration of degraded grasslands, generating benefits for climate change mitigation, adaptation and environmental sustainability.

Adapting to the inevitable

National Action and International Cooperation Without urgent mitigation action the world cannot avoid dangerous climate change. But even the most stringent mitigation will be insufficient to avoid major human development setbacks. The world is already committed to further warming because of the inertia built into climate systems and the delay between mitigation and outcome. For the first half of the 21st Century there is no alternative to adaptation to climate change. Rich countries already recognize the imperative to adapt. Many are investing heavily in the development of climate defense infrastructures. National strategies are being drawn up to prepare for more extreme and less certain future weather patterns.

The United Kingdom is spending US$1.2 billion annually on flood defenses. In the Netherlands, people are investing in homes that can float on water. The Swiss alpine ski industry is investing in artificial snow-making machines. Developing countries face far more severe adaptation challenges. Those challenges have to be met by governments operating under severe financing constraints, and by poor people themselves. In the Horn of Africa, 'adaptation' means that women and young girls walk further to collect water. In the Ganges Delta, people are erecting bamboo flood shelters on stilts.

And in the Mekong Delta people are planting mangroves to protect themselves against storm surges, and women and children are being taught to swim. Inequalities in capacity to adapt to climate change are becoming increasingly apparent. For one part of the world-the richer part-adaptation is a matter of erecting elaborate climate defense infrastructures, and of building homes that 'float on' water. In the other part adaptation means people themselves learning to float in flood water. Unlike people living behind the flood defenses of London and Los Angeles, young girls in the Horn of Africa and people in the Ganges Delta do not have a deep carbon footprint. As Desmond Tutu, the former Archbishop of Cape Town, has argued, we are drifting into a world of adaptation apartheid.

Planning for climate change adaptation confronts governments in developing countries with challenges at many levels. These challenges pose systemic threats. In Egypt, delta flooding could transform conditions for agricultural production. Changes to coastal currents in southern Africa could compromise the future of Namibia's fisheries sector. Hydroelectric power generation will be affected in many countries. Responding to climate change will require the integration of adaptation into all aspects of policy development and planning for poverty reduction. However planning and implementation capacity is limited.

Infrastructure, in climate change adaptation, as in other areas, prevention is better than cure. Every US$1 invested in pre-disaster risk management in developing countries can prevent losses of US$7. In Bangladesh, research among impoverished populations living on *Char* islands shows that adaptation against flooding can

strengthen livelihoods, even in extreme conditions. Many countries lack the financial resources required for infrastructural adaptation. Beyond disaster prevention, the development of community based infrastructure for water harvesting can reduce vulnerability and empower people to cope with climate risks.

Partnerships between communities and local governments in Indian states such as Andhra Pradesh and Gujarat provide examples of what can be achieved. Insurance for social protection. Climate change is generating incremental risks in the lives of the poor. Social protection programmes can help people cope with those risks while expanding opportunities for employment, nutrition and education. In Ethiopia the Productive Safety Net Programme is an attempt to strengthen the capacity of poor households to cope with droughts without having to sacrifice opportunities for health and education. In Latin America conditional cash transfers have been widely used to support a wide range of human development goals, including the protection of basic capabilities during a sudden crisis.

In southern Africa cash transfers have been used during droughts to protect long-run productive capacity. While social protection figures only marginally in current climate change adaptation strategies, it has the potential to create large human development returns. The case for international action on adaptation is rooted in past commitments, shared values, the global commitment to poverty reduction and the liability of rich nations for climate change problems. Under the terms of the UNFCCC, northern governments are obliged to support adaptation capacity development. Support for the MDGs provides another powerful rationale for action: adaptation is a key requirement for achieving the 2015 targets and creating the conditions for sustained progress.

Current pledged funding amounts to US$279 million for disbursement over several years. This is an improvement over past delivery but still a fraction of what is required. It represents less than one-half of what the German state of Baden-Würtemberg will allocate to the strengthening of flood defenses. It is not just the lives and the livelihoods of the poor that require protection through adaptation. Aid programmes are also under threat. We estimate that around one-third of current

development assistance is concentrated in areas facing varying degrees of climate change risk. Insulating aid budgets from that risk will require additional investment of around US$4.5 billion. At the same time, climate change is contributing to a diversion of aid into disaster relief. This has been one of the fastest growing areas for aid flows, accounting for 7.5 percent of total commitments in 2005.

Estimating the aid financing requirements for adaptation is inherently difficult. In the absence of detailed national assessments of climate change risks and vulnerabilities, any assessment must remain a 'guesstimate'. Building human resilience is another priority area. Investments in social protection and wider human development strategies are needed to strengthen the capacity of vulnerable people to cope with risk. Our ballpark estimate is that at least US$40 billion will be needed by 2015 to strengthen national strategies for poverty reduction in the face of climate change risks. To put this figure in context, it represents around 0.5 percent of projected 2015 GDP for low income and lower middle income countries.

Provision for disaster and post-disaster recovery will also have to be strengthened as droughts, floods, storms and landslides pose greater threats. Provision of an additional US$2 billion a year is implied by our estimates. Adaptation financing requirements should be seen as 'new and additional' commitments. That is, they should supplement rather than divert existing aid commitments. Northern governments have pledged to double aid by 2010, though the record on delivery is mixed. Any shortfall in delivery will compromise progress towards the MDGs and compound problems in climate change adaptation.

The headline figure for new and additional adaptation financing appears large- but has to be placed in context. The total of around US$86 billion by 2015 may be required to prevent aid diversion. It would represent around 0.2 percent of developed country GDP, or around one-tenth of what they currently allocate to military expenditure. Measured in terms of returns for human security, adaptation financing is a highly cost-effective investment. There are a range of innovative financing mechanisms that could be explored to mobilize resources. These include carbon

taxation levy administered under cap-and-trade programmes and dedicated levies on air transport and vehicles.

International support for adaptation has to go beyond financing. Current international efforts suffer not just from chronic under financing, but also a lack of coordination and coherence. The patchwork of multilateral mechanisms is delivering small amounts of finance with very high transaction costs, most of it through individual projects. While project-based support has an important role to play, the locus for adaptation planning has to be shifted towards national programmes and budgets.

The integration of adaptation planning into wider poverty reduction strategies is a priority. Successful adaptation policies cannot be grafted on to systems that are failing to address underlying causes of poverty, vulnerability and wider disparities based on wealth, gender and location. Dialogue over Poverty Reduction Strategy Papers (PRSPs) provides a possible framework for integrating adaptation in poverty reduction planning. Revision of PRSPs through nationallyowned processes to identify financing requirements and policy options for adaptation could provide a focal point for international cooperation.

Indigenous peoples and climate change in Latin America and the Caribbean

This topic addresses the social implications of climate change and climatic variability on indigenous peoples and communities living in the highlands, lowlands, and coastal areas of Latin America and the Caribbean. Across the region, indigenous people already perceive and experience negative effects of climate change and variability. Many indigenous communities find it difficult to adapt in a culturally sustainable manner. In fact, indigenous peoples often blame themselves for the changes they observe in nature, despite their limited emission of green house gasses. Not only is the viability of their livelihoods threatened, resulting in food insecurity and poor health, but also their cultural integrity is being challenged, eroding the confidence in solution provided by traditional institutions and authorities. Field research found among indigenous communities in three major eco-geographical

regions: the Amazon; the Andes and Sub-Andes; and the Caribbean and Mesoamerica. It finds major inter-regional differences in the impacts observed between areas prone to rapid and slowonset natural hazards.

In Mesoamerican and the Caribbean, increasingly severe storms and hurricanes damage infrastructure and property, and even cause loss of land, reducing access to livelihood resources. In the Columbian Amazon, changes in precipitation and seasonality have direct immediate effects on livelihoods and health, as crops often fail and the reproduction of fish stock is threatened by changes in the river ebb and flow. In the Andean region, water scarcity for crops and livestock, erosion of ecosystems and changes in biodiversity threatens food security, both within indigenous villages and among populations who depend on indigenous agriculture, causing widespread migration to already crowded urban areas.

While climate change affects everyone, it will probably hit the most vulnerable groups hardest. Indigenous peoples, according to the UN Development Group Guidelines on Indigenous Peoples Issues, are among the first to face direct adverse consequences of climate change, partly owing to their close relationship with the environment and its resources. The Permanent Forum, which runs from 21 April to 2 May, brings together more than 1,000 indigenous representatives, senior UN officials, and representatives of governments, civil society and academia to address the theme. Climate change, bio-cultural diversity and livelihoods: the stewardship role of indigenous peoples and new challenges. Emerging evidence suggests that the livelihoods and cultural identities of the more than 370 million indigenous peoples of North America, Europe, Latin America, Africa, Asia and the Pacific are already under threat. For example, “climate change has really taken a toll on our traditional way of life and affected the source of livelihood of the Boro indigenous people in Northeast India,” said Dharmodip Basumatary from the Boro community, who is currently an indigenous fellow with the Office of the High Commissioner for Human Rights (OHCHR) in Geneva.

“Our age-old cultivation method, which entirely depends on rainfall, has been suffering due to changing weather patterns and a decrease of forest land,” he added.

Indigenous peoples from different parts of the world whether in industrialized or developing countries – echo concerns about the impact of climate change in the survival of their communities. “The Samburu and Maasai peoples are the first communities to face and feel the effects of climate change, due to our closeness with the environment and distinct ways of livelihood that depend on access to land, natural resources and sustainable development. We face marginalization, forced adaptation and losing our identities,” said Jane Naini Meriwas from the Maasai community in Kenya, who is also an indigenous fellow with OHCHR. **“**Wisconsin and the Great Lakes region are home to some of the best-managed indigenous forestlands, wild rice beds, and fisheries in the United States, all of which hang in the balance due to global climate change,” said Doug Kiel, another OHCHR indigenous fellow, from the Oneida tribe of Indians in the United States.

The UN Declaration on the rights of indigenous peoples establishes the right of indigenous peoples to the conservation and protection of the environment of their lands and resources. The rights recognized in the Declaration constitute the “minimum standards for the survival, dignity and well-being of the indigenous peoples of the world.” “As climate change will inevitably affect the enjoyment of human rights, safeguarding of human rights should be a key consideration in efforts to address the impact of climate change,” said Kyung-wha Kang, Deputy High Commissioner for Human Rights, when she addressed the Bali Conference on Climate Change last December.

“The human rights approach compels us to look at the people whose lives are most adversely affected, and to urge governments to integrate their human rights obligations into policies and programs to deal with the climate change as well as to the international community to assist in this process,” she added.(April 2008 IPCC Fourth Assessment Report: Climate Change 2007)

Adaptation measures to climate change

Developing rational adaptation measures and enhancing the adaptation capacity will play an important role in minimizing the adverse impacts of climate change and promoting sustainable development in China. The pertinent adaptation measures for main sectors should include: Agriculture: a) strengthening agricultural infrastructure; b) breeding stress resistant crop varieties; c) developing new agricultural technologies including biotechnology; d) promoting large scale plantation of superior crop varieties in suitable areas; e) adopting special techniques to increase and stabilize crop yields in order to enhance the agriculture sector's resistance to disasters.

Flood and drought control: a) strengthening hydrological infrastructure to enhance the capacity of flood and drought control, water supply, and emergency response; b) incorporating the potential impacts of climate change on water resources as limiting factors in construction projects.

Forestry: a) continuing reforestation efforts; b) enhancing the abilities of tree species to adapt to environmental changes; c) strengthening nature reserves management; d) preventing and controlling forest fires, forest diseases and insects.

Grassland management and animal husbandry

a) Determining, grazing capacity of pastures in terms of climate change; b) halting over-grazing and avoiding prairie degradation; c) stopping and reversing the trend of desertification to enhance the resistance of livestock production to climate change. Coast protection: a) raising the design standards of facilities for tide prevention; b) enforcing tide prevention facilities in the coastal areas;

Climate prediction and forecast

a) improving the forecast of climate hazards; b) establishing prediction, monitoring and control systems in order to enlarge the coverage of epidemic supervision area. Regional adaptation measurements may include the following. In Northeast China, climate warming provides advantageous conditions to move winter wheat cultivation areas northward and enlarge rice paddies as suitable.

In North China, adaptation could involve establishing water saving systems, preventing and managing desertification, and promoting regional social and economic sustainable development. In Northwest China, administrators should focus on reasonable allocation of water resources, development of water saving agriculture, protection and improvement of ecosystems and the environment, and enhancement of adaptive capacity in agriculture in dry-land areas.

In Central China, capacities should be built for controlling and mitigating droughts, floods and other disasters, In Southwest China, adaptation to climate change involves strengthening prediction and early-warning systems for landslides and mud-rock flow, speeding up and improving water and soil conservation, and protecting the prairies in Tibet. In the coastal areas of East China and South China, the protection level of storm-tide stopping levees should be raised due to sea level rises, and the abilities to monitor and to issues early warnings for typhoon and storm surge strengthened. Since adaptation measurements can help alleviate negative impacts of climate change, it is important to progressively incorporate them into national medium and long term development plans and strategies. It is necessary to develop a monitoring system to examine the impacts of climate change and to establish a science and technology system to research into adaptive strategies. Building multi-disciplinary research and management teams in China at advanced international levels is critical for enhancing the analytical and decision-making abilities to respond and adapt to climate change.

Uncertainties in climate change, Impact assessment and their improvement.

There are many uncertainties in the current impact assessment methodologies and results due to limited scientific research conducted in China on climate change. Because many models take climatic and non-climatic scenarios (including socio-economic assumptions) as input parameters when assessing climate change related impacts, vulnerability and adaptation, a high level of uncertainty originates from the assumptions of scenarios. Main uncertainties come from the two aspects, that is the imperfection of climate models and the uncertainty of future GHG emissions, which can be reduced only if we are able to accurately project non-climatic scenarios of socio-economic, environmental and land use changes, and technology advancement in the next several decades to one century.

> The Uncertainties of impact assessment models come from four main Sources. They are:1) limited understanding of climate change impacts on various ecosystems and the interaction among them; 2) not all factors considered in the impact assessment models; 3) the impacts of climate change on trade, employment, and socio-economic development are seldom considered in impact assessment models; and 4) insufficient consideration to the effects of adaptation measures on lessening the vulnerability to climate change.

An effective way of reducing the uncertainties is to construct climate change scenarios under various GHGs emission scenarios. To counter the “scientific uncertainty”, various models and climate change scenarios should be employed in the impact assessment. To reduce the uncertainties, it is also necessary to improve the understanding of the response mechanisms of ecosystems to climate change, through collecting the data of long-term changes in plant/animal communities and species, investigating different ecosystems in different areas, better controlling confounded factors during the experiments, and distinguishing the effects of climatic factors from non-climatic ones. We should strive to develop integrated models for impact assessment and improve the projection of non climatic factors. More consideration

should be given to technology advancement, policies, major construction Adv. Clim. Change Res., 2007, 3 (Suppl.): 6J11 11Advances in Climate Change Research.3

Developing countries in the context of climate change mitigation and energy system

Transformation from a socio-economic point of view, even more important than the actual impacts of climate change is thus the vulnerability of societies to climatic changes, also considering their capacities to effectively adapt to them6. For example, a highly developed society with only a limited share of the agricultural sector in GDP will be less vulnerable to probable yield losses induced by climate change than a comparably poor society with a high share of the agricultural sector.

The World Bank (2010) shows that countries generally expected to be affected most severely by physical impacts, also are those that have the lowest capacity to adapt to those impacts in terms of adaptive and social capacity including literacy rate, income distribution, economic management, structural policies, capacity to absorb finance and governance.

These countries are exclusively located in the global South, mainly in Sub-Saharan Africa, Latin America and South Asia. Herein, a prominent ethical dilemma can be identified: Developing countries that have contributed very little to global climate change in the past are also the countries that are generally most vulnerable, both with respect to the actual impacts and the possible adaptive capacity (Edenhofer et al., 2010; Füssel, 2010).

India, Bangladesh, Pakistan, Afghanistan

Current climatic trends Afghanistan is a mountainous and very dry country located in the arid subtropics at 37° North of the equator. Afghanistan has an arid and semi-arid continental climate with cold winters and hot summers. The lowland plains in the south of Afghanistan experience extreme seasonal variations in temperature, with average summer (JJA) temperatures exceeding 33°C and mean winter (DJF) temperatures of around 10°C. Much of the country is at very high altitude and

experiences much lower temperatures all year round, with average summer temperatures not exceeding 15°C, and winter temperatures below zero in the highest regions. Afghanistan is currently suffering the most severe drought in living memory. The country is characterized by large areas with little to no precipitation; that which does occur falls mostly as snow on high mountains from winter storms (of Mediterranean origin) between November and April with peaks in February/March. The snow season varies considerably with elevation.

The Asian summer monsoon system helps to keep rainfall low over Afghanistan. Dust storms are a significant part of the climate system associated with northerly winds in warm months. Despite the absence of good long term climatic records, available data and trends from neighboring countries indicate that mean annual temperature has increased by 0.6°C since 1960, at an average rate of around 0.13°C per decade. Increases have been most pronounced during the autumn (SON), with increases at an average rate of 0.29°C per decade and a significant increase in the number of exceptionally hot days and nights. Changes in precipitation regimes tend to vary more between regions than temperature. Mean rainfall over Afghanistan has decreased slightly (at an average rate of 0.5mm per month (or 2 percent per decade) since 1960. This is mainly due to decreases of around 2.7mm per month (6.6 percent per decade) in spring (MAM) rainfall. The proportion of rainfall that occurs in heavy events has not changed with any consistent trend since1960.

Vulnerability to climate change: Mali

The existing studies on vulnerability in Mali were conducted within the implementation framework of the UNFCCC and particularly the initial national communication. These studies cover the water resources and agricultural sectors. Indeed, 95percent of Mali’s population depends on the primary sector, which provides the basic raw materials required by the industrial sector and which thus contributes an important part of the GNP. The study area is located in the upper valley of the Niger River, one of the main agricultural areas of the country.

The objectives of the exercise were to (i) evaluate the eventual consequences of climate change on yields of millet and sorghum in the area, (ii) evaluate the socioeconomic impact of climate change and (iii) propose strategies for adapting to any climate changes that may ensue. The area covered by the study straddles two agro-climatic zones: a sahelo-Saharian zone (average rainfall less than 600 mm, a vegetation period ranging from 45 to 90 days, transhumant animal husbandry and dry crops, notably millet and flood recession crops), and a Sudano- Sahelian and Sudano-Guinean zone (average rainfall from 600 mm to 1,200 mm, vegetation period of 130 days, cash crops, dry crops and animal husbandry).

Adaptation strategies

The adaptation strategies cover the agricultural sector and water resource sector.

Agricultural sector

Following the droughts experienced in the 1970s, the Malian Meteorological Department, with the assistance of the international community, developed a two–pronged approach to tackle the impact of drought on agriculture. The first approach involves keeping the decision-makers and agricultural officials regularly informed about the state and evolution of agro-pastoral fields by means of a follow-up of relevant indicators (meteorological indicators, rainfall, water reports, hydrological indicators etc.), and their impacts on crops, pastures and well points. The second approach involves providing the rural community with the technical knowledge they need to enable them to plan and manage their agricultural activities more efficiently.

Climate change and Indigenous people

The impacts of climate change on indigenous communities are significant. The cultures that support Traditional Knowledge (TK) around the world are often living in marginal ecosystems, such as the Arctic, mountains, deserts and small islands. These marginal ecosystems are often the sources of key ecosystem services (e.g., role of mountain ranges in sustaining water balance) and are critical for maintaining the

overall resilience and adaptive capacity of social-ecological systems are most vulnerable to climate change and will suffer the greatest change often for the worse as a result of climate change. Importantly, the TK of indigenous peoples is proving critically valuable service to the global community.

Evidence of climate change in Nepal

The Himalaya region has been experiencing the multitude of undesired change that cut across both biophysical and social realms. Observed biophysical changes include unpredictability in the timing and magnitude of rainfall, frequent occurrence of extreme heat during the summer season, glacial retreat and melting snow (Sharma et al., 2009; Gurung et al., 2010; MoE, 2010; Chaudhary et al., 2011).

Temperature is rising over the past 100 years (Yao et al. 2006; Chapagain et al. 2009). These changes have already been posing serious threats on water, biodiversity, human health, agriculture, and consequently on food security throughout the region and downstream (Chaudhary & Bawa 2011). Vulnerable social and economic conditions pose further threat to the region. Recent social changes include rapid exodus of able-body manpower from the country, frequent economic crises, social and political unrest, and shrinking human capital. Since the region is the water tower of Asia and the lifeline for nearly one-fifth of world population, the current trend of climate change in the region will continue presenting an immense threat to humanity (Immerzeel et al., 2010). While any one of these factors will likely pose significant challenges on livelihoods of the people of the Himalaya region, the threat posed by changing climate and uncertainty associated with it cannot be ignored.

The country is facing tremendous pressure in its ecology and biodiversity resulting from social, economic and climate change, which is eventually affecting local livelihoods and wellbeing of people. People living in remote hills and mountains have limited ability to cope with changes and thus are under great threat. Nepal has three physiographic zones (mountain, hill, and Terai) and five climatic zones (tropical, sub-tropical, temperate, sub-temperate, sub-arctic and arctic) across 800

meters length east-west and 200 meters width north-south and across elevation range of below 100 to 8848masl, the highest pick in the world.

The mountains are experiencing rapid snow melting while the Terai is facing prolonged drought. Agriculture and other activities are adversely affected by these changes.(CARE/LI-BIRD, 2009).6 Both observed data and local perception reveals that climate change is no longer a future Reality-it is already happening. As already mentioned, any departure from the expected "normal" climate poses serious threats to the livelihoods of the people of the Himalaya region (Chaudhary &Aryal 2009; Gurung et al., 2010; Sharma et al., 2009).

In the last decade, the possible threat of changing climate change has received an overwhelming public attention (Maplecroft, 2011). However, we are hitherto short in understanding of climate change occurring in the nation and its impacts on ecosystems, biodiversity, agriculture and livelihoods, which have been impeding policy advocacy and real action on ground. There is a dearth of literature that describes the challenges and solutions of climate change (Chaudhary & Bawa, 2011). Literature describing the roles of institutions in mitigating and adapting to climate change is also scanty (Chhetri et al., 2012). As a consequence, rhetoric has yet to be translated into action. Even at global level, while information on observed and predicted change is amply proliferated and exchanged, adaptation techniques are poorly studied and exchanged at a wider level.

Local people have been coping with changes using their own knowledge, resources, and skills (Chapagain et al., 2009) and such knowledge and skills can be taped to develop efficient adaptation plans. Adaptation techniques developed by Local Initiatives for Biodiversity, Research and Development (LI-BIRD), a national NGO in Nepal, using such local capitals and implemented with local participation have greater chance to become sustainable, low cost, and socially feasible (Thapa et al., 2012). LI-BIRD has been working with local communities to develop locally feasible adaptation measures with the participation of local knowledge, resources and skills.

The local level examples shared in this paper can be useful for other countries that share similar threats and socio-cultural and political challenges. People in other developing world can adopt the local technologies promoted by LI-BIRD in Nepal. This paper (a) reviews an observed and perceived climate change in Nepal, (b) discusses impacts of climate change on ecosystems, biodiversity, agriculture and human wellbeing, and (c) offers, by drawing upon experiences of an NGO, Local Initiatives for Biodiversity, Research and Development (LI-BIRD), some community-based mitigation and adaptation techniques for curbing challenges resulting from climate change.

Nepal has been constantly experiencing changes in weather and climate throughout the country. Temperature data analyzed for the past clearly show the increasing trend of temperature over time, although the progression is not linear (Shrestha et al., 1999; Agrawala & Berg, 2002; Shrestha & Devkota, 2010), nor is the change uniformly distributed across the geographic regions (Shrestha &Bawa, 2012). In Nepal temperature has increased at the rate0.74^{o}C to 0.18^{o}C of 0.03-0.060C per annum between 1977 and 1994, with the higher altitude regions experiencing more rapid increase than the lower altitude regions (Shrestha et al., 1999; Shrestha & Bawa, 2012). Another study showed a rate of 0.74^{o}C to 0.18^{o}C 0.40C per decade between 1981 and 1998 for the country (GoN, 2004). In a district in Nepal (Gorkha), an average temperature for 2001-2006 was found 0.74^{o}C to 0.18^{o}C 1.50C greater than 1978-1982 (Lamichhane &Awasthi, 2009). Other researchers have also found similar trend (Shrestha & Devkota, 2010; Sharma et al., 2009).

According to MoE (2010), pre-monsoon rainfall is decreasing and post-monsoon is increasing in some pockets of Western Nepal. Similarly, early monsoon and delayed withdrawal of monsoon has become normal (GoN, 2004). However, it is paradoxical that precipitation has been increasing in the high rainfall regions and decreasing in low rainfall or drier regions (GoN, 2004). For instance, precipitation has increased by 774mm in Lumle (high rainfall region) and increased by 36mm in Mustang (low rainfall region) over the past four decades (DoHM, 2007). Nepalgunj,

one of driest cities, also sustained a wettest monsoon season in the last 123 years in 2006 (Sharma, 2006).

Extreme events are also increasingly replacing normal monsoon seasons (Baidya et al., 2008); short-duration heavy downpours are more frequent than ever. In Laprak Gorkha, a total rainfall was recorded 341.8mm between 4pm to 7am (15 hours) in July 3, 1999. In Nepane Kaski, 128mm rainfall occurred between 11pm to 12:30am (1.3hours) in July 15, 2006. Similarly, in Nepalgunj, Banke, 336.9mm rainfall was recorded in 24 hours in August 27, 2006 (SOHAM, 2006; Gurung, 2006). Similarly, increase in average temperature of Rasuwa, Dhading, Banke and Bardiya districts was also noted between 1977 and 2007. The degree of increase was higher in Rasuwa (0.030C), a high mountain area, followed by Dhading (0.020C), a middle hill area, and Bake and Bardiya (0.010C), the Terai area (CARE/LI-BIRD, 2009).

The study also found out a gradual increase in maximum and minimum temperature in the Terai region and an abrupt change and erratic precipitation trends were observed in the high mountain areas. Alteration of climate change is Corroborating with the observed changes is the perception of the people of the Himalaya region (Chaudhary & Bawa, 2011). People have perceived change in their climate and are based on their day-to-day observations of weather change patterns and impacts resulting from it (Chaudhary & Aryal, 2009). They also associate various effects occurring at local level with the change in weather and climate based on their experiences in planning agricultural activities according to weather patterns. From local perceptions, it is obvious that temperature is rising, rainfall patterns have become erratic and unpredictable, and snow is melting faster than before in the Himalayas (Sharma et al., 2009; Chaudhary & Bawa, 2011; Chaudhary et al., 2011).

A study done in the Siddhi village of Central Nepal also reported the farmers' perception in the increase of temperature as well as decrease in rainfall (Shrestha & Shrestha, 2010). Another perception study on the trend of climatic hazards done among 486 shifting cultivators of eastern and central Nepal found that 45 percent and 55percent households have experienced heavy but short-duration rainfall and

prolonged drought, respectively (Thapaet al., 2012). Studies done in the western Nepal also report similar trend of temperature and rainfall (Gurung et al., 2010).

People also experience hotter summer, shorter and less intense winter, intense but short down pours, less cold days, and reduction of frost and fog (Chapagain et al., 2009; Gurung et al., 2010; Chaudhary & Bawa 2011). The proportion of people observing these changes was more for high hills than the low hills (Chaudhary & Bawa, 2011). Thapa (2012) suggests that there is a delay in onset of monsoon season (shift from June-August to July-September), which is in contrast to Chaudhary & Bawa (2011) findings from Darjeeling (India) and Ilam (Nepal) hills. As already mentioned, a report by the Government of Nepal suggests an early onset and late withdrawal of monsoon. The differences in trends reported in various literature might be the function of spatial variation as sites considered by different studies differ. People also associate several local level impacts with weather and climate change. Some of impacts are discussed below.

Above-mentioned changes have ensued the following impacts: drying up of water table, early flowering and budburst in some species; adaptation of natural vegetation, cultivated crops, weeds, crop pests, and mosquitoes to higher altitude regions; and early crop maturity leading to yield loss (Chaudhary & Bawa 2011; Chaudhary et al., 2011). The impacts are severe in several regions of the country. As many as 70 percent people in a part of Nepal and Indian Himalaya believe water sources are drying up, which could have direct impacts on agriculture, wilder biodiversity, ecosystem health, and daily water use in already water-scarce hills and mountains. Erratic and intense but short-duration rainfall has been increasing the threats of landslide (MoE, 2010), because short duration rain doesn't recharge or saturate soil as effectively as prolonged rain does.

Impacts are also seen in watershed; for instance, lake ecosystems are greatly affected by increased siltation, decreased agricultural workforce, and declined productivity due to prolonged dry spells (Thapa et al., 2012). People may experience yield loss in major staple crops. Change in floral composition is also inevitable due to

change in water regime on ground. On the other hand, several life-threatening GLOF are not far from reality (Ives, 1986; Bajracharya et al., 2007).

Scientists have alerted that about 25 glacial lakes in Nepal are prone to outburst, which may cause massive damage on forests, agricultural lands, physical properties, and human lives as history shows. Scientists have linked this catastrophe with increased snow melting and glacial retreat resulting from increased temperature (Bajracharya et al., 2007). Using a remote sensing tool, Shrestha & Bawa (forthcoming) have observed a shift in flowering time in the Himalayan flora, which corroborates to local perceptions. Nearly 50percent people among 250 the Darjeeling (India) and Ilam (Nepal) Himalayas have experienced an early flowering in selected species, which include rhododendron, magnolia, peach, pear, and marigold.

The study found out food shortage, crop failure, loss of livestock, and water scarcity as the major shocks to the shifting cultivators, which were highly influenced by the climatic hazards and their variability (Thapa et al., 2012).Temperature rise has also benefited the high altitude regions. An increase in temperature has resulted in the shifting of climatic suitability of crops in the Mustang (a mountainous) district of Nepal. In the case of apple, there is a clear notice of unsuitability of apple cultivation in lower elevation unlike in past years but apple cultivation is expanded in the higher altitudes (Pradhan et al, 2012).

People now can also grow cabbage, cauliflower, tomato, chilly, mango and other tropical species that were not possible about a decade ago due to cold, frost, snow, and intense cold. In Nepal's high mountain region, change in rainfall and temperature resulted in early flowering and vegetation shift. Similarly, frequent flooding in the mid and far western Terai washed away productive lands, reduction in crop yield and damage to infrastructure, livestock and human settlement; whereas the prolonged drought, drying of water sources and outbreak of pests have been threatening crop production in the western and central Nepal (CARE/LI-BIRD, 2009).

Climate change impact on livelihood and natural resources of upper Mustang, Nepal

The Annapurna Conservation Area Project (ACAP) is the largest undertaking of NTNC and also the first Conservation Area launched in 1986 and largest protected area in Nepal. It covers an area of 7,629 sq. km. and is home to over 100,000 residents of different cultural and linguistic groups. ACAP is rich in biodiversity and is a treasure house for 1,226 species of flowering plants, 102 species of mammals, 474 species of birds, 39 species of reptiles and 22 species of amphibians (ACAP, 2012). Shift in development activities along with flux climatic factors are more responsible for the changing socio economic trend of the community. These factors are not responsible only for changing socio economic factors but also livelihood of the people in the community. Climate change is expected to influence crop and livestock production, hydrologic balances, input supplies and other components of agricultural systems. However, the nature of these biophysical effects and the human responses to them are complex and uncertain (Adams et al., 1998).

The location and area of natural vegetation zones on the Trans Himalayan region will change substantially under projected climate change scenarios. Areas of temperate grassland and cold temperate coniferous forest could expand, while temperate and cold deserts may shrink. Climate change may also result in a shift of the boundary of the farming-pastoral transition region to the south in Northeast China, which may increase grassland areas and provide more favorable conditions for livestock production. However, the transition area of the farming-pastoral region is also an area of potential desertification, and if protection measures are not taken in new transition areas, desertification may occur (Li & Zhou, 2001; Qiu et al., 2001). More frequent and prolonged droughts as a consequence of climate change together with other anthropogenic factors may also result in desertification.

Main economical source of higher Himalaya dwelling people is animal husbandry which needs very huge area of rangeland ecosystem owing to low productivity and slow growth. There is significant uncertainty about the effects of global warming on the vegetation and animal productivity of large dry land ecosystems. Although high altitude dry lands might enjoy increases in net primary

productivity (NPP), locally, the greatest confidence is in predicting implications for vegetation production, with lesser confidence in implications for vegetation composition, animal production, and adaptation options (Campbell and Stafford Smith 2000).

Climate change has been reported to impact on grassland productivity, ecosystems, and the distribution and composition of plant communities (Wilkes, 2008). Some rangelands might suffer from degradation due to the warmer and drier climate (Dirnbock et al., 2003). Degraded rangeland already accounts for over 40percent of dry land on the Tibetan Plateau (Zhong et al., 2003; Gao et al., 2005; Eriksson et. al., 2009); and it is expanding at a rate of 3 to 5percent each year (Ma & Wang 1999). Increases in evaporation, reduction in snow cover, and fluctuations in precipitation are key factors contributing to the degradation of dry land ecosystems. Rangelands are those areas of the earth which, due to physical limitations, such as low and erratic precipitation, rough topography or cold temperatures, are unsuited for cultivated agriculture and are a source of forage for wild and domestic animals of the mountain region (Miller, 1998). Due to climate change and global warming the snowline in these mountain regions are moving increasingly northward, resulting in the depletion of rangelands and thus creating scarcity of fodder.

As the animals have to be moved higher and higher for grazing, this is directly affecting the lives of mountain women: they face shortage of cow dung, the main source of energy, which is also becoming scarce. Ultimately, because of the scarcity of their main source of fuel, people have to resort to chopping firewood from the forests, which lead to further ecological degradation and unsustainable management of rangeland resources, thus adversely affecting the environment of the rangeland areas. Moreover, the shortage of food supply for livestock also leads to malnutrition and ultimate degradation of livestock resulting in decline in commercial activities and thus shortage of food supply for the people themselves, such as yak butter, cheese, meat and wool. Following effects are expected to livestock and rangeland:

a) Expected higher temperatures may increase livestock deaths in some regions unless some kind of shelter is made available; b) Forage production may be

expanded as growing seasons lengthen, but this benefit will depend on water availability; and c) Shifts in plant species in rangelands, particularly an increase in perennial herbaceous species, will create greater spring water demands.

Climate change impact

Journal of Agriculture and Vol : 11, Jun.2010 Technical Paper 59. The relation between climate and maize production in Nepal was studied for the period 1970/71-2007/08. Due to the topographical differences within north-south span of the country, Nepal has wide variety of climatic condition. About 70 to 90percent of the rainfall occurs during summer monsoon (June to September) and the rest of the months are almost dry. Maize is cultivated from March to May depending on the rainfall distribution. Due to the availability of improved seeds, the maize yield has been steadily increasing after 1987/1988. The national area and yield of maize is estimated to be 870,166 ha and 2159kg/ha respectively in 2007/08. The present rate of annual increase of temperature is 0.040C in Nepal.

Trends of temperature rise are not uniform throughout Nepal. An increase of annual temperature at Rampur during 1968-2008 was only 0.0390C. However, at Rampur during the maize growing seasons, March/April – May, the trend of annual maximum temperature had not been changed, but during the month of June and July, the trend of increase of maximum temperature was 0.030C to 0.040C /year.

Economic growth of the country has not improved over time to cope up with the population growth, which is 2.3 percent per annum. Around 68 percent of Nepal's population depends upon agriculture and contribution of this sector to the GDP is about 40 percent (SOURCE ???????, CHECK AND CORRECT THE FIGURE) . Though priority is given to agriculture sector, the crop production in the country is not sufficient to meet the demand of the peoples. According to the Population Census 2001, the number of agricultural holdings in the country is 3.2 million and total cultivated area is 23.21 million hectares. Starting from 1995, Nepal is implementing the twenty year long Agricultural Perspective Plan (APP) to overcome the problems of food insecurity and poverty.

In Nepal maize is grown in the sub tropical to cool temperate climates. For higher yields, crop water requirement is 500-600mm depending upon the climate and duration of the crop, there should be adequate water during the crop establishment period. Water deficit during the grain filling period results in reduced grain weight. However, during the maturity and harvesting period, rainfall has negative impact on maintaining grain quality. *The Journal of Agriculture and Environment Vol:11, Jun.2010*

Vulnerability assessment of indigenous people's livelihood: Nepal

Vulnerability assessment of indigenous people's livelihoods due to climate change- This study was conducted to document the vulnerability of indigenous Tharu community to the emerging climate change in the Darakh VDC of Kailali district of the Far-western region of Nepal, and recommend adaptation measures. The study VDC lies in Western Terai Landscape Complex Project Area working district and the findings of the study are expected to contribute to conservation and sustainable use of biodiversity that form the basis of livelihood of indigenous local communities.

The study analyzed temperature and precipitation records of last three decades (1980-2009), and peoples' perception of the observed variation in climate that has affected ecosystem services. The study attempted to document the most effective measures adopted by local community to natural hazards such as flood disasters. The study revealed that overall temperature in the area is rising, but precipitation is decreasing. The temperature increase is in parity with the observed temperature trends in Nepal, however, the precipitation trend show high fluctuation with increased rainfall intensities and decreased rainy days. Heavy rainfall events have become pronounced since last 5 years. Tharu communities have experienced increasing floods, inundation and drought in recent years.

Floods have increased disaster risks in the study area. There is no significant evidence to suggest adaptive responses adopted by Tharus and therefore they need to work on to enhance their resilience so that they can withstand the threats of floods which is likely to increase with emerging climate change. The study also examined

other impacts such as increase in insects and pests, and change in time of crop harvest etc. The study concluded that the extreme weather events have increased the vulnerability of agriculture based livelihoods of Tharu communities that warrants immediate attention to enable them to adapt to the emerging threat. (CITE SOURCE)

Climate Change Mitigation Initiatives

Local Solutions: Experiences from LI-BIRD

Solutions that are locally developed by using indigenous knowledge, local resources, and participatory methods are socially acceptable and viable in long run. LI-BIRD promoting several such local and participatory initiatives in rural areas of Nepal. Framework of action LI-BIRD follows and some successful case studies are presented below.

Climate integration framework

Addressing the challenges of climate change needs interventions both in the forms of mitigation and adaptation. As mitigation is a long-term process and costly in many cases, adaptation is a better choice to respond to ongoing and immediate threats. To make adaptation effective, LI-BIRD employs the following four-tier approach: (a) vulnerability assessment, (blunder standing of local knowledge in responding to climate change risk, (c) blending local and scientific knowledge, if necessary, and (d) implementing or tailoring new knowledge. For implementing new knowledge, LI-BIRD develops an appropriate policies and implements them both at national and local levels; builds local and national capacities to implement policy; generates internal and external support to provide appropriate support to local communities; and strengthens networks and partnership to improve public awareness, information sharing, community participation, lobbying, and policy advocacy.

Home garden diversification

Diversification of home gardens and its efficient management for women, disadvantaged groups including indigenous communities (*janajatis*) and *dalits* is

adaptive approach at household level to address and respond to impacts like drought and floods. This adaptive approach has significantly contributed to improve nutritional status and reduce economic vulnerability of poor and disadvantaged communities in Nepal.

The various components, and their efficient management, of home gardens such as kitchen waste water management, cultivation of neglected and underutilized crop species, integration of small farm animals and fish, cultivation of vegetables, integration of fruits and fodder, and market linkage have contributed to increase their adaptive capacity and make home gardens resilient to climate stress by Diversified family nutrition and increased nutrition sources. ii. Increased household income and income generating options (such fruits, fish, vegetables and livestock) iii. Increased homestead biodiversity. iv. Optimized utilization of available resources through integrated management

Capacity building through awareness and network

LI-BIRD has established a mechanism of raising public awareness on climate change through publication of research findings, field cases and information on climate change through mass media. Capacity building of mass media and determining the role that the media can play in order to improve information sharing, both from science to local level and from local level to policy makers, are urgent matters (Lamsal, 2011). In the country like Nepal, poor dissemination of information to the marginalized and climate vulnerable communities and their access to such information is very limited, which has also limited their capacity to adapt to the impact of climate change. In this context, the approach of utilizing mass media especially local FM radio network for climate change communication is one of the strategies to increase access of marginalized, poor and climate vulnerable communities to information and then the adaptive technologies and options.

Asia summit on climate change and Indigenous peoples

The objectives set forth for this Summit were To enable representatives of indigenous peoples to share the impacts of climate change and the results of the researches done on indigenous peoples' local mitigation and adaptation measures.

To enhance the understanding and knowledge of the participants on climate change and the state of negotiations at the UNFCCC and to discuss and agree on positions on certain key issues

- To collectively deliberate on strategies to ensure that indigenous peoples' rights and development are taken into consideration by States Parties to the UNFCCC, multilateral organizations and other actors involved in developing and implementing policies, programs and projects on climate change at the national, regional and global levels
- To develop a roadmap for indigenous peoples to guide them on how to effectively engage with the processes leading up to COP 15 in Copenhagen and beyond
- To build an Asia-wide network of indigenous peoples on climate change which will monitor, engage with and influence the climate change processes at national, regional and global levels. The main findings, conclusions and recommendations from the presentations, case studies and workshop group reports are the following;

Vulnerabilities to climate change and solutions through Indigenous knowledges

- Indigenous peoples in the Asia region inhabit the most fragile ecosystems ranging from tropical rainforests, high mountain areas, low-lying coastal areas and floodplains as well as temperate forests. Because most of them are dependent on the land and natural resources from these ecosystems, they are in the forefront of climate change impacts and threats. These include intensified typhoons, cyclones, monsoons and storms, long droughts and expansion of decertified areas, melting of glaciers leading to flooding and decrease of river flows and water supplies, sea-level rise, stronger sea waves and currents,

coastline erosion and salinization of freshwater resources and soils, rampaging and long staying floods, landslides and increase in cases of vector-borne and water-borne diseases (malaria, dengue, cholera and other gastro-intestinal diseases), phenomenal temperature rise causing heat strokes and more forest fires. The unprecedented increase in disasters and calamities caused by global warming due to climate change was a common observation by all participants.

- Indigenous peoples, the world over, have contributed the least to the climate change crisis. Yet, they are the ones suffering the most from the adverse impacts of climate change and even from some of the solutions to the problem. Their ecological footprints are very small as most of them still practice their sustainable traditional livelihoods which include, among others, swidden agriculture, hunting and gathering, trapping, pastoralism, extraction of non-timber forest products, small-scale mining and 6 agro-forestry.

They have resisted the deforestation and destruction of their forests by loggers, plantation owners, extractive industries and other corporate and state interests. They also have fought against the extraction of oil, gas and minerals from their lands which has kept carbon under the ground. Thus, indigenous peoples have contributed significantly to reducing greenhouse gas emissions, historically, and up to the present.

Unfortunately, indigenous peoples' positive contributions to the abatement of greenhouse gas emissions are not generally recognized nor compensated by the UNFCCC and other multilateral and bilateral bodies. To make matters worse, they have own right to control and manage their traditional lands, their right to subsistence and to practice their own traditional cultures and livelihoods, and their right to self-determination have been and continue to be grossly violated by States and non-state actors (corporations, elites from dominant populations). Their traditional knowledge and customary laws and practices on natural resource management as well as disaster management have contributed in keeping the forests, maintaining biological diversity and cultural diversity. This knowledge has enabled them to adapt to and mitigate climate change. For example

Most of the cultures of indigenous peoples are based on the diverse ecological systems they inhabit and relate with. Their cultures, norms, values and practices revolve around land, water, air, sun, flora and fauna, their relationships with the living earth, the seen and the unseen, as well as with the past and the future. Thus, the changes to the ecosystem brought about by the variability of the climate have affected their life ways and diverse cultures as well as the biological diversity in their territories. Climate variability, such as changes in rainfall patterns, affects their food security as well as the practice of agricultural rituals and their traditional knowledge, innovations and practices. Climate change has led to long drought periods leading to the water crisis, food insecurity, increased health problems, and forest fires.

The burdens of indigenous women and children are much heavier because of the need to seek for water sources far away from their homes and the care of increasing numbers of sick young and elderly family members who are suffering from heat strokes and vector and waterborne diseases. The increased temperature also makes it very hard for farmers to work long hours in the fields. In Jharkand (India), for example, they have experienced the highest temperature in 2007 with 55 degrees Celsius. Several elderly people died of heat strokes and forest fires increased.

The highest temperature in the past ranged from 40-45. Jharkand is a summer destination for Indian and other tourists because of its cool climate. Rice planting whether in wet terraces or in the hills, start once the rains come. With the changes in seasons, however, indigenous farmers have to change their planting seasons which also affects the periods for cultural rituals and traditions. Certain rituals are done during land preparation, planting, harvesting and weeding, threshing and transporting from harvest from the fields to storing this in granaries. So this is not just done for production of food.

Rituals which pay respects and provide propitiation to the water deities, gods and goddesses; rice gods and goddesses, spirits in the forests, etc. continue to be practiced although the times when these rituals are performed are profoundly disturbed.

Agricultural production of the Santal, Munda and Oraon, indigenous peoples who live in North Bengal, has decreased significantly because of increased precipitation in their territories. The Rakhine are the indigenous peoples live in the coastal areas have suffered worst floods because of the rising sea level which caused coastal and river bank erosion and the depression of the Sundarbans, one of the best floodplain mangrove forests in the world.

This same conclusion from the Malaysia case study indicates that food insecurity worsened due to changes in weather patterns. Bumper crops from rice and fruit trees are much less and the quality and quantity of fruit harvests have suffered. The Indigenous participants from Indonesia reported that there are new species of insects invading indigenous communities after long bouts of drought. Unusual insect behavioral patterns are taking place causing massive destruction of crops. Locust invasions and plagues in Indonesia, for example, have increased in occurrence and intensity. After the 1950s this occurred once in 20 years.

Traditional livelihoods and other economic activities of indigenous peoples are also adversely impacted by climate change. In Malaysia, for example, rubber tapping has been a source of cash for many indigenous peoples in Sarawak and Sabah. Latex is tapped when the leaves of the rubber tree are shed around August and September. With the changes in weather, leaves shed as early as January and thus there is less latex gathered which means less income. Other fruit trees like durian and engkabang (also known as ilipe nut) are indigenous species in Sarawak and these are sources of cash and food. Bumper crop harvests from these trees have decreased significantly because of weather changes. Clove production, a major source of cash, amongst the indigenous peoples of Lombok in Indonesia dropped by 40 percent in 2007.

Asian indigenous women are much more vulnerable to climate change impacts compared to the men because they are often the subsistence producers and are heavily reliant on the quality and quantity of natural resources. They are the main caregivers, water and food providers and yet they have the least access to land, education and health facilities, technologies and agricultural technical assistance and inputs, and

disaster relief services, infrastructure development and credit assistance. Many of them suffer from discrimination in their own indigenous societies, in the dominant society and in the labour market.

Climate change has adversely affected the livelihoods of indigenous women in the villages of Khuti District in Jharkand, India.

Tourism, which is a main source of livelihood for many indigenous peoples, has decreased in recent years because of the accidents caused by avalanches and landslides.

Most watersheds in Asian countries are found in indigenous territories because they mainly inhabit mountains and forests. Their traditional water management systems lack government support.

Deforestation which contributes 20 percent of greenhouse gas emissions, was identified as a major problem in almost all the countries.

Many indigenous peoples who live and depend on forests have resisted and struggled against projects like the Tropical Forestry Action Programme (TFAP) and against big logging and plantation companies. They have asserted their prior rights to own and control their forests.

Many conflicts in indigenous peoples' territories in Asia have been conflicts over the ownership and use of forests. Because of indigenous peoples' struggles to protect their territories and to stop deforestation, most of the remaining rainforests and secondary forests in Asian countries are found in indigenous peoples' territories.

Indonesia has the distinction of being a country with the highest rate of deforestation, estimated to be two million hectares per year. Despite it not being fully industrialized, it is now the fourth biggest emitter of greenhouse gases. This is mainly due to deforestation. Indigenous peoples in Indonesia suffer the most from this and

there are hundreds of legal cases filed against plantation owners and financiers, loggers and miners. Cambodia passed an Economic Concession Act which allows the state to sell lands, including forests, to loggers, plantation owners or simple land speculators. Indigenous peoples have raised the issue of deforestation and destruction of their spirit forests in 2007, before the UN Special Rapporteur on the Situation of Human Rights and Fundamental Freedoms of Indigenous Peoples and in the 2007-2008 sessions of the UN Permanent Forum on Indigenous Issues.

Another example shared was the case of Jharkand, which used to have very dense forest, which are fast disappearing because of logging and mining. Indigenous peoples who live in low-lying coastal areas are also very much affected by climate change and unsustainable practices such as cyanide fishing, harbor dredging, coral mining, deforestation, coastal development, agricultural runoffs, pollution from mining operations and careless divers.

According to them, the rise in temperature of the sea, along with the pollution and destruction of coral reefs, has lowered their daily fish catch from 30 kilograms a few years back to five kilograms today. Coral bleaching has been observed and their capacity to fish has also decreased because they cannot stay long in the sea lest they get heat strokes. They mainly practice subsistence fishing using bamboos, fishing hooks and spears as their tools. They also maintain strict rules which regulate the amount of fish taken and they have delineated sacred areas called *panyaan*, where no one is allowed to catch fish. Aside from fishing they also do subsistence agriculture and agro- forestry. Some solutions being proposed and implemented for mitigation has caused additional problems for indigenous peoples in Asia. The call for a shift away from fossil fuels into alternative, renewable sources of energy is causing further expropriation of the lands, territories and resources of indigenous peoples.

This spurred AMAN, the national federation of indigenous people's organization in Indonesia, to request for a study from the UNPFII on this situation. When the report came out, AMAN used this to support their submission to the Committee on the Elimination of Racial Discrimination (CERD), a UN Treaty Body. Subsequently, the CERD recommended to the Indonesian Government to review the

law which pushed for expansion of oil palm plantations and to ensure that the rights of indigenous peoples are respected.

The proposal for Reduced Emissions from Deforestation and Forest Degradation in Developing Countries (REDD) gained currency in the UNFCCC negotiations.ipcc 2007

REDD poses both threats and opportunities for indigenous peoples.

If REDD is designed in the wrong way and does not respect the rights of indigenous peoples to their forests, this could lead to the expropriation of indigenous owned and controlled forests and the further destruction of indigenous peoples' forest management systems. The opportunities offered by REDD will depend largely on how indigenous peoples can effectively influence the negotiations for the inclusion of REDD in the COP 15 Copenhagen Agreements and their involvement in designing REDD at the national and global levels. It is fair to say that references to indigenous peoples in the UNFCCC negotiations and documents were introduced due to the debates around REDD.

Rotational agriculture or Swiddenor shifting cultivation

Rotational agriculture or Swiddenor shifting cultivation is an indigenous agricultural practice embedded with complex and sophisticated systems of resource management and knowledge of land use and cultivation, soil types and fertility and climatic variations. Green manure, crop rotation, composting, fallow periods and agro forestry increase the production of biomass and enhance soil fertility and organic matter content. Thus, the capacity of soil to sequester carbon is further increased. Scientists claim that soils contain 75 per cent of terrestrial carbon.

Climate change is a human rights issue

The consequences of ecosystem changes have implications for indigenous peoples' use, protection and management of wildlife, fisheries and forests, affecting the customary uses of culturally and economically important species and resources, to

indigenous peoples climate change is, however, not simply a matter of physical changes to the environments in which they live.

Subsistence livelihoods and Indigenous peoples

The impacts of climate change on ecosystems and their services will not be distributed equally around the world. Dry land, mountain and Mediterranean regions are likely to be more vulnerable than others (Gitay et al., 2001) and ecosystem degradation is largest in these regions (Hassan et al., 2005). Climate change is likely to cause additional inequities, as its impacts are unevenly distributed over space and time and disproportionately affect the poor (Tol, 2001; Stern, 2007). The term 'double exposure' has been used for regions, sectors, ecosystems and social groups that are confronted both by the impacts of climate change and by the consequences of economic globalisation (O'Brien &Leichenko, 2000). Thus special attention needs to be given to indigenous peoples with subsistence livelihoods and groups with limited access to information and few means of adaptation. As a result climate change and sustainable development need to incorporate issues of equity (Kates, 2000; Jain, 2003; Richards, 2003).

Seven valleys of Nepal and its' similarities:

Nepal is home to eight of the 14 highest mountains in the world including Mt. Everest which stands tall at 8,848 meters. The Himalayan mountain range extends across the country from the eastern to the western edge. The mountain ranges of Nepal also draw tourists for spiritual reasons. The Himalayas in Nepal speak of a mysticism & history that has not only changed the lives of its inhabitants but also protected the country from numerous invasions. Today, these mountains make up for some of the best known trails in the world. Likewise, several diversities mysticism valleys are in Nepal whatever similarities have found. The Tsum valley, study area is the one of them all of remain has described below.

Lang Tang valley

Langtang valley trekking :Widely identified as "the valley of glaciers trek", the valley of Langtang is situated 19 miles north to the Kathmandu which lets you view the massive snow capped Himalayas and eye-catching glaciers. The entire Langtang valley is dominated by Mt Langtang Lirung lying at an altitude of 7246m. On the way to trekking, Encounter Nepal design Langtang Valley trekking which puts forward the view of the stunning Helambu valley, the towering mountain lakes at Gosainkunda, the fascinating Langtang National park and the wonderful ice flutes of Gyangchempo which will be a memorable experience.

Along with the view of pine forest, swift mountain streams, uneven rock and snow- topped peaks, grassy downs and meadows spread with daisies and wild primula, Langtang valley trekking will give an occasion to past the region of Langtang National Park established in 1976 to look after the distinctive flora and fauna found there. One of the exceptional animal red pandas, Himalayan black bear, wild dog, snow leopard, ghoral and above 250 species of birds has been protected in this area. Sal, Nepalese alder, different types of rhododendron, chirpine, silver fir, oak forest, hemlock, birch, larch and many more floras will be visible during the trekking.

Khumbu valley

The Khumbu region is the most accepted rambling area within Nepal within the pedestal of Mount Everest. The forename itself brings to mind a intelligence of anonymity the untamed as well as the uncharted. It conveys up descriptions of enormous mountain range, craggy mount inhabitants, doey eyed yaks and of course the soaring King of them all, Mount Everest. The region is one of the chief region's that is dwelling in the direction of the celebrated Sherpa populace, those bandy legged strapping man as well as women that pass through the peak trails in addition to accomplish in the direction of the peaks shipping important heaps as well as single-handed by oxygen. The constituency is to be found within Nepal's north east as well as is the residence on the way to Namche Bazaar, the full of life Sherpa defrayal that is the focal point of the neighborhood.

Gyokyo valley

In **Gokyo valley trek, there is a** Gokyo Lake which is situated at the high altitude of about more than 4200 m. Another major place of attraction is the world's second largest glaciers named Ngozumpa Glacier. Apart from the busy schedule of Everest Base Camp Trek, it is moderately less inhabited. Also it provides remarkable and terrific high altitude trekking. From the top of the Gokyo ri one can view dazzling range of Himalayas which are more than 8000 m including Mt. Everest (8884m), Mt.Cho-oyo (8160m), Mt. Lhotse (8520m), Mt. Makalu (8460m).Tea house at **Gokyo valley** is situated nearby the bank of third lake which is the largest lake out of five lake which exist in Gokyo Valley. Because of this location factor one can have the view of image of mountain during full moon night with image of even moon on the lake with cup of hot coffee or tea on the hand.

As recommended by the trekkers who had conducted both Gokyo Valley Trekking and **Everest Best Camp trek** they suggest Gokyo Valley Trekking for better view of Himalayan range as people visit Everest Base Camp just to gain the opportunity to say "I had been to base of Highest peak" as well as Everest Base Camp is mainly focused on close up view of Mt. Everest where as from Gokyo one can have extremely long panoramic view of mountain. One can view the dramatic as well as heavenly view of landscape of mountains with Gokyo Lake on its lap while exploring the heart of Sherpa locality like Khumjung, Namche and other Sherpa village during *Gokyo Valley Trek.*

Ruby valley

Ruby valley trekking is trek falling between Manaslu Conservation Area and Langtang National Park. Along with the wide varieties of striking panorama of magnificent Himalayan view of Ganesh Himal I (7429m.), II (7118m.), III(7110m.), IV(7052m.), V(6986m.), VII(6350m.); Manaslu (8163m.), Lamjung Himal (6800m.), Langtang Lirung (7300m.) and other several peaks, you will also see twin cascades Ganga and Jamuna which adds delight to your spirit. Best seasons to go for Ruby Valley Trek are in March- April and May since you can witness the hillsides here

beautifully filed up with blossoming rhododendron, national flower of Nepal. En route you will pass through several villages of diverse ethnic people including Tamang, Chhetri, Gurung and observe their culture and way of life. Besides, Ruby valley trekking does not have tea houses or lodges, basic infrastructure and that is why, tent or home stay is a ordinary option for accommodating while trekking.

Narphu valley

For Himalayan addicts only, The Nar and Phu valleys are newly opened, spectacular regions of ethnically Tibetans inhabitants for those of you that think you trekked all. This is a trek that combines high peaks and passes, glaciers, remote villages, narrow canyons, lovely forests, amazing rock formations, yaks, gompas and unique Himalayan cultures. Trekking the standard Annapurna circuit, the bridge leading over the Maryland River to the steep portals of the Nar/Phu valley system is easily missed, but although the entrances is narrow and forested, the valley system above opens up to a huge expanse of high snow-peaks, ancient villages and high altitude grazing settlements.

Limi valley

Humla, Limi valley trekking : Nestled deep between the sweltering Indian sub-continent and the frozen plains of Tibetan Plateau, Humla lies hidden in the far northwest corner of Nepal. It receives heavy snowfall and remains isolated and snowbound throughout the winter; lower parts of Humla are mostly habitat by the Khasa tribe. Lying on the far North West of Nepal, Limi is one of the isolated valley and extending from the border of the Himalayan pass near Hilsa to another pass Chang-la between Nepal and Tibet. The longest River of Nepal, Humla Karnali flows into Nepal border at Hilsa where the valley starts from west side. This ancient Trans Himalayan Limi valley is beautiful and scenic. The top of Gyuckarka at 5,000m offers wonderful panoramic scenery of Nepalese Himalayas from Saipal 7,031m, Byas, Rishi, Api, Kanjirawa, Kanti and Gorakh Himlayan range.

This region is also famous for rare flora and fauna, like the marmot, wolf, wild yak, blue sheep, wild ass (Kyang) musk deer, harin, Himalay black beer and occasionally the snow leopard in this exotic region. Indigenous Tibetan cultured people are settled here and they have their own Tibetan dialogue and language with their unique tradition and culture, large beautiful villages like Haljee and Gomb yak are located in the wild patches of Limi Khola.

Tsum valley

The Tsum valley has long history of Buddhism. The Buddhist saint Milarewa is believed to be meditated in the caves of these mountains. Traditionally, the valley was a culturally distinct geographical called "Tsum Tso Chuksum", which means thirteen provinces ruled as a single territory. The ancient remains of the Tsum Kingdoom are still visible today. Due to its remoteness and inaccessibility, this sacred valley and its people have been bypassed by mainstream development for centuries. As a result, the unique culture of this valley has remained intact. A located in the serrated and natural environment of Northern Gorkha at an altitude from 1905m to 5093m on the Tibetan border, Tsum valley is new marvel for tourist attraction. An exploration program was organized by Trekking Agencies Association of Nepal (TAAN) and Nepal Tourism Board (NTB) on May 11, 2008. (NTB May 11, 2008). Tsum Valley was recently opened by the government in last October 17, 2007 where previously, it was a restricted from any tourism or recreational activities.

Adaptation and vulnerability to climate change

Definition of adaptation

Many definitions of adaptation can be found in the literature. Some of the simpler definitions describe adaptation as involving "changes in a system in response to some force or perturbation, in our case related to climate" (Smithers and Smit, 1997), or as referring "to adjustment in individual, group and institutional behaviour in order to reduce society's vulnerabilities to climate" (Pielke, 1998). The definition of adaptation taken here is that of Smit et al. (1999; 2000) and of the IPCC (2001):

adaptation refers to the "adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts". The term adaptation refers to changes in "processes, practices, or structures to moderate or offset potential damages or to take advantage of opportunities associated with changes in climate" (IPCC, 2001).

Some definitions only refer to societal adaptation: Adaptation to climate is the process through which people reduce the adverse effects of climate on their health and well-being, and take advantage of the opportunities that their climatic environment provides. Other definitions distinguish between different types of adaptation: The term adaptation means any adjustment, whether passive, reactive or anticipatory, that is proposed as a means for ameliorating the anticipated adverse consequences associated with climate change. Another definition given is very broad: Adaptation to climate change includes all adjustments in behaviour or economic structure that reduce the vulnerability of society to changes in the climate system.

The definitions given here have much in common. They all refer to adjustments in a system in response to climatic stimuli. However there are differences in the scope, application and interpretation of the word adaptation. The enhancement of adaptive capacity is a way of reducing vulnerabilities and promoting sustainable development (IPCC, 2001). Institutional and economic parameters determine the vulnerability and adaptive capacity of societies. There is therefore a clear role for public policy to create the right environment for appropriate adaptation to climate change (Adger, 2001b). Adaptations can also be short or long term and localized or widespread (IPCC, 2001).

Adaptation strategies

It is generally agreed that effective adaptation strategies should reduce present vulnerability as well as future vulnerability to climate change. Adaptation measures can contribute to equitable and sustainable policies and to the present development decision framework by reducing present day risk from climate variability and by being relevant to immediate national development priorities (Downing et al., 1997;

Adger, 2001b; Apuuli et al., 2000; Hulme et al., 2001). This strategy can be called a "no regrets" adaptation strategy. Reducing present vulnerability to climatic hazards should help to prepare for the potential future impacts of climate change. For the most vulnerable groups, adaptation strategies are vital, as failure to adapt to climate change could lead to "significant deprivation, social disruption and population displacement, and even morbidity and mortality" (Downing et al., 1997).

Many adaptation strategies, such as large-scale agriculture, irrigation and hydroelectric development, will benefit large groups or the national interests but they may harm local, indigenous and poor populations (Kates, 2000). As Kates (2000) states, "one group's adaptation is another group's hazard". Adaptation is not cost-free and does not yield the same benefits everywhere. Win-win solutions are unlikely with climate change, as there will always be winners and losers from extreme events (Adger, 2001b). The costs of adaptations need to include the secondary effects of the adaptations themselves, and the losses suffered by the groups bypassed or marginalized as a result of the adaptations (Kates, 2000).

Adaptation in the United Nations Framework Convention on Climate Change (UNFCCC)

The UNFCCC was accepted at the United Nations Conference on Environment and Development at Rio in 1992. Although the main aim of the UNFCCC is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (UN, 1992), a number of articles refer to the need for adaptation to climate change.

Article 3.3, although it does not mention the word adaptation, still states that "The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects". With regard to the implementation of adaptation measures as part of a response strategy, the UNFCCC, through Article 4.1(b) commits parties to "formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing

measures to mitigate climate change and measures to facilitate adequate adaptation to climate change" (UN, 1992). Article 4.1(e) continues by saying that all parties should "cooperate in preparing for adaptation to the impacts of climate change" and it recognizes the vulnerability of Africa as it commits parties to "develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture, and for the protection and rehabilitation of areas, particularly in Africa, affected by drought and desertification, as well as floods" (UN, 1992).

Adaptation in the climate change negotiations

During the 1990s, most of the scientific research and most of the negotiations concentrated on mitigation. This resulted in the formulation of the Kyoto Protocol in 1997. There was a divergence between the priorities of the developed countries, which were to reduce greenhouse gas concentrations (also the main objective of the UNFCCC), and those of the LDCs, which were to reduce their vulnerabilities to climate change, which is primarily caused by the emission of greenhouse gases from the developed countries (Apuuli et al., 2000). However, in the last few years the scientific community has increasingly realized the importance of adaptation, especially for the developing countries and particularly the LDCs, which are most vulnerable countries to climate change. Even if emissions of all greenhouse gases stopped today, some degree of climate change would still occur and LDCs would suffer from the impacts. For this reason it is vital to emphasize the importance of adaptation. As Nordhaus observed, "mitigate we might; adapt we must" (Pielke, 1998). In 2001 the parties to the UNFCCC accepted the Marrakech Accords at the seventh Conference of the Parties (COP 7).

Conclusion

Climate change research is nascent in the developing countries that bear the major portion of consequences resulting from climate vagaries. Hence, more research effort is needed to aptly understand real problems, and driving forces of such problems, and devise efficient adaptation and mitigation measures.

This should be achieved by employing participatory approach as developing countries lack infrastructure to record quantitative data to measure change and make a precise prediction. While bottom up approach to identifying locally feasible adaptation tools will be a first step to generate knowledge, investment should be made to introduce advanced technologies in order to generate quantitative information so that we can easily discern change, make prediction for future, and accordingly devise national strategies with more confidence.

Longitudinal research is necessary if a country can afford. Many local adaptation techniques might be used as such while several others can be combined with scientific knowledge generated using modern tools and techniques, to make is more robust, reliable, replicable, relevant, remedial, resilient and resource conserving in nature. Several of such knowledge thus can be adopted at cross-country levels but with possible modifications to tailor to local needs and capacities. It is also important to raise public awareness at all levels as national and local level planners, policy makers, implementers and victims of climate change have little knowledge about change process, driving factors and remedies.

Even capacities of scientists and climate advocates need to be strengthened through latest scientific inventions as they lack access to information due to costly journal fees and unreliable access of internet. Exchange of knowledge is also not efficiently done among stakeholders within country. It is important to share national, regional, and global policies, treaties, legislations and strategies with all national and local partners through their proper networks and help them tailor priorities and allocate resources accordingly. This will help them draw more resources from international and global community. More specifically, the global financial commitment on adaption in the least developed countries should be increased and committed funds (e.g.) least development country fund, special climate change fund, adaptation fund, climate investment fund, and green climate fund) transferred timely and appropriately through proper channels.

Furthermore, the climate vulnerable countries must prioritize implementation of their adaptation programs and plans (e.g. NAPAs) to build community resilience to

climate change, making sure the funds disbursed are properly distributed among target beneficiaries. To achieve aforementioned goals, we not only require research and development fund-both public and private-but also existence of several organizations like LI-BIRD to generate, translate, and disseminate knowledge, build community capacity in adaptation, and strengthen NGO networks to expand collaboration, scale out good practices, and foster policy advocacy. There is a lot to learn from LI-RBID approach and practices, which are viable, robust, need-based, and thus responsive to real challenges. It is also important to properly integrate LI-BIRD framework with NAPA and LAPA, where the countries have privilege of mainstreaming these strategies into climate change and development plans of the country.

Conceptual framework

Conceptual Framework starts with a problem and ends with tentative empirical generalization. The generalization ending one cycle is the beginning of the next cycle. This cyclic process continues indefinitely, reflecting the progress of research. Figure 1.2 illustrates the conceptual framework of the research study.

Conceptual Framework

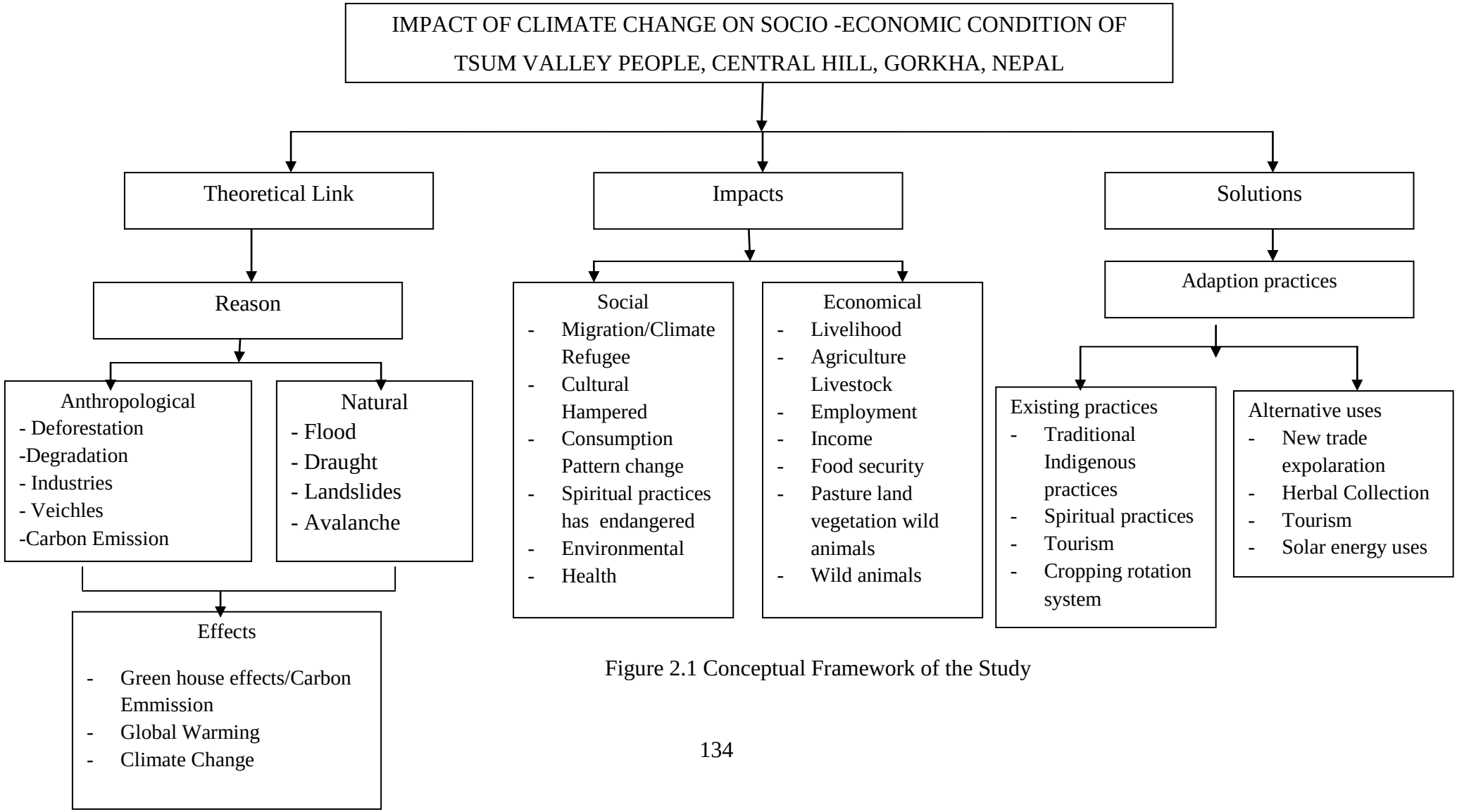


Figure 2.1 Conceptual Framework of the Study

The conceptual framework consists of theory and practice of the mountain peoples' socio- economic activities under the climatic changes. The components of setting research questions, designing the modality of research, collection of information, analyzing them and making generalizations to them have been involved in conducting this study.

CHAPTER III
RESEARCH METHODOLOGHY

Introduction

This chapter presents a research methodology framework of this study based on the conceptual framework models presented in chapter II. From the conceptual framework, an analytical framework is worked out. Components such as justification for the selection of field survey method as the main research method, use of study tools, data collection and analysis procedures and validity and reliability of the study tools are sketched in details under the respective readings. The researcher used mixed methods considering the both quantitative and qualitative approach. The researcher used different tools for information collection, like face to face interview, in depth interview, focus group discussion and self observation.

In the previous chapter, the researcher reviewed thematic, related literatures and contemporary research studies and drawn the conceptual framework. In this chapter presents a conceptual framework of this study based on the theoretical models discussed in the previous chapter. From the conceptual framework, an analytical framework is worked out. Components such as justification for the selection of field survey method as the main research method, use of study tools, data collection and analysis procedures and validity and reliability of the study tools are sketched in details under the respective readings. The researcher used qualitative and quantitative method for research study. The researcher used different tools for collection the information's like interview taken senior citizens, household, agricultural expert, focus group discussion and used Practical rural appraisal (PRA) tool historical time line.

Nature of the Research

This study is mainly conducted in ethnographical approach for detailing out case studies within qualitative approaches for collecting and interpreting the data and the nature of the study is exploratory cum descriptive in the sense of uncovering the

hidden multiple realities of the research settings. The scientific method the accepted approach used in this study. The post positivism paradiagm called scientific method also. During the late 19th and throughout the 20th century, post positivism worldview has comprised. The strategy of inquiry is grounded theory for qualitative and non experimental designs such as survey for quantitative study. In grounded theory research strategies, researcher derives a general, abstract theory of a process, action interaction grounded in the view of participants. This process involves using multiple stages of data collection and the refinement and interrelationship of categories of information (Charmaz, 2006; Strauss & Curbin, 1990).

Mixed method (More Qualitative than Quantitative) research approach

Qualitative and quantitative inquiry employs different philosophical assumptions; strategies of inquiry, and methods of data collection, analysis, and interpretation. Qualitative procedures express a different approach to scholarly inquiry than of quantitative research. Although the processes are similar, qualitative procedures rely on text and image data, have unique steps in data analysis, and draw on varied strategies of inquiry. In fact, the strategies on inquiry chosen in a qualitative project have a impressive Influence on the procedures, which, even within strategies, are anything but uniform. Looking over the landscape of qualitative procedures shows diverse perspectives ranging from social justice thinking (Denzin & Lincolen, 2005), to ideological perspectives (Lather, 1991), to philosophical stances (Schwandt, 2000), to systematic procedural guide lines (Creswell, 2007). All perspectives contend for center stage in this describing model of inquiry called qualitative research. Qualitative research is a synonymously termed for a number of research approaches associated with the interpretive and critical science perspectives.

Quantitative approaches rely on data, which has been chosen for the study. Its data based on numbers of sampling population size and count their numbers only. Validity depend its either majority or minority numbers of responses. However many research have been conducted on quantitative base. Many investigative and

experimental researches have based on quantitative approach. But in this research, the researcher used quantitative approach in less than qualitative.

All of the particular approaches reflect a continuum of inquiry foci tightly bound to the qualitative paradigm and each may have characteristic interpretive methodologies. Qualitative research methods are valuable in providing rich descriptions of complex phenomena; tracking unique or unexpected events, illuminating the experience and interpretation of events by actors with widely differing stakes and roles; giving voice to those whose views are rarely heard; conducting initial explorations to develop theories; and to generate and test hypothesis; and moving toward explanations (Best & Kahn, 1999). Qualitative research is characterized by an emphasis on describing, understanding and explaining complex phenomena on studying. For example, patterns, the relationship, and configurations among factors; or the context in which activities occur. The focus is on understanding the full multi-dimensional, dynamic picture of the subject of study.

Qualitative inquiry is less a science and more a practical philosophy and is the result of and opposition to the dominance of logical positivism, thereby depending more on non statistical ways of analyzing and interpreting data. It is a source of defining interpretation as a genuine alternative to explanation. However, according to Kuban (1976), the methodological status hierarchy in science tends to rank hard data above soft data where hardness refers to the precision of statistics and numbers. The important thing the researcher had to realize that qualitative approaches are not weaker or softer than quantitative approaches but that they are different. The researcher found out that studies that were qualitative in nature used a variety of interpretive methods in which the researcher played a more central role in the clarification and interpretation of the behavior and observation observed.

This type of research enabled the researcher to become the key instrument for the study which is what initially aroused the researcher interest in conducting a qualitative study. Lincoln and Cuba (1985) refer to this type of research as “naturalistic inquiry” which implied that interpretive techniques resulted in a more natural approach than the tests and surveys used in the more traditional quantitative

approaches. As per Denzin and Lincoln (2000), "Qualitative research is an inquiry project, but it is also a moral, allegorical and therapeutic project". In other words, qualitative researcher was required to write moral stories in addition to recording human experiences. As per these authors, the researcher's account acted as a setting which could have individuals and society to carry on and succeed. Such beliefs seems to describe the kind of inquiry the researcher wished to conduct.

The researcher found that all qualitative research methods tended to make use of "qualitative data, context sensitivity, emphatic neutrality and inductive analysis" (Best & Kahn, 1993). The very nature of the in-depth detailed descriptions of events was what made qualitative research so powerful. The richness of the data permitted a fuller understanding of what was being studied that could be derived from quantitative experimental research methods. The particular importance of perspective sensitivity was that the data were not generalized to other situation socially, spatially or temporally. Inductive analysis enabled the researcher to explore the data without prior hypotheses.

This openness to find whatever there was to find was unique to qualitative research and acceptable the researcher to discover reality without having to fit it into a preconceived theoretical perspective. These aspects of qualitative inquiry further urged the researcher to pursue it as a method of choice. However, gradually a shift occurred in terms of research making room for a revised agenda that emphasized description, introduction of ground theory and the study of people understands there by deepening dependence on qualitative methods for studying various climate change issues. This is another reason the researcher was drawn towards electing a more qualitative than quantitative research methodology.

Two primary characteristics of this design are the constant comparison of data with emerging categories and theoretical sampling of different groups to maximize the similarities and the differences of information (Creswell, 2011). Based on that theories research has conducted. In the process of data collection the open ended questionnaire has used for the in-depth interview. Nonetheless, all perspectives contend stage in this describing model of inquiry called qualitative research. The

processes are similar as per quantitative and qualitative data analysis, and draw on varied strategies of inquiry.

Looking over the landscape of qualitative procedures shows diverse perspectives ranging from social justice thinking (Denzin & Lincolen, 2005), to ideological perspectives (Lather, 1991), to philosophical stances (Schwandt, 2000), to systematic procedural guide lines (Creswell, 2007).

Significant of the site selection

Peculiar geographical location (Hidden Valley) is beauty in Nature. It is mountainous remote area from district head quarter Gorkha. Rich in natural resources but no conservation and less research have done .It is anthropologically an important place for study (polyandry practiced place and excluded from 2011 population census, prohibited area till to 2063 BS, 2006). Non-violence area, people never slaughter animals, even as sacrifice to the gods in the Tsum valley. The settlement of a typical ethnic group (Tsmuba), and recognize by disadvantage group of indigenous people. There is no research have done in this valley about their livelihood and the impact of climate change. Therefore, researcher decided to select the area for the study.

Population and sample size

The Total population of Tsumba as per census 2011 is 1911.Sample size has been taken 100 for this study. This sample size has represented the whole Tsum valley people because the study group consists of members who were able to function as informants by providing rich and detail description of the factors being investigated. "Tsum Welfare Committee (TWC)", an organization of Tsum people has lot of information about the Tsum people's concern. TWC recommended the persons who have knowledge more about Tsum. A preliminary study was conducted on experts to select specific. Sample size had fixed by 10 percent of the total household through purposive sampling method. Purposive sampling has been used to select the respondents or households based on some criterion (experience on crop production, livestock, herbal collection, tourism and being long time spender, more than 40 years

in the valley) on these basis the group meeting held on by the help of Tsum welfare committee and had chosen households as per purposive sampling .

Methods and tools for information collection

Direct interview

A direct interview was conducted in the selected households with the help of semi-structured questionnaire. Mostly senior persons who could well articulate and explore their experiences and knowledge and such persons are found out through the link of person to person those who have similar experiences and knowledge about concerned issues was preferred for interview as much as possible.

In-depth interview

For in depth interview, researcher have taken 6 respondents have taken for case study, those who have in-depth knowledge, experience, and history of Tsum Valley and its people. The areas of case study persons are selected from senior citizen, Chairperson of Tsum Welfare Committee, and Rimpoche, those who are recognized as an incarnation of Lord Buddha.

Focus Group Discussion (FGD**)**

FGD was conducted with three different groups. The groups are selected from youth, female and experts (Teachers, Trekking Guide, persons from social warfare committee).

Participatory rural appraisal (PRA**)**

Historical time-line is used for proper tools for PRA which measures the climate change based on long time distanced.

Organizing and preparing data for analysis

Raw data

This is the frame work of Qualitative Research design, above figure shows different step of research design. First step the researcher has taken raw data after that organized and prepared data for analysis then proceed data reading and coding then researcher created themes of study finally she interpreted of theme . The plan of study posse and explains the procedure for analyzing and interpreting the findings.

Research design

A research design is the deal of the conditions for the conditions for the collection and Analysis of data in a manner that aims of combining relevance to the research purpose with economy in procedure. In fact, a research design is the conceptual structure within which research is conducted. In constitutes the blueprint for the collection, measurement and analysis of data (Kothari, 1994). It is the plan of the study, which is determined by purpose of the study (Cohen, Manion & Morrison, 2000). It helps to layout the plan of study group and explains the procedure for analyzing and interpreting results and findings.

Interpretation in-depth interview

It is the plan, structure and strategy of research conceived so as to achieve answers to research questions and to control variance. It is intended at enabling the researcher to answer questions as validity, objectivity, specifically conceived and executed to bring empirical evidence to bear on the research problem (Kerlinger, 1886). A research design is the determination and statement of the general research approach or strategy adopted/or the particular project. It is the heart of planning. If the design adheres to the research objective, it will ensure that the client's needs will be served (Luck & Rubin, 2005).

A research design is the specification of methods and procedures for acquiring the information needed. It is the over-all operational pattern or framework of the

project that stipulates what information is to be collected from which source by what procedures (Green & Tull, 2004). A research design is a framework of blue print for conducting the marketing research project. It details the procedures necessary for obtaining the information needed to structure and/or solve marketing research problems.

This is a study of climate change impact on socio-economic condition of Tsum valley central hill Gorkha, Nepal. The research design is under take to the impact of climate change in Tsum valley in Nepal. It explores the existing situation of climate change in Tsum valley people of Nepal. After the intensive and insightful study of the overall problems and adaptive measures about the practices of climate changes in mountain region people's, the study may contribute for the economic development of Nepal. This study is to find out the implications on enquiry and access due to policy measures of climate change observe in mountain people of Nepal. Thus, the study has adopted the following methods in order to collect needed information for the study.

a. General asking the questions who were concerned in that valley.
b. Interview with selected persons, dharma Guru (Lama), migrated from Tsum and expert those who were related in the field.
c. Focus Group Discussion (FGD) was conducted with three different groups. The groups are selected from youth, female and experts (Teachers, Trekking Guide, persons from social warfare committee).

Participants and research background

Data analysis involves collecting open-ended data, based on asking general questions and developing an analysis form the information accomplished by participants (Creswell, 2011). The general rule in qualitative research, the researcher used purposive sampling technique. In purposive sampling, the researchers handpick the cases to be included in the sample on the basis of their opinion of their typically or ownership to the particular characteristics being required.

The researcher conducted this study in Tsum valley Gorkha District, Nepal. The study area represent the rural mountain region of Nepal because the study group consists of members who were able to function as informants by providing rich and detail description of the factors being investigated. A preliminary study was conducted on experts to select specific behaviors that could be studied as representative of rural mountain people. As a researcher, the researcher had a planned schedule to go through research participants and observed their particular activities. The researcher targeted groups who were live in tsum valley and known more about. The researcher started to move from a lower chum (Chumchet VDC) to upper Tsum (Chhekampar VDC) to get the information of Climate Change impact in tsum valley. The researcher had a contact with different Persons who were involved in the study of tsum, collected the written documents and made many appointment to with Tsum Welfare Committee Chairperson, advisor and to other members.

A first, the researcher chose seven of the farmers who were involved in agricultural practice in Tsum valley, three were Lama Guru who practice buddism in Tsum valley. Researcher gave them the prepared theoretical question on "Impact Study of Climate Change on Socio-economic condition of Tsum valley" to check the knowledge on Climate Change impact and other socio economy related matters.

The researcher checked the answer paper with the help of one of the export who was involved in climate change and environment sector. The farmers answered researcher questions and then the researcher took them as a research participant.

For the rationale of study, the researcher was then inundated with hundred participants; seventy man and thirty women aged twenty to eighty six who were born in Tsum valley and involving in agricultural field and other related jobs to sustain their livelihood. Their selection was based on obtaining a wider reach to explore new emerging concept. Even though the total number of respondents group was relatively small, the selected numbers allowed to generate sufficient and depth of data. The material in the data from those research participants met the requirement for generating a variety of agricultural practice concepts.

Data collection procedure

The mission of data collection begins after a research problem has been defined and research design chalked out. While deciding about the method of data collection to be used for the study, the researcher should carry on two types of data viz., primary and secondary. The primary data are those which are collected in excess of and for the first time and thus happen to be original in character. The secondary data, on the other hand, are those which have already been collected by someone else and which have already been accepted through the numerical process.

The researcher would have to decide which sort of data he would be using for his study and accordingly he will have to select one or the other method of data collection. The methods of collecting primary and secondary data differ since primary data are to be originally collected, while in case of secondary data, the nature of data collection work is just that of compilation. The primary data were composed using structured and unstructured questionnaires, interview with expert, who is involving since long time in Tsum valley. Similarly, focused group discussions were carried out.

All through the inquiry, in-depth interviews were used to explore issues in more detail. In addition to this, directly field observation was the part of data collection. Data collection was done in different stages. The first stage was preparation phase and second stage was field visit for data collection. The researcher first approached to the respondents by explaining the purpose of the visit and arranged time and accordingly followed by visit to them and uncover the data through filling questionnaire, interview, focus group discussion, historical timeline, PRA tool and case studies, observation as well.

Tools for data collection

The method of collecting the data depends upon the nature, object and the scope of the enquiry. This study research has used a number of tools to produce information on the theme under study. Qualitative and Quantitative data collection tools were developed and used in this regard. Observation, interviews, structured and

semi structured questionnaire, focus group discussion and PRA is the major tools for qualitative data collection. A detailed clarification of each of the study tools is presented in the following: Interview

Interviews allow respondents to open out in a relaxed manner. Since, the interview in historical research is not as prepared as in a regular interview, the situation allows respondents to drive through their experiences and perspectives more freely. The researcher conducted on interviews with Key people: Manasalu Conservation Area Project (MCAP) staff, local households, aged local people, climate change specialist from Kathmandu, local teacher, local health worker, TWC member, Dharma Guru (Rimpoche and other Buddhism practitioners, etc.) have been consulted about shifting of snowline, change rainfall pattern, watercourse flow, trend of livestock holding, decrease in pasture land quantity and quality, new and persistent plant in rangelands and problem faced on wood roofed houses. For this, several related inquiring hints and search tips were used for each of the research questions that reflected major aspects and domains of agricultural practice in mountain people of Nepal. The rationale of using this approach is based on the view that the participants' perspective on the phenomenon of interest should unfold as the participant views it, not as the researcher views it (Marshall &Ross man, 1995).

The interview schedule was mainly of open ended nature. This tool was used for interviewing selected authorities of agricultural and other related to the livelihood practices in Tsum valley. There are a number of techniques to interviewing. The researcher developed interview guide to make the responses systematic. Patton (1990) has also given three basic approaches to collecting qualitative data through open-ended interviews. They are: informal conversational interview, general interview guide approach and standardized open-ended interview.

According to Patton, the informal conversational interview is the most open-ended approach to interviewing, which relies totally on the spontaneous generation of questions in the natural flow of and interaction. The general interview guide approach involves outlining a set of issues that are to be explored with each respondent before interviewing begins. The interviews conduct simply serves as basic checklist during

the interview to make sure that all relevant topics are covered. Finally, the standardized open-ended interview consists of a set of questions carefully worded and set with the goal of taking each respondent the same questions with essentially the similar words. Regarding the approaches, the researcher used the interview guided approach. From the interview, the researcher was competent to identify the situation, impact and problem of the study area. One of the reasons behind the selection of this technique of data collection was to assemble information systematically as needed.

Questionnaire

The questionnaire is a widely used and useful instrument for collecting survey information, providing structured, often numerical data, being able to the administered without the of the researcher, and often being comparatively straightforward to analyze (Wilson and Mclean, 1994).The researcher will have to judge the appropriateness of using a questionnaire for data collection and a set of questionnaire was used in collecting data through authorities. The respondents were asked about their views on strengths and weakness of existing their situations of Tsum valley, Nepal. Questionnaires administered personally to individuals have a number of advantages. The person administering the tool has an opportunity to establish rapport, explain the purpose of the study, and explain the meaning of items that may not be clear.

Although the prior discussion may seem to discredit the questionnaire as a respectable research technique, the abuse or misuse of the device is considered. Actually the questionnaire has unique advantages, and properly constructed and administered, it may serve as a most appropriate and useful data-gathering device in a research project (Best & Kahn, 1999).

Focus Group Discussion

An open discussion and interaction was conducted through interview technique to collect personal experiences, opinions, beliefs of the students which helped to draw implications for future action on impact of climate change in

mountain people's livelihood in Nepal. In this connection, Patton (1990) also emphasized on people's response. According to Patton, "What people say is a major source of qualitative data, whether what they is obtained verbally through an interview or in written form through document analysis or survey responses". Reasons in selecting the group interview and interaction techniques through interview guide approach match the view of a Patton (1990).

Focus group discussion was arranged to have an interaction session with the farmers having wide range of experiences on the applicable and emerging adaptation practice to mitigate the climate change impact in Tsum Valley, study area issues in the global as well as local contexts. The sharing and interaction about the experiences helped to widen idea on the current climate change impact mitigation practice in Tsum valley people of Nepal.

Observation

In observation, the researcher became a participant in the culture or context being observed (Torchim, 2002). In this study, the role of the researcher was that of an observer, that is, during the field visit people of Tsum valley are involving different sector to maintain their livelihood. Caring the cattle, performing cultural dance, farming in the agricultural field, prepare ahead plan to collect the yarchagumba, medicinal herbs from the forest, the researcher try to find out how the people were adapting the existing situation in their everyday life and answered their queries.

Field report was taken as supportive sources of data collection during the observation. This provided the researcher with: physical map out support, recordings of the social situation of the people. The researcher recorded different activities of Tsum people looking for, "What the farmers are farming in the field, what types of technology are using and which crops are most popular inTsum valley? Observed beautiful natural landscape and Snowcap Mountains, observed many ancient Budda Gumbas in Tsum valley. The field report was taken during each observation to determine how the climate changes affect the people's livelihood in theTsum valley?

How people examine the impact of climate change and what could be the responsible factors by Tsum People?

Historical timeline PRA tool

Regarding the PRA tool expected all participants have knowledge about the topic. Aged local people were participated in that discussion. The question was asked for 20 years back and now comparatively. Extreme events and evidence was taken from discussion and confirmed actual date and time also. Major question was how doing examine the impact of climate change in Tsum valley people?

Analysis of qualitative data and their interpretation, qualitative data analysis involves organizing, accounting for an explaining the data; in short, making sense of data in terms of the participants' definitions of the situation, not anything patterns, themes, categories and regularities. It is a process that brings order, structure and meaning to the mass of collected data. It includes data reeducation, classification, displaying, content analysis and drawing conclusion. Data from the interviews and other qualitative methods were in the form of written notes and transcripts of tape recordings.

As the research continued, filed notes were expanded and translated. To develop a category system, the content of the transcripts was analyzed to identify common themes and points for further discussion, while processing the qualitative data exact treatment was carried out and issue wise classification of the findings were presented on thematic basis. The analysis of qualitative data relies on a systematic organization of data into categories and themes, the researcher identified patterns and relationship on which to base and analysis of the findings.

Data analysis procedures differ from researcher to researcher. In this study, at the beginning, the collected data was structured according to the responses of the respondents. After processing the data, necessary interpretation was made in a descriptive and analytical way. Interpretation is the heart of analysis through which finding occur, explains Patton. According to the author, "interpretation involves

explaining the findings, answering why questions, attaching significance to particular results, and putting patterns into an analytical framework". In order to process and analyze the data, the researcher used three interrelated parts of analysis, viz. data reduction, data display and conclusion drawing and verification as championed by Mills and Huber man (1994). Regarding the first part of the analysis, the researcher used data reduction technique through summarizing and sequencing the collected information in a repeated sequence.

Data reduction is a form of analysis that sharpens sorts, focuses, discards, and organizes data in such a way that final conclusions can be drawn and verified. In the second part of the analysis, the researcher used data to present important views or thoughts in an impact of climate change on socio-economic condition of people. The opinions of the respondent were carried out to clarify the ascending and descending order of participation in the case of Tsum valley people.

In the third part of the analysis, the researcher used conclusion drawing and verification technique to analysis through verification, argumentation and explanation of the collected information. According to Kahn (1990), the first step is organizing the data, the second step is description of data and final one is interpretation of data.

Validity and reliability of the study tools

As the study has used open-ended and closed-ended questionnaires, and interview guidelines, they are also used in qualitative research (Best & Kahn, 1999).The study has used both these techniques and a case study format which can qualify it as a qualitative research also. As the study has used case study approach as one of the methods, it claims to have nearness with the ingredients of a qualitative research. Qualitative research studies use these techniques in isolation or in combination (Best & Kahn, 1993) Further, Best and Kahn (1999) have argued that the basis of the validity of a questionnaire is asking the right questions, phrased in the least ambiguous way. They also discussed about the panel of experts who may rate the tool in terms of how effectively it samples significant aspects of its purpose, providing estimates of content validity.

The validity and reliability of data depend to a great extent on the methodological skill, sensitivity, and integrity of the researcher organized and exact observation involves far more than just being present and looking around. Skillful interviewing involves much more than just asking questions. Generating useful and credible qualitative findings through observation, interviewing and content analysis requires discipline, knowledge, training, practice, creativity and hard-work. On viewing the different perspectives of reliability and validity, the researcher has presented the following arguments to claim the validity and reliability of the methods and tools used in the present study. First, the researcher developed a set of questionnaire and to minimize ambiguities. In this connection, Best and Kahn (1999) have also argued that the basis of the validity of questionnaire is asking the right questions, phrased in the least vague way.

In this regard, the following activities have done carried out to ensure validity and reliability. Orientation has given to the Tsum valley people those who are living in Kathmandu. They could know about the objective of study and Tsum people organization also knows about on that study. Orientation has given to the assistant who help me for technical support as well as documentation" for documentations, explanation of each of the questions and eligibility and selection of respondents. Pre-test of the questionnaire have done before data collection to know comprehensibility and appropriateness of language, sensitivity of questions.

Translation of questionnaire into Nepali language has done. Local language have used during data collection if needed. Supervision and monitoring have done by the researcher. Collected data had recheck and verified in the field. The set of questionnaire was administered by the researcher oneself as researcher was the main conductor of the process. In the same way, a plan chart was prepared prior to the development of the questionnaire, focus group discussion guidelines and interview guide to keep them in sequence. Second, the researcher oneself was the observer as well as the enumerator of the case of the students. The researcher oneself visited the of the study area to gather the information through the case study format.

Regarding the characteristics of qualitative case study, Stake (cited in Denzin & Lincoln,1994) states that the qualitative case study is characterized by the main researcher spending substantial time on site personally in contact with activities and operations of the case, reflecting, revising meanings of what is going on. Third, in order to protect the content validity, the researcher distributed the research topic along with the objectives, the research questions, the research methodology ant the set of questionnaire to panel of experts. The suggestions, comments and reforms provided by the panel were included while finalizing the research tools. In this regard, Best and Kahn (1999) have also argued that this technique is one way of securing content validity of the study. According to them, panel of experts might rate the instrument in terms of how effectively it samples significant aspects of its purpose providing estimates of content validity.

Fourth, people's opinions, thoughts, beliefs and experiences were observed directly through focus group discussion. In this regard, Patton (1999) suggests that what people say is a major source of qualitative data. That is why; the researcher used and interview and focus group discussion to collect the needed information. This tool was also able to crosscheck the information obtained from other sources. Fifth, the researcher used the interviewing method for gathering information in the research, which is one of the best tools in qualitative research. That is why, the other researchers of the same background and the same context can replicate the findings of the research. In this regard, Denzin and Lincoln (1994) opine that the consistency is the context to which findings can be replicated, or reproduced, by another inquirer.

Further, Maurice Punch states that qualitative case study method relies on interviewing, observing (cited in Denzin & Lincoln, 1994).For the case study of the samples, the researcher did exactly the above mention activities. Last, but not the least, the data triangulation was a major tools for the validation of the study. This is the method of collecting the information through different perspectives with different tools. The researcher used multiple tools and techniques, such a set of questionnaire, case study, in-depth interview, focus group discussion along with notes and review of

related literature that represent Dentin's (1978) triangulation. Reliability and validity are essential to effectiveness of any data- assembly procedure.

These terms are used here in the most general way. Reliability is the degree of consistency that the instrument or procedure demonstrates. Whatever it is measuring, it does so consistency. Validity is the quality of a data-gathering instrument or procedure that enables it to measure what it is supposed to measure. Reliability is a necessary but not sufficient condition for validity. It is no doubt that observation, interviews, or the use of questionnaire, case study is such tools where responses are more qualitative and they are not always readily quantifiable. One should attempt to improve the reliability and validity of the procedures, but precise determination of the degree to which they are achieved is often elusive, particularly in the case of validity (Best and Kahn, 1999). The rigorous process that the researcher underwent per tainting the development and administration of the research tools, as stated above, thus placed the tools to stand the test of reliability and validity by qualifying them to have the ingredients of good and study tools.

Information Management

Data management is the important parts of a research process. This process begins right before the data collection and ends right after the data have been analyzed and archived. Data management is useful to practical of primary data collection that leads to systematic, logical process of gathering, storage and repossession. Data reeducation, displaying and interpretations are the major sub process in my research. In this study, the researcher begins data management before the data collection and applied the principles of data gathering, sorting, storing, filtering and retrieving relevant to research objectives.

Trust worthiness of the information

Validity means that the observation, interviews or content analysis really contain the information that the researcher thinks they contain. At their most general level of definition, these concepts are obviously important in any form of research;

however, because of its more subjective nature, qualitative research introduces some nuances into the use of these terms (Denzin & Lincoln, 2000).

The concepts of reliability and validity must be re-examined and expanded for qualitative data-while some qualitative theorists would maintain that such quantitative terms do not apply at all in qualitative research, others would maintain that the essential definitions still apply in this chapter. Although, there are problems with validity, compared with more traditional quantitative research, qualitative methods are more valid in that they recall getting of the underlying concept being observed rather than measuring an artificial entity created by a data collection process. This process called triangulation has adopted in the study as a method of trust worthiness. To the extent that interpretation is necessary and it has interpreted correctly, then the subjective qualitative measurement will be superior to a more objective, quantitative assessment of the same outcome or situation. By observing something from different angles or viewpoints, they fix on its true location. Triangulation is about union, validation and correspondence of results from different methods. Methodological triangulation was used to ensure the credibility of the findings.

Triangulation tests the consistency of findings obtained through different instruments. The aim in triangulation is to choose triangulation source with different biases, different strengths, so they would complement each other. Method triangulation was done by comparing data from two different methods of data collection. The most important ways to make the inquiry trustworthiness of research findings is by triangulation as mentioned by Tellis (1997).

In this context triangulation according to him is considered as a combination of methods that is necessary in order to gain any picture of the relevant phenomenon of the entire trigonometry model and multiple sources of data collection strategies were used in this analysis to triangulate the finding of this study. For the same, multiple sources of data such as observation, interviews, and focus group discussion were used. The researcher self involved in this process and asked the similar questions to special respondent. This process enhanced the sincerity of the patterns that emerged and became a useful tool for this study.

Ethical consideration

Providing emphasis on ethical concern the researcher spent considerable time in the field. Before entering into the research matters, the researcher made intensive discussion about their day to day activities, agriculture practice method, importance of important of technology and other climate related sectors.

Any research study raises ethical considerations. Addressing ethical question is important in the qualitative research. In detail, unstructured nature of qualitative research and the facts, it raises issues that are not always anticipated mean that ethical considerations have a particular resonance in qualitative studies (Lewis, 2003).

The researcher explained the purpose of interviewing and discussion in the particular subject and made clear that the information would only be used for study purpose not for other official use. The researcher interviewed with them only after their consent and acceptance. Prior to conducting research, the researcher entered into an agreement with the participants that clarified the nature of the research and their responsibilities. The researcher informed them with information about the purpose of study, how the data will be used, the subjects likely to be covered, the amount of time required. The researcher used the language that is logically understandable with resource participants in obtaining their appropriated informed consent.

Finally, the researcher their feelings, expressions and concerns were fully respected and honored. To make the frank and open, the researcher made clear that the name of the village, location of farming would be anonymous. In conclusion, here is given some points for the ethical consideration for the study.

- Approval for data collection has been taken from Manaslu Conservation Area Project (MCAP) Office Gorkha.
- Approval letter for Data collection has been taken from the Singhania University Rajasthan
- Study permission letter has been taken from National Trust for Natural Conservation

- Privacy and confidentiality has been maintained
- Participation in the interview has been done voluntary. Respondents have given choice that they could withdraw from interview at any time or refuse to answer any particular question if felt uncomfortable.

Role of the researcher

The researchers' role is important to the production and interpretation of qualitative data and the identity, values and beliefs of the research. As a key informant interviewers (KII) researcher was involved in related field since long time, member of household, the researcher took a frame of reference that was based in pedagogy. From this point of exit, the researcher planned schedule to go through research participants and observed their particular activities. In this frame of position, the researcher's self played an important role in the analysis of the data.

Chapter Summary

In this chapter, the basic ground rules of the research methodology have been described which adopted on the study. All sampling strategies, data collection techniques, tools, and techniques of data analysis and reduction were discussed in this chapter. The mission to find answers to research questions and gained informed knowledge the researcher determined to conduct a more qualitative study. Researcher used different tools for data collection like interview, observation, questionnaire and case study which helped to effectively answer the research questions.

CHAPTER IV
DESCRIPTION OF THE STUDY AREA

Introduction

In this chapter, researcher has explained about the study area in different segments. Which represents the geographical, ecological, demographic, culture and religion, natural resources, strengths and weaknesses of the study area information in concise.

Perhaps one of Nepal's most beautiful valleys, it is cut off from the southern lowlands of Nepal by deep, forested gorges and swift rivers and from Tibet in the north by snow-covered passes. It is popularly known as the 'Hidden valley". It is one of the eight sacred valleys (called Beyuls) in the inner Himalayas and owes its genesis to the eighth century Buddhist saint Padmasmbhava.

Tsum Valley, Gorkha District, Nepal

Geographical location

The Tsum valley is a sacred Himalayan pilgrimage valley situated in Northern Gorkha, Nepal. It is about 47 km far from district head quarter of Gorkha, centre hill, Nepal. There are 56 VDCs in Gorkha District. Chhekampar and Chumchet VDCs are belongs to Tsum valley. The valley is bounded by three high passes, the Ngula Dhojyang (5,093 M) to the east, Thapla pass (5,104 m) to the west, and Yamdro, also called the Humlung pass (5,326 m) to the North. The altitude of the valley ranges

from 1905m at Lokpa to over 5093 m at Ngula Dhojyang on the Tibetan border. It lies between latitudes 28□ 20' 14.6" N and 28□ 36' 47.7" N and Longitude 84□ 57' 18.8" E and 85□ 11' 35.6" E. (ICIMOOD Great Himalaya Trail 2008).

Lower Tsum and Upper Tsum (Tsum settlements)

A village of Chekampar, upper Tsum

Chhekampar is a probably the least heard of and least visited place in Nepal because of its remoteness, inaccessibility and dangerous trails. It is for these reason that it is called "The hidden valley" of Gorkha District. (Bhandari Bishnu, 1997, IUCN). According to Bhandari not mentioned about a lower chum, Chumchet VDC, included the chumchet VDC called Tsum valley or Hidden valley.he says the treatise Mechmahakali (His majesty's Government, 1974), which is a compromise account of Nepal and its people, does not ever mention it. In 1970, the Remote Area Development Committee (RADC) of His majesty's Government sent a number of high level survey team to assess the situation of the remote areas of the country.

The survey of the Mnang and Gorkha areas, including larke, Bihi and Prok was done by a team led by Dor Bahadur Bista (Durgamchhetra Bikas Samiti, 1970), but their report also failed to mention chhekampar or the area. Along with the Bhandari's opinion, there is not done any study about Chumchet VDC comparatively the Chhekampar VDC. Both VDCs are included in the Tsum valley.

Chhekampar village is called the upper Tsum while Chumchet village is called the lower Tsum. The Tsum valley is extremely rich in cultural assets. The valley is dotted with Gombas (Buddhist monasteries), chortens and mani walls. The longest mani walls (over 250m) are at Dzong and Phurpe. The valley preserves steps of the great Buddhist Yogi Chyuchin Milarepa and story about Guru Padmasambhava circumbulation.

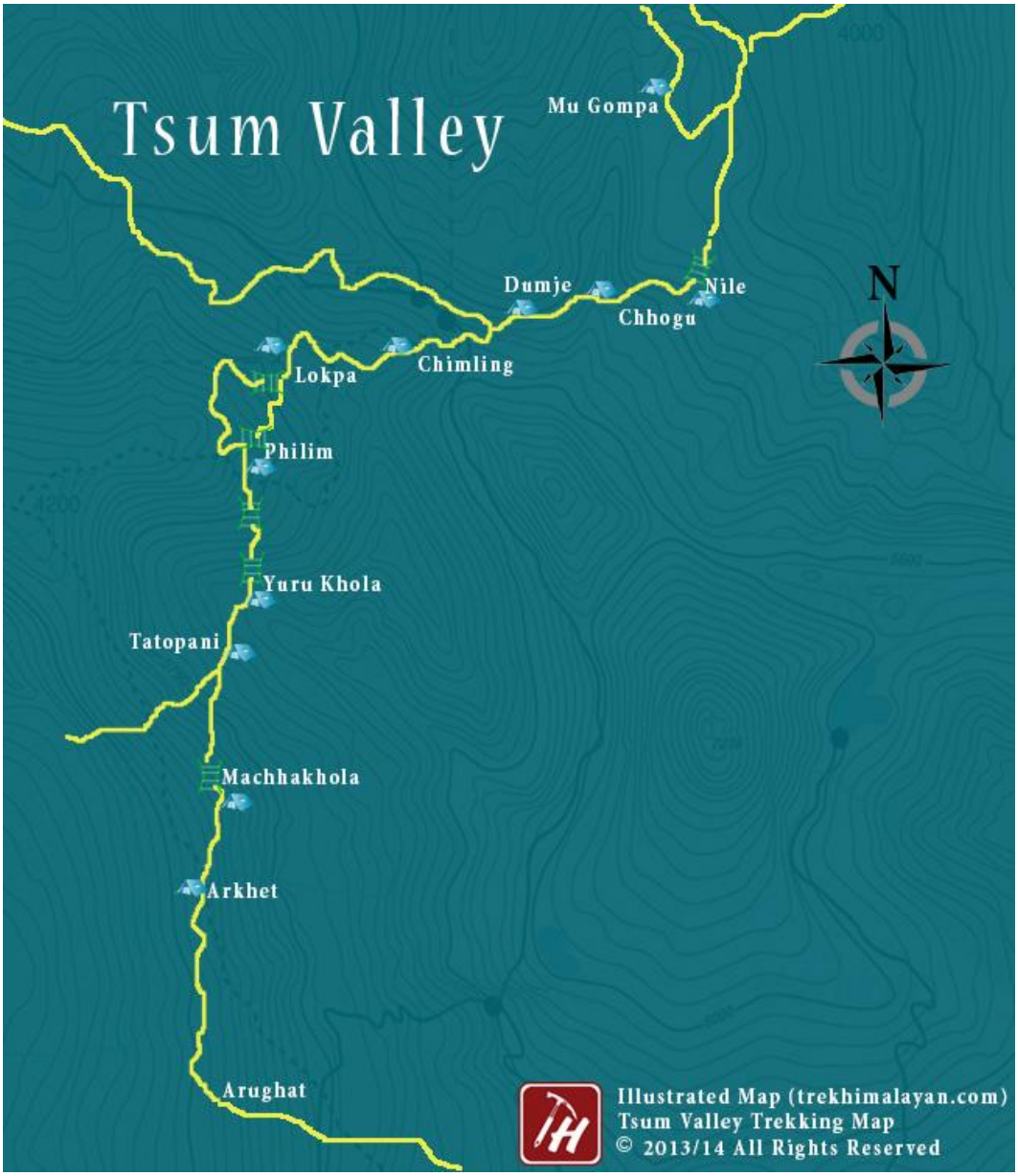
Chumchet village development committee is a lower part of Tsum valley. At the time of the 1991 Nepal census it had a population of 979 and had 221 houses in the village. But the latest national census of Nepal 2011, it has been decreased in total number of Tsumba.

Few of the Lama Guru (Buddist priest) and aged local male those who did business could speak Nepali. Many teachers have changed finally one brahmin (so-called upper caste of Nepal) teacher successes to teach in the school. Now there are seven primary schools in Tsum valley, altogether lower and upper Tsum.

Tsum valley trail route

The trail route has shown that how people arrive to this study area, Tsum valley. After 3 to 4 hour travel on bus from the district headquarter to get the trail route beginning point Arughat then have to follow all the route accordingly until to Tsum valley. Many people combine the Tsum valley with the Manaslu Circuit, starting in Arughat Bazaar and ending in Besisahar, which is also the starting point for the Annapurna circuit. You can already catch a jeep further north from Dharapani onwards. Others proceed back to Arugath the same way, a circuit is not possible. You start low, walking through green countryside, and passing small Hindu villages. You enter the Tsum valley going right from the main trail and you soon enter a beautiful

forest with pines and rhododendrons. Eastwards the valley opens up to reveal a beautiful countryside and small Tibetan-style villages.



Tsum valley trek detailed itinerary

Day 1: From Kathmandu drive to Arughat Bazaar (8-9 hours)

After 8-9 hrs bus ride reach to Arughat Bazaar in Gorkha district. The village of Arughat is in two parts, on opposite sides of the Buri Gandaki. Arughat Bazaar is large, clean and prosperous with hotels and shops selling cloth, food and hardware.

Day 2: Arughat to Soti Khola (6-7 hours)

From Arughat Bazar have trek to Soti Khola. Along the way enjoy with splendid views of Shringri Himal. Then trek through Gurung and Magar villages, past fields and cascading waterfalls, till we reach Soti Khola.

Day 3: Soti Khola to Machha Khola (6-7 hours)

From Soti Khola to Machha khola (Fish river). Machha khola is a village situated above a stream with the same name

Day 4: Machha Khola to Doban (6-7 hours)

The trail from Macha Khola to Doban involves some steep ascents and descents. We climb a well – crafted staircase over a ridge to Doban. Doban lies at the confluence of the Shiar Khola, which flows from the east, and the Sarpu khola, which flows from the west.

Day 5: Doban to Philim (6 hours)

The route climbs on a rugged rocky trail, climb up and down ravines and notched trees. We get good views of Sringri himal as we continue up to the village of Philim at 1550m.This is a large Gurung village with fields of corn and millet. There are several good campsites and can set up camp surrounded by alder, blue pine and poplar trees.

Day 6: Philim to Chumling (Lower Tsum) (7 hours)

We take the trail up through Philim and head up over a ridge that leads to Ganesh Himal Base camp and Chumling(Lower Tsum). There are several good campsites at Chumling.

Day 7: Chumling to Chhokangparo (Upper Tsum) (5-6 hours)

From Chumling to Chhokangparo. Upper Tsum valley (part of the Inner Himalaya) open from Chhokangparo.Chhekamparo is a village situated on flat land and made up of two settlements Chhekam and Paro. From the valley, the Ganesh Himal range can be seen directly to the south where it provides spectacular views of the Baudha and Himal chuli peaks to the south-west.

Day 8: Chhokangparo to Nile/Chhule, visit Milarepa Piren Phu Cave on the way (6-7 hours)

From Chhokangparo to Nile/ Chulle. This is the last village heading north in the upper Tsum Valley. Nile is on the western, sun-side of the Shiar Khola, about 20 minutes walk across from Chhule.

Day 9: On the way to the Piren Phu cave. Piren Phu (pigeon cave) is one of the most sacred caves in the Tsum valley. It is located at the foot of a rugged cliff near the village of Burji. Milarepa, the famous Tibetan saint, was believed to have meditated here. There are two separate gumbas attached to the rocky cave. Richly painted Buddhist murals, excellent artistic scripts carved on stones, long prayer flags and significant Buddhists paper scripts make this cave one of the most important socio-cultural asset in the valley.

Beautiful views can be had of the Shiar Khola, Rachen Gumba, the mountains and settlements amidst vast agricultural land.

Day 10: Nile/Chhule to Extra day for excursion

a hike up Mu Gumba and reach the base of Pike Himal (4865m).We are quite close to Tibet and get a good view of the Tibetan peaks as well as the Ganesh Himal range. After the day's excursion return to at Mu Gumba (Trekhimalay.com).

Historical background of Tsum valley

The Tsum valley has long history of Buddhism. The Buddhist saint Milarewa is believed to be meditated in the caves of these mountains. Traditionally, the valley was a culturally distinct geographical called “Tsum Tso Chuksum”, which means thirteen provinces ruled as a single territory. Tsum comes from the Tibetan word Tsombo which means vivid. The ancient remains of the Tsum kingdom are still visible today.

The remote Tsum valley is one of the hidden gems of Nepal. Tsum valley is known as the Beyul Kyimolung, the holy hidden valley of happiness, first described by Guru Rimpoche (Padmasambhava) in the eighth century. Milarepa meditated in

the caves of Piren Phu and there are centuries old nunneries. The Tibetan Buddhist culture is still very prevalent in Tsum and the scenery is just stunning, with beautiful forests and countryside, with Ganesh Himal towering above the valley.

Tsum comes from the Tibetan word ‘Tsombo’, which means vivid and after visiting Tsum, you can only agree. In the remote borderlands of the high Himalayas, several valleys are said to be Beyul's - hidden or secret valley, that are only open to those with a very pure mind and heart. According to ancient scriptures, they were established by Guru Rimpoche, the eighth century. Indian saint credited with spreading Buddhism into the Himalayas and Tibet. Hidden valleys are havens of peace, prosperity and spiritual progress, a place of refuge for believers. In the seventeenth century the Tsum valley that branches of Budhi Gandaki river towards the north of Ganesh Himalaya (Mountain) in upper Gorkha, was named Beyul Kyimolung, even non-Buddhists understand why Tsum is perceived as a blessed land.

Guru Drukpa Rimpoche(Nwang Khenrab)

The local people are mostly of Tibetan origin and speak a unique dialect. Trails are strewn with artistic chortens and lined with mani walls made of thousands of stone slabs carved with drawings of deities and inscribed with prayers (VDC profile Chhekampar, 2009).

The hidden valley is surrounded by the Baudha Himal and Himal Chuli to the west, Ganesh Himal to the south, and Sringi Himal to the North.

Ecological

The Tsum valley has four distinct climatic zones: Sub-tropical (between 1000 m and 2000m), cool temperature (between 2000m and3000m), sub-alpine (between 3000m and 4000m), and alpine (4000 to 4500). In alpine regions drop below freezing and snowfall occurs for up to six months. Summer temperatures in the sub-alpine and alpine regions rarely go above 10□ C. The monsoon falls between June and September.

Legend has it that Padmasambhava created beyuls as a refuge for people fleeing from the adverse effects of war, famine or religious persecution.

Demographic

The Population record of Tsum valley, according to 2001, Chumchet Village Development Committee (VDC) had female-509 and male 500) total -1009. Chhekampar Village Development Committee (VDC) had female -648 and male were 547, there were 1195 in total of Chhekampar. The data shows, Tumbas were 2,204 altogether . Numbers of female were 1,157 and male numbers were 1,047 (Census, 2001).

Population data has been fluctuated of Tsumbas. for example. The data of Durgam Chetra Bikas Samitee (Remote Area Development Committee) of Nepal, 1992 shows the population number of Tsumba has decreased. Another data the census of 2001 has has shown increased. But the census of 2011 has shown in decreased number. Tsumba people did not satisfy with this record.

At the time of the 1991 Nepal census it had a population of 979 and had 221 houses in the village. Based on latest Population Census 2011, total population of tsum valley including Chhekampar and Chumchet are 1911, (Male 925 and Female

986), at Chhekampar 263 hhs and 266 at Chumchet total hhs are 529. (Sources: Volume 02, NPHC 2011(National population and Housing Census 2011).

Table no. 4.1 Population composition at chhekampar VDC of Tsum valley

Ward No.	Villages	Male	Female	Total	Households No.	Per hhs no.
1	Chhekampar	145	142	387	58	4.94
2	Dozong	26	19	45	10	4.50
3	Ngakyu	63	61	124	25	4.96
4	Laru	61	58	119	27	4.40
5	Lamagaun, Burji, Khangsar	96	85	181	32	5.65
6	Lar, Phurpe	72	74	146	24	6.08
7	Phurpe, pangdun	67	61	128	21	6.09
8	chhule	96	101	197	41	4.80
9	Nile	81	91	172	27	6.36
Total		707	692	1399	265	5.27

(Source : Gorkha development Project 1992)

Table no. 4.2 Population composition at chhekampar VDC of Tsum valley

Ward No.	Villages	Female	Male	Total	Households No.	Per hhs no.
1	chhekampar	141	141	282	65	
2	Dozong	53	49	102	23	
3	Ngakyu	48	63	111	19	
4	Laru	73	94	167	30	
5	Lamagaun, Burji, Khangsar	116	106	222	50	
6	Lar, Phurpe	58	52	110	28	
7	Phurpe, pangdun	79	60	139	24	
8	chhule	109	95	204	41	
9	Nile	100	105	205	47	
Total		777	765	1542	327	

(Source: Village developmet profile 2011)

Social

Culture and religion

Against the majestic backdrop of the Ganesh Himal, Sringi Himal and the Baudha Himal ranges, this serene Himalayan valley is rich in ancient art, culture and religion.

This land is so unexplored that many religious and archeological leftovers are still intact at many places in Tsum. People of Tsum valley still have practiced polyandry system and they have unique culture, tradition and a dialect of their own. Their unique festivals observed here are Lhosar, Dhacyhang, Saka Dawa, Faning among others.

Cultural program at Chhekampar, Tsum valley

Tsumba (The Local inhabitant of Tsum), especially the women, spin and weave yak wool to make tan(woolen mattress),Chuktu(Woolen Blankets), Carpets and Chuya (woolen Kimonos). Man used Docha (shoes- inside Leather), wool cap, wool paint, Bakkhu (made from sheep wool with the skin) and Chuya, Angdep, Pankep, Meetil, Ghore and tonamthuck used by women in Tsum.

Male participated in the cultural program

Many festivals are celebrated throughout the year in the Tsum valley. All are practice Buddhism. Several mask dances and rituals are celebrated in local gumbas and there are numerous festivals preserving the valley's century old practices. Such as Losar, Dhachyang, Saka Dawa and Faning.The main rivers in the Tsum valley are Lungdang Khola,Shiar Khola and Sarpu khola,all of which originate from glaciers in

the area are fed by numerous tributaries flowing from glaciers. There are a few lakes in the Tsum valley. Some lakes with potential to attract to tourists are Chho Syang – Mu, Khungyu Lake, Chho Lungyu and Yamdro Lake.

Food habit

People have changed in their Food habit. According to one of the respondent Sonam, 34 from chhekampar, locals eat four times in a day. They consumed potatoes, Tibeaten tea (buttered and salted), chhyang (local beer brewed from corn or millet), rakshi(local wine), Dhindo (porridge), gruel and Tolo(a kind of food found in the forest), saatu(wheatflour), Chamba(also flour of wheat) and Roti(a flat bread made of buckwheat or wheat) now they eat Chaowmin, Thukpa, Biscuit, mo mo, Rice and drink three in one coffee import from Tibet, milk tea and rice are new imported food.

Marriage

The people of Tsum are unique in the marriage custom. Typically people choose their own spouses, rather than having marriages arranged by parents. Polyandrous marriage used to exist in the area but now it is find only three houses in chhekam.

Monasteries (Gumbas)

This is the home of around 100 monks and nuns at Mu Monastery and Rachen Nunnery. The young monks with their teacher live at Rachen and at Mu Gumba. Rachen and Mu Gumba are the ancient monastery of Tsum valley.

Mu Gumba (3700 m)

The largest monastery in the region, Mu Gumba is located at the highest and farthest point in the Tsum valley. Mu Gumba was established in 1895 AD and is situated at an altitude of 3510m.The monastery houses religious books, including Kangyur, a life sized statue of Avalokiteshwara, and images of Guru Padmasambhava and Tara.

Thirty monks were living at Mu monastery when Geshe Lama Konchok was abbot in the 1970's. The three monastic practices (monthly confession and the two summer retreat ceremonies) were observed. During summer Geshe la would take the

monks and nuns to some holy place in the valley such as one of the Milarepa caves and give teachings for several months, begging in the surrounding villages for food for his disciples, of the original 30 monks only 7 are still there, all of them 60 years or more. They spend their time in lifelong retreat, living in utmost poverty. One of them explains the situation like this: "Before, it was very sad here; the walls were falling down, there was hardly any food, and nobody came to make offerings or to support us. It seemed there was no hope." Because the monastery could not provide education, food and shelter, not one single boy or man had joined the monastery in the past 20 years.

Now, however, there is hope. Since the monastery was handed over to the care of Lama Zopa Rinpoche. The Caravans of yaks travel to Tibet every two months to get the necessary food supplies**.** Some ten young monks have joined the monastery and are studying Tibetan and learning prayers and rituals from a qualified resident teacher that joined the monastery from Sera University in India earlier this year.

Snowfalling at Mu Gumba

Dhephyudonma Gompa (4060 m)

Dephyudonma Gumba is one of the oldest monasteries in the tsum valley and is situated in the rugged mountains, a 2 hr walk from the village of Chhule and Nile. The history of this monastery is directly associated with the dawn of Buddhism in the valley. The monastery is run by Lama Serap of Nile Ladrang from the Kangin sect. There are a few campsites and drinking water facilities.

Rachen Gumba

From Mu Gumba we take the trail to Rachen Gumba, a nunnery. The nunnery is situated in the Shiar Khola Valley in the foothills of the mountains bordering Nepal and Tibet. Rachen Gumba was established in the year 1905 AD and is one of the largest nunneries in the Tsum valley. It houses nuns belonging to the Ngak-pa sect, which does not allow animal slaughter. The nunnery houses one thousand clay, moulded statues of Avalokiteshwara, a brightly colored, carved throne and pillar, and a large prayer wheel. The interior is richly painted with murals about Buddhism and its history.

After Rachen nunnery was founded in 1936 by Drukpa Rinpoche, many women joined. They are dedicated their whole life to spiritual practice under the

guidance of experienced masters, and eventually the nunnery grew even larger than nearby Mu monastery.

Rachen nunnery is currently home and safe haven for around 80 nuns, with more young women registered to be ordained in the near future. The oldest nun is 75 years old, and the youngest is now 7 years old. Many of the nuns come from poor families, and have suffered a life of abuse, beating and threats of forced marriage before joining the nunnery. Being young and female in these remote areas means quite often to be a victim of abuse; one of the ways to escape this fate is to run away as far as possible, or join a nunnery, an accepted place of protection and refuge.

There is an even greater interest in joining the nunnery now that the living conditions have improved. By entering the nunnery they have the chance to make their life most meaningful through the study of the Dharma. Taking on incredible hardships, living the simplest life they proceed steadily on the path to liberation.

Chhorten (Kannis)

The Tsum valley landscape is dotted with mani walls, chortens and kaanis (gateway chortens). Chortens are Buddhist religious monuments, also known as stupas, which are distinct features in tsum valley. They are erected to ward off evil spirits from places that are identified as thresholds such as confluences and bridges or to commemorate the visit or death of historic figures, lamas or even relatives. Kaanis are also called gateway chortens placed before the entry of any village which travelers are supposed to walk through. Mani walls are long walls made of mani stones i.e. stones with carved mantras. The main purpose of these mani walls is to ask the help of the gods for the well-being of travelers.

Natural resources

Shiyar khola and many others stream had in Tsum for drinking water accessibility but now some river have shrinked and ward no. 4and 5 in chhekam have supported drinking water by a NGO. Summer temperatures in the sub-alpine and alpine regions rarely go above 10̊ c. The monsoon falls between June and September.

The main rivers in the Tsum valley are Lungdang Khola, Shiyar Khola and Sarpu khola,all of which originate from glaciers in the area are fed by numerous tributaries flowing from glaciers. Snow fall time has changed before started to October to December and now to April May. This time when the researcher was in the field, snowfall has observed in the last of May, 2012.

Wildlife and vegetation

Wildlife in the Tsum valley is rich and diverse. There are 33 species of mammal, including the Snow Leopard, musk deer, Himalayan Tahr and Blue sheep. There are also over 110 species of birds, 11 species of butterflies, and 3 species of reptiles. There are approximately 2000 species of plants, 11 types of forests and over 50 species of medicinal plants.

Many medicinal herbs have to find in the valley. Most important is Yarchagumba (cordyceps sinensis). Now it has been major income source of tsum people. People are motivated to collect the various medicinal herbs and sale it.

Medicinal herbs

Field Study, 2012

Kutkee , Kumaki ,Timur ,Jimmu,Chiretta, padamchal, pach aunle, gurjo, amla, silajit, dhupi, nirmashi and Mushroom and yarchagumpa (cordyceps sinensis.)

Yarchagumpa (catarpilar fungus, cordyceps sinensis)

Yarchagumpa (cordyceps sinensis) a strange plant that grows out of the anterior end of a caterpillar is found in the alpine region of the Himalayas and is regarded to be a tonic for humans. It is avalible in the alpine pastures above shiyar khola. It is considered to be highly aphrodisiac and has a good market in Tibet, Nepal, Taiwan, HongKong and japan. Nepal has declared it is an endangered herb making its selling and buying illegal. This has promoted sale of the drug in Tibet rather than in Nepal.

Crop production

Wheat is the main crops of Tsum people. It is ready for harvest within 11 months. Buckwheat and oilseed has been following crops. Circular migration has been practices in Tsum valley.

Wheat crops of lower Tsum(Chumchet), Field Study, 2012

Wheat, Buckwheat, Oil seed potato, peach, maize is grown in the Tsum valley. Wheat is the main crops of Tsum people. It is ready for harvest within 11 months. Buckwheat and Oilseed has been following crops. Circular migration has been practices in Tsum valley. Potato takes six months to be mature likewise naked barley nine months and buckwheat six eight months and green vegetables are ready within four months. Wheat takes eleven months.

Vegetables

Potatos, raddish, round raddish, turnip, carrot, cabbage, are found in the past. Now many green vegetables can product in tsum valley.

Fruits

Apples, peaches and walnut had in tsum and these were ripe in Kartik (November). Some new fruits can found in this valley due to change in climate. Crop rotation

Crop rotation system is a good practice for conserving soil fertility conservation, since people have been rotating crops for years. One of the respondents says, wheat is grown one year and naked barley follows the next year. Same way, buckwheat is planted in the fields only after every three years.

Animal husbandry

Herding is the common practice in the mountain areas and is the second most important economic activity in Tsum region after the agriculture. Common herded animals are including yak, sheep, chhyangra and horse. Among them animals, the most important are yak, nak and yak, which provide wool and important milk products like butte. Yak (Jopo/Jomo) is the important means of transportation. Other wildlife are in the area, rhesus macaque (Rhesus mulatta), langu r(presbytis entelus),marmot(mamotta bobak), snake (Amphiesma Himalayana), common lizard (calotes versicolor) and jackal (canis aureus), Himalayan chamois (nemorhaedus

ghoral), clouded leopard (neofelis nebulosa), snow leopard (felis uncia) and Himalayan black bear (selenarctos thibetanus).

Mobility/ migration

Many of the villagers have rented apartments in Kathmandu, where they stay in the winter. Some have bought land for building in Kathmandu, Gorkha and Pokhara. The people of Tsum, especially chhekampar have a high geographically mobility compared to that of other people in the area. They are still active in trade with Tibet and during the off- season, they go south for trade. Many people been to overseas and many parts of India to do trade. They sell medicinal herbs in the south of Tsum valley, salt, leather, wool and aromatic garlic leaf brought from Tibet.

Situation of using wood for fuel in the areas

Average fuel wood consumption of tsum people as per households increases as one move from south 3874 kg to north 7790 kg in the region (Baskota and Sharma 1994). Generally, wood, twigs and crop residues are the main sources of fuel for rural people. In chhekampar, dung cakes are also used as fuel in the winter. Dung cakes are not used in the summer because it is windy season and they produce heavy smoke in the house.

Food sufficiency

The nature of food sufficiency in chhekampar VDC is the theme of table. 60 percent of the households have enough grains produced from their fields for only 6 months of the year. For the rest of the year they have to buy food stuffs from outside. Only 30 percent of the households said that they have food sufficient for nine to twelve months of the year, food shortages are mitigated by bringing grains from the south or from Tibet.

Period of sufficiency	**% hhs**	**no. of hhs**
Less than 6 months	35	92
6-9 months	25	66
9-12 months	30	78
Surplus for sale	0	0
Missing values*	10	29

* Absence of data or data are inapplicable.

Source : Gorkha Develoment Project, 1992.

People's perceptions on the quality of life horse riding picture

The neutral level is at 2. People's perception of the off farm employment and income is satisfactory and better than before. However people perceive the fuel wood supply to be worse than it was before. A large percent of respondents reported that farm income has remained at the same level. About 47 percent of the respondents felt that the forest protection is better than it was before.

Characteristics	percent perception level				
	Worse	same	better	total	
Forest protection	15.6	37.5	46.9	100	2.3
Fuel wood supply	50.0	46.9	3.1	100	1.7
Off- farm employment	-	28.1	71.9	100	2.7
Farm income	–	78.1	21.9	100	2.5
Off farm income	-	40.6	59.4	100	2.6
Overall perception	11.0	46.0	43.0	100	2.3

(Baskota and Sharma, 1995)

Land tenure: Respondent's perception about selected characteristics of the quality of life on a 3 -point likert scale, where worse=1, same=2, better=3.

Treatment: Medicinal herbs used by lama guru and Amchi do the treatment of people's diseases, now people go to sub health post after go to the Amchi.

Adaptation practice: people have collecting the yarchagumba regularly since seven to eight years. It has covered people's income decreased by agriculture. Sonam says there is not recorded all the individual's who collect the yarchagumba but their income has three to four lakhs minimum within two months. Most of the people from chekampar has involved to collecting that plants, many farmers have left the farming because they earned more than the crop production. Internal tourism has developed, seven youth have skill and knowledge about tourism and they are trained.

Vegetable gardening: increased production of vegetables would also improve the dierty habits of the people. Production of vegetables is possible in this area and introduction of improved varities of vegetables seeds and storage facilities could bring significant improvements to the area. Although all of these possibilities are equally important for the overall socio economic development of the region, priorities must be set considering the limited resources available in the area. Since smaller investments and an equitable distribution of benefits are most important in the beginning, we think that ecotourism should be given the top priority in the development of the area.

Strength and weakness of the valley

The strongest point of this valley is very beautiful place by nature. The local people are mostly of Tibetan origin and speak a unique dialect. Trails are strewn with artistic chortens and lined with mani walls made of thousands of stone slabs carved with drawings of deities and inscribed with prayers. The people here never slaughter animals even as sacrifice to the gods**.** Due to its remoteness and inaccessibility, this sacred valley and its people have been by passed by mainstream development for centuries. As a result, the unique culture of this valley has remained intact. People believe on spiritual power, it means do love and save the nature.

The weaknesses of this valley have been faced erratic snowfall as well rainfall since 7 to 8 years. Another problem has people facing of drinking water in Tsum valley. After some years back only two to three stream have remain in valley. People used to bring the drinking water from the fresh stream. But now, many sources have been shrunk. Deforestation has been increased , crop production has been decreasing, migration has increased, the young people migration trend has slowly increased even they admire their birth place. Remoteness, transportation inaccessibility, local unemployment is weaknesses of this valley.

A scene of environment pollution (field study, 2012)

Chapter Summary

Analysis of available information is crucial in assisting national governments and the donor community to best target policies, and to make interventions and strategies climate-sensitive. Climate change impacted to the Tsum people's livelihood. Community perception on climate change communities had stressed on delayed and

erratic rainfall and prolong drought which has caused the water stressed. Besides that, they shared their experience of upward shifting of snow line. Early maturity of some crops and new cropping opportunity along with increased incident of insect-pest were also shared by farmers during the study.

There is lot of sectors in Tsum valley people have felt impact of climate change effects. So, it is easy to access the information. It will be a guide for the new generation for the study of climate change effects in the Improve protected areas in mountains, Improve ecological connectivity, Retain permeable landscapes, Reduce anthropogenic stresses, Protect key ecosystem features, Restore ecosystems and species, Identify refugee and Relocate. In relation to all of these guidelines, the availability of information from earth observation in combination with in- situ data and flexibility in management approaches will be critical to maintaining biodiversity and ecological resilience in mountains in a changing climate. Beyond these issues, many places are suffered by climate in Nepal.

Tsum valley is one of the risk places in Nepal and required to assess the effects of climate change on their livelihood condition. In conclusion, it is suggested that responses to climate change impacts require plural institutions and that approaches must follow incremental solutions at local, regional and national scales.

CHAPTER –V
DATA ANALYSIS

Introduction

In this chapter, researcher have analyzed and organized all the information into demographic, social and economical as per research objectives.

The research findings have been derived from 100 respondents' interviews, three focus group discussion, six in-depth interviews, historical time line and field observation. Researcher has analyzed the all findings as per research questions and set it under the basic three sectors as impact, adverse consequences and adaptation practices as per research questions and objectives of the research : Demographic, social and economic impact of climate change. Likewise adverse consequences, adaptation practices as per research questions. Research methodologies have more focused on qualitative approach than quantitative.

Demographic description

Demographic condition of the study has been explained as research findings. Sex, marital status, age, education and profession have been described in this section. Data show the number of married people of respondents who were more than unmarried. Male respondents were higher than female respondents. The study has been carried out up to five classes in the government schools. The study showed that the students have to move out for further studies after they complete their primary level education. People have options that either they study at government schools or study at Buddhism at Gumba (Monastery). However, the second option is preferable to the first. . According to the respondents, there are available basic facilities as food, shelter and clothes in the Gumba whereas government schools do not have those all. There is a culture that the people send their daughters to make nuns and son to make monks in the Gumba. Mu and Rachen are the ancient Gumbas of this valley. There were 80 nuns in the Rachen and more than 35 monks in the Mu Gumbas during the research period. There is a number of respondents who are engaged in farming,

livestock and third is medicinal herbal collection. The herbal collection profession is a new and major source of income for people.

Sex and marital status

Table 5.1 reveals that out of the total respondents around three-fourth were male and one-fourth female. Among them, more than three-fourth (78%) of the respondents were married and 22 percent were unmarried. Number of male respondents were 75 percent and female were 25 percent. In comparison to the female respondents, males were larger in number. Obviously, married respondents have more knowledge because of their experiences in age basis than unmarried personnel do.

Table: 5.1 Distributions of respondents by sex and marital status

Sex and Marital Status	Number	Percent
Male	75	75.00
Female	25	25.00
Married	78	78.00
Unmarried	22	22.00

Field Study, 2012

Age status

According to age status, 29 percent of them were 35 to 44 aged out of the total respondents of this study. Only 2 percent were aged 22 and below 25 and then 85 aged numbers were 2 percent and 23 percent were from 25 to 34 years old and rest is 20 percent which was from 55 to 64 aged and 16 percent were 45 to 54. Data show that there are diversity in age group of respondents. As per their age group, information can be diversified in the subject matter. However, aged people have supposed to be aware of the impact of climate change more than young generation.

Table: 5. 2 Distributions of respondents by age group

Age Group	Number	Percent
22- 24	2	2.00
25-34	23	23.00
35-44	29	29.00
45-54	16	16.00
55-64	20	20.00
65-74	3	3.00
75-84	5	5.00
85 <	2	2.00

Field Study, 2012

The response on climate change impact has analyzed on the basis of both primary and secondary resources mainly in three sectors as mentioned below.

Education

There are three primary schools in upper Tsum and same numbers of schools are in lower Tsum. Number of students is less than hundreds up to five classes. Many students go to Gumbas than in government schools. Students get scholarship and food and resident in Gumba. Many nuns are studying Buddhist religion in the Gumba, there are more than thirty monasteries (Gumbas) in Tsum valley altogether. Mu and Rachen Monastry are the ancient historic Gumbas.

There is a school which is established by chhiring phunjo 86, from Chhekam, semi business man and semi farmer. As he shared his experiences, it was started by 1969A.D. It was not easy to open the school then. In addition to this fact, Nepali spoken teacher could not speak Bhote language, that is Tsumba language and vice-versa. When teacher agreed to come for teaching then students would not come to school. Just opposite to the absent of the teacher, the students would be present. It was so difficult then, he remembered the story. Few of the Lama Guru (Buddist priest) and old aged local male people those who did business only could speak

Nepali. Many teachers were changed, finally one Bahun (so-called caste, upper level caste of Nepal) teacher became success to teach in the school. Now there are seven primary schools in the Tsum valley, altogether lower and upper Tsum.

In comparison to the census 1991 and 2001 show the increment in literacy rate in both male and female. It is positive change. Literate women were 56 now it has been increased 250 female as literate. On the other hand, literate male number were 224 in 1991 which increased now 359. IUCN survey 1995 describe that there were three primary schools in chhekampar. Total students were 153. According to 2011 VDC profile, SLC passed out students number is 40(including both male and female) intermediate 24, bachelors than up to 3. Altogether 15 are female and 52 are male. Based on VDC profile 2011, total students are 188. Whereas, the total number was 153 in the study area based on 1995 survey of IUCN.

Professions of respondents

Respondents reported that many farmers of Tsum valley have shifted to herbal collection as per seasonal farming. Table 5.3 show that 25 percent respondents are involved in farming. Rest of the respondents, around 15 percent were herbal collectors whereas 14 percent were involved in animal husbandry. Housewives were 9 percent which is more than respondent number of Lama Buddhist in the research. Social workers and students were equal number of respondents which was 5 percent. Government job holders were less than others, which was 2 percent. But it was equal by gender. Senior citizens were 10 percent which percent was not least but it was more eligible as per their experience. Based on that data, more people have dependent on farming, whereas agriculture has been decreasing trend in the study area.

Medicinal herbal collection is the second higher profession of respondents which is 15 percent out of total. Majority of respondents reported that the earnings from herbal collection have more sufficient than the farming. But there is lack of exact record of herbal collectors in the villages. Livestock seems still in third position as per income sources. The percent of senior citizens and housewives of respondents

do not seem to be earning groups which was 19 percent altogether. It was bigger number than other remaining except farming, livestock and herbal collectors. Based on that description, we figure out the economic condition of Tsum people have sustained by herbal collection.

Table: 5. 3 Distribution of professions and number of respondents

Profession	Number of involved respondents	Percent
Social work	5	5.00
Teaching	3	3.00
Study(student)	5	5.00
Lama Buddhist priest	6	6.00
Housewife	9	9.00
Trekking Guide	5	5.00
Herbal collection	15	15.00
Farming	25	25.00
Livestock	14	14.00
Health (health worker)	2	2.00
Study (Buddism)	2	2.00
Business	4	4.00
Nothing doing (Senior Citizen)	10	10.00

Field Study, 2012

Social impact of climate change in Tsum valley

Impact of the climate change, Tsum people has been felt many changes in the socio- climatic condition. Means increased temperature, change in wind speed, and change in rain fall, flash flood, drought, landslides, shrinking the water resources, drought river, season change in flowering time. Rhododendron has flourished in February whereas it had in April -May in the past. A young respondent, trekking guide of Chhekampar 25 said, in Tsum valley, animals breeding duration, bird

nesting, snow fall time has changed. All mountains are going to be black, there is no snow. Range of water fall has changed, thickness, rapid speed and no long time raining.

Migration, whether seasonal or temporary, is a key strategy of adaptation for many households. While it does reduce risk and in the short term can contribute financial resilience through remittances and reduced reliance on land-based livelihoods, it also alters community relationships and local resource management dynamics. People have to return back to the valley when season comes for collecting the Caterpillar fungus, (cordyceps sinensis) the local name is "Yarchagumba." Yarchagumba has become an essential income resources of the Tsum valley people now.

Language

During the research period, the researcher used interpreter in the typical village group discussion. Most of the old aged women were not able to understand Nepali. Nepali is the official language of country. Tsum people speak Tsumba language. Chhiring phinjo said "that their language Tsumba was easier for communication though most of the Tsumba can speak Nepali language. There was difficult for the year when I was doing struggle for school establishment. Teacher and students were both unable to understand and speak their language each other". Once, the research team self had to face a problem due to not understanding language. We asked for food but they did not give any answer .We then moved to another house and fortunately the house owner the next house could understood our language and we ate rice.

There are 59 ethnic groups are recognized by government in Nepal but many are unrecognized. They have their own language and own culture but the concept of one language one country, dominated to other language.

Communication facilities

There is only aVHF set for communication in the study area. CDMA set can catch the tower for communication. However, the researcher's phone did not work in the field because I had NTC Sim. I could not communicate to my families, relatives as well as my friends during the whole research period. After spending 17 days in the field, we went to District headquarter of Gorkha then I called to my relatives. First, they surprised and asked how we were. Therefore, there is an urgent need to establish the communication center by the help of wireless phone connection tower.

Hampered in cultural assets

Respondents feel that their cultural assets have been exasperatingly hampered. Traditional knowledge and skill are in the verge of extinct, cattle trade has been decreased, days of festival have decreased due to busy time of respondents. The way of celebrating festival has been changed by decreasing in the quantity of instrument and material, food and time. The youths do not prefer the traditional uniform People could not contribute enough time for cultural program.

Food consumption pattern has been changed and most of the people do not eat local foods. Youths are less interested to do farming, most of the youths are engaged in herbal collection as seasonal farming, majority of people have migrated to the city, there is a traditional system to look after crops called Ghyapo System, the one who is selected for a Ghyapo (a person who care planted crops with spiritual knowledge and power) should perform his duty honestly. Now youths are not interested to be Ghyapo in Tsum. Ghyapo system is an indigenous system of Tsum People. It has own rules and regulations, senior citizen has doubt that it has got gradual losing.

Marriage system

The people of Tsum are unique in the marriage custom. Typically people chosen their own spouses, rather than having marriage arranged by parents. Polyandrous marriage was in practice earlier but this has been vanishing. Now this is only limited to three houses in Chhekam. The researcher observed in two family

during the field study. The researcher stayed in the both family house during the field study. They reported that, polyandrous families have more unity among households' members than monogamous families. Not distribute pastoral properties to others. He gave example if the family has 6 yak and there is practice of polyandry marriage then should not distributed the yaks for each family members. But it is not easy for new generation to manage properly. Whereas female must have skills to manage the family and also need to tolerance power, but it is difficult for new generation he said.

Festivals

Many festivals are celebrated throughout the year in the Tsum valley. Several mask dances and rituals are celebrated in local Gumbas and there are numerous festivals preserving the valley's century old practices. Like, Losar, Dhachyang, Saka Dawa, Narag and Faning. Lhosar (Tibetan New Year) celebrate in the Nepali month of Falgun, which is the first month of Tibeaten calendar. Many Tsumbas celebrate the festivals in the capital. One of the respondents added that they could not perform as in Tsum valley. It means that migration has affected their festivals.

People's Life Style

Chhekampar is a probably the least heard of and least visited place in Nepal because of its remoteness, inaccessibility and dangerous trails. It is for these reasons that it is called "The hidden valley" of Gorkha District. (Bhandari, 1997, IUCN). According to Bhandari not mentioned about a lower chum, Chumchet VDC, included the chumchet VDC called Tsum valley or Hidden valley. He writes the treatise Mechmahakali (His majesty's Government, 1974), which is a compromise account of Nepal and its people, did not ever mention it. In 1970, the Remote Area Development Committee (RADC) of His majesty's Government sent a number of high level survey teams to assess the situation of the remote areas of the country.

The survey of the Manang and Gorkha areas, including larke, Bihi and Prok was conducted by a team led by Dor bahadur Bista (Durgamchhetra Bikas Samiti, 1970), but their report also failed to mention Chhekampar or the area. Along with the

Bhandari's opinion, there is not done any study about Chumchet VDC comparatively the Chhekampar VDC. Both VDCs are included in the Tsum valley.

Life style of Tsum People has been changed. Most of the people do not eat local food; do not wear traditional uniform. Tsumba (The Local inhabitant of Tsum), especially the female had skill to weave tan (woolen mattress) made by yak wool, Chuktu (Woolen Blankets), Carpets and Chuya (woolen Kimonos). Through the year, they are hardly found those types of of skilled women in the valley. Male used to wear Docha (shoes- inside Leather), wool cap, wool paint, Bakkhu (made from sheep wool with the skin) made by themselves. Chuya, Angdep, Pankep, Meetil, Ghore and Namthuck are used by female in Tsum. All female hang a silver spoon with their beautiful west belt and wear different color stone as for neckless or earring. There is a saying about beautiful female in the area. "Cock is beautiful among the Birds whereas female is beautiful among the male". Tsum female wear a Ghore, it is a piece of clothe like a kerchief. If young female wear a different color of Ghore, it is copied by other female same. It is like a fashion. Respondents reported that it was a unique culture of Tsum female. Every young woman follows and wants to be same in the case of Ghore. They don't know how they want to be e and how it continues in the days to come.

Farming is the main occupation of the majority of people but now they have detached from the farming. Female had skills on weaving mattress and their dresses, Like Bakkhu, Meetil, Pangkhep, Angdup, and other items. Now they are leaving their skills slowly. Man used to do small trade especially, importing of the goods like, leather, wool, salt and Jimmu (Aerometic garlic leaf) from Tibet and goes to south for sale.

Implication of migration

When male migrate then female and children have to be involved in farming, animal husbandry and any other household works. Children have to quite their school during farming season due to inaccessible human resource. It is difficult to farming into the steep land. Whole family members need to do farming. Mountain farming is a

like family farming; otherwise there is no option for farming. Snowfall has been decreased and effect on nature's beauty and also in tourism. Mountain has been going to dark, decreased in bio-diversity; farmers are forced to shift in to the herbal collection and leave their traditional agriculture.

People have been sustained due to remittance. People's consumption habits have been changed due to climate change. Food's price has been increased due to transportation cost. People have used less local food. For example, they have to buy one packet of noodles in the increment of 100 percent price. They have to pay double in each objects in the retail price. In Tsum valley, many things have been lost due to changes. In order to know the priorities ranking in the study area, first of all, carried out the impacts of climate change. We saw closely the impacts of climate change on agriculture, forestry, health and sanitation, hydrology and water, ecology and environment and biodiversity sectors. At a very glance, we had guessed the agriculture and forestry issues.

Economic impact

Income source of respondents

Among the various income sources of respondents, agriculture is the main but motivation of people has been decreased to it since seven to eight years in Tsum valley. Mono crop, especially wheat production has been practiced in Tsum valley. It takes eleven months to get ready for eating. The causes of changes in snowfall pattern crops have affected lack of irrigation. Likewise, the grasses in the pasture land cannot grow properly. This means pasture land is in endangered which impacts on animal husbandry. Many blocks of sheep and yaks are in endangerd due to decline of pastureland. Income sources of people's have decreased. Now, people are diverted towards the new business as Yarchgumba collection whereas people never collect it before. Small trade and trekking is the other income source of people. This one is also the new business of people.

Adverse consequences

According to response of respondents and researcher's field observation, there were many problem have seen facing by people within 20 years. Likewise, snowfall timing has changed, pasture land has decreases, people are less motivated towards the agriculture, crop has damaged by disease, rapidly increase of migration, price of goods have increased, local food has overlapping by imported foods, peoples' food habit has changed, animal husbandry has decline. Lack of firewood due to deforestation. one of the resource of firewood, Betula utilis (local name "Bhojpatra") has in endangered. It's all having impact on peoples' livelihood.

Crop disease

There was not seen this type of crop disease in Tsum valley before 20 years. Hardly found nyabu (a kind of disease find in wheat) but the lama Guru (called labrang) controlled it by his mantra. Since 5 to 7 years there is found a disease in wheat crop. Most has damaged the crops in a lower chum. Nyabu, destroys the root of crop first and then slowly shift up on the top of crop. All ripen crops seem to be black in color. People of Chumchet have been facing reverse effect during these years. Chumchet has produced more grain than Chhekampar in past years. Most of the labour had sent to the Chumchet and they took the grain like maize, wheat for their wages. But now labour goes to Chekampar for their daily wages work. A respondent added, people left the worship of nature, they do not believe in the religion causes Chumchet has faced the problem now. He suggested to follow the religious activities properly but did not follow yet

Shifting cultivation

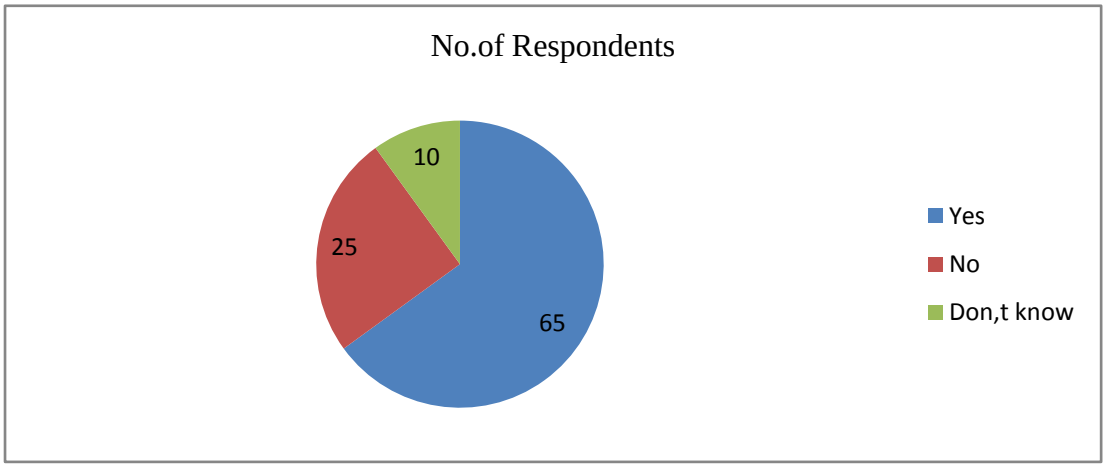
Many of villagers have shifted to herbal collection from the agriculture. Agriculture decreased much more than 20 years and out migration has increased in Tsum valley within 10 years. People live in capital till to over the winter season in Tsum valley. Now the trend of people living at capital has increased. Many youths have dream to live with their parents in the capital. But some are able to stay with

their parents. Whatever labour cost has been high in the valley due to intensive migration of youths.

Impact of climate change

In the research area, there have been seen many impact on different sectors like, snowfall, rain fall, water level, temperature, vegetation, agriculture and animal husbandry. The researcher collected the respondents' knowledge on climate change impact through the interview. The question was asked based on their knowledge on climate change did affect or not. According to the chart 5.4, 65 percent respondents have accepted the impact of climate change in Tsum valley. Whereas, 25 percent respondent, responded just no and 10 percent did respond don't know. This has shown, the question asked about on changes of impact of climate change among the known and unknown persons based on their knowledge level.

Chart:5.4 Impact of climate change based on respondents knowledge



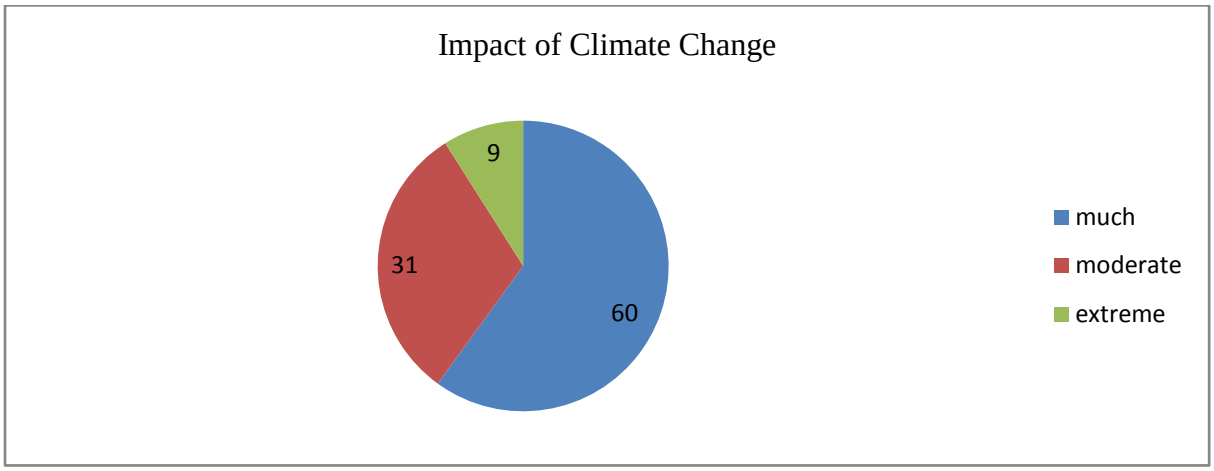
Field Study, 2012

Impact level of climate change

The impact of climate change level has based on people's experiences. The chart 5.5 explains about 60 percent respondents have knowledge on impact of climate change and said it was extreme. Respondents 31 percent said moderate and 9 percent

much. Based on respondents' response, the impact of climate change has seen in the area.

Chart : 5.5 Impact level of climate change

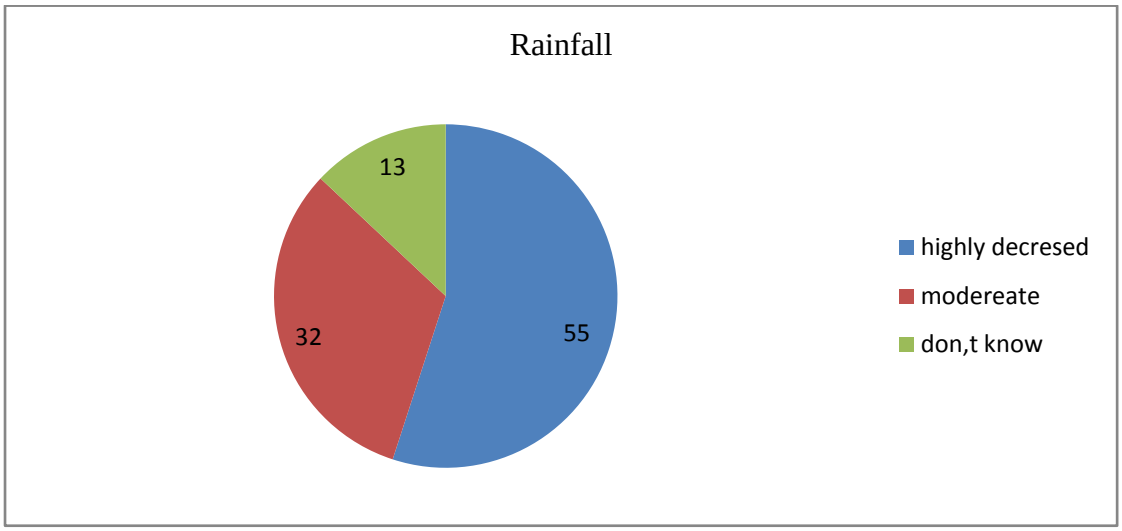


Field Study, 2012

Rainfall pattern

About the rainfall in Tsum valley 55 percent said there is changes in rainfall pattern. Rain fall has highly decreased than before. On that issue, 13 percent don't have knowledge and 32 percent said it has moderate in rainfall pattern. The response of respondent has shown that there is impact of climate change in the valley. The results, affected the agriculture, pastureland, vegetation and resource of drinking water. Many insect and crop disease have shown. Mosquito has seen there but never seen before. People's livelihood has been difficult in the valley. Some of the respondents said the pattern of rainfall is very different than before. Time of raining is very short and falling speed has strong whereas the raining period was long in before but now raining period has very short. After that, the hazardous month was shifted and affected farmers' agricultural calendar. See in given chart below.

Chart: 5.6 Impact on rainfall pattern



Field Study, 2012

Snowfall

Respondents said snow fall time has changed in Tsum valley since 5 to 6 years. Tsum valley has four distinct climatic Zones: Sub-tropical (between 1000 m and 2000m), cool temperature (between 2000m and3000m), sub-alpine (between 3000m and 4000m), and alpine (above 4500m). In alpine regions drop below freezing and snowfall occurs for up to six months. Summer temperatures in the sub-alpine and alpine regions rarely go above 10□ c. The monsoon falls between June and September. The main rivers in the Tsum valley are Lungdang Khola, Shiar Khola and Sarpu khola, all of which originate from glaciers in the area are fed by numerous tributaries flowing from glaciers. There are a few lakes in the Tsum valley. Some lakes with potential to attract to tourists are Chho Syang Mu, Khungyu Lake, Chho Lungyu and Yamdro lake. Now the snowfall time has shifted to March-April and increased snowmelt.

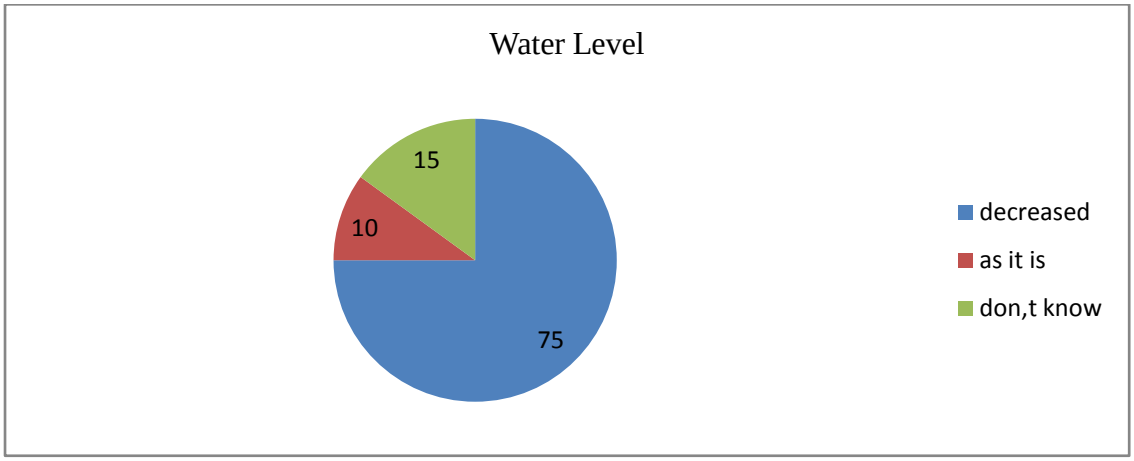
Moreover, increasing plants cover of snow between bushes and trees in regions with formerly low vegetation and shallow snow cover. The main consequences of increased snow melting, an increase in soil dry due to little water released from the snow cover. Respondents said, a delay in the start of the growing

season consequently has negative effects. Communities with a naturally late snowfall, on the other hand, are adapted to a long and continuous snow cover. A delay in snowmelt causes no decrease in growth, rather the opposite: the long-lasting snow cover might have beneficial effects by protecting plants from the adverse climate, access the water for irrigation and the remaining snow free season is generally warmer after later snow melting.

Response on water level decreased in Tsum valley.

The water level in Tsum valley has decreased, 75 percent respondents have reported it has decreased and 10 percent said there is not any change. The respondents, 15 percent said don't know. Respondents said some water resource has shrunken and problem has been shown in irrigation and drinking water. In chhekampar VDC, ward no. 4 and 5 have problem due to lack of water resources though there is managed by a support of NGO, ARK Nepal.

Chart: 5.7 Change in water level due to climate change



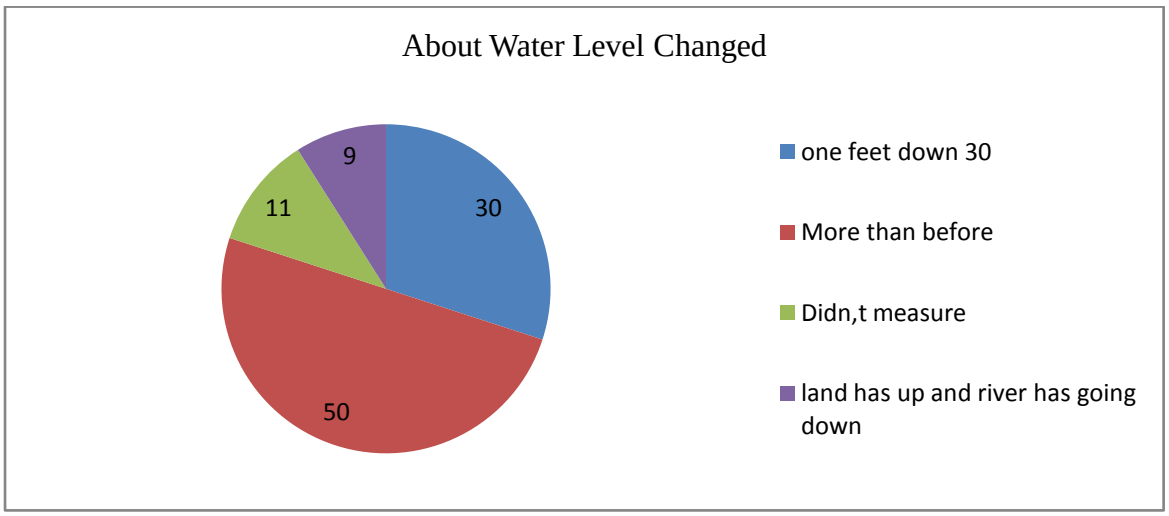
Field Study, 2012

Changed in water level

The question was, how people could explain if there is decreased the water level? Respondents said 'yes' we have observed. Based on 30 percent assumed one foot has down and 50 percent more it than before, 11 percent said we did not measure,

9 percent reported depth of river has been increasing. It is seen there are changes on water level, according to their response and observation of the researcher. Some river seems to be dry, no water and only has wood bridge.

Chart: 5.5 Change in water level



Field Study, 2012

Animal husbandry

Herding is the common practice in the mountain areas and is the second most important economic activities of Tsum region after the agriculture. People take their herds to higher elevation in summer when the temperature rises, and come down, as it gets cold. Common herded animals are including yak, sheep, chhyangra and horse. Among them animals, the most important are yak, which provide wool and important milk products like butter. Yak (Jopo/Jomo) is the important means of transportation. Sheep are in endangered animal in the valley. The wool used to prepare mattress and sent it to the lower region as exchange for grains or money. Butter used to meet the local people's own needs, especially for making traditional salted Tibetan tea, drunk in large quantities.

A herd of Sheep was seen at lower Chum on the way to Larke pass during the field visit. It was hardly found in the Tsum area. According to Bhamdari, a herd of 22

blue sheep (pseudois nayaur) were seen at Bhanjo at an altitude of 3850 m and in winter they are seen around Mu Gumpa. (Bhandari,1997). The researcher did not see any of sheep herd only seen a Yak and Horse at the Mu Gumpa. Nima lama reported, Other wildlife animals have in the area, like rhesus macaque (Rhesus mulatta), langur (presbytis entelus), marmot (mamotta bobak), snake (Amphiesma Himalayana), common lizard (calotes versicolor) and jackal (canis aureus), Himalayan chamois (nemorhaedus ghoral), clouded leopard (neofelis nebulosa), snow leopard (felis uncia) and Himalayan black bear (selenarctos thibetanus). Yak, yak 1626, horse and mule are 278 (VDC profile of Chekampar, 2011).

According to 1990 government record, there had 3,501 sheep in Chumchet and 301 in Chhekampar and number of sheep,yaks and horses had been more there. Now, there is not seen any sheep herds in Chhekam and number of horses and yaks have been decreased in the valley.

Grassland or pasture land

Respondents reported that some species of trees have endangered in Tsum valley. Changes in snow fall timing, freezing and melting affected the growth of grasses. As the results pasture land has been declined in the valley. Sheep farming has in endangered. Cattle and yaks are also decreased, one of the vegetation Betula utils ("Bhojpatra" local name) has in most endangered. People said, it is the impact of climate change.

Impacts on agriculture

Over two-third of Nepal's population depends on agriculture for a livelihood. Farmers follow a traditional set-planting pattern, relying on rainwater and the seasons. Now the old rhythms are disturbed by unpredictable rains or prolonged droughts. In the past four decades, the agricultural productivity of major grains in Nepal has gone from being the highest in South Asia to the lowest. Since 1960, the number of global weather related disasters have increased fourfold, real economic losses seven fold, and insured losses.

A part of this rise in the disaster losses can be attributed to rapid weather changes. Developing countries are the most vulnerable to natural disasters that have serious economic impacts (WWF Nepal, 2006). In case of Tsum valley, Local farmers shared that they felt there is a shift in seasons of panicle initiation, flowering, and wheat crops maturity period for a week or more week. Generally, they used to spread wheat seeds in their farm in the first-second week of November but presently they start spreading in second and third week of November. They added that monsoon is very late these days, by last week of February or first week of March. whatever all activities of wheat cultivation are shifted accordingly. Apart from these, farmers have realized that oilseed and other agriculture products buckwheat like vegetables are not much grow these days. It may be due to changes in snow fall time in Tsum valley.

In results, the insects have destroyed crops and production has been declined in this valley. Many farmers have leaved the agriculture and shifted to herbal collection. The research of Nepal Agriculture Research Council (NARC) had carried out studies on the impacts of climate change on some cereal crops of Nepal and indicated that there might be impacts on season of flowering, milking and ripening of maize, wheat and rice. Hence, there is a shifting paradigm in cropping season, (MoEST, 2007).

Wild animals

Tsum valley is a non-violence area. People do not slaughter animals. Though changes of climate such as snow fall, rainfall has effect the growth of vegetations. Wild animals come to down and destroy the crops. One of the respondents said, a species of jackal did not seen in the valley. Monkeys are the newcomer species in that valley. According to respondents, due to untimely snowfall four hundred yaks have died in this valley in the last year. Behind the reason, lack of enough grasses and extreme changes of environment, animals could not able to adjust.

Water resource and its management

Ward no 4 and 5 of Chhekampar VDC in Tsum valley have shrunken water resource since 5 years. There is a organization which have worked to manage drinking water in that village. The organization is Karitas Nepal. Many resources are going to be shrunken.

Drinking water management

Shiyar khola and many other have for drinking water accessibility but now some river have shrunken and ward no 4 and 5 in Chhekam have supported drinking water by a NGO. There were 5 water well in the Chhekampar, Lar but there is one remained now.One of the respondent said, water level has in down and settlements have become up.There is problem for irrigation**.** In ward no. 3,4 and 5 scarcity of drinking water, ARK Nepal a NGO did support to bring drinking water from the Chipchipe khola near by settlements about four km far. According to a respondent, a member of Tsum welfare committee, there has been kept two water tank for drinking water and distribute to fifty households in the villages.

Water and sanitation

Lack of knowledge on health and sanitation, people are in risk. In the mountain, there is lack of health facilities. Health post or sub-health post does not provide proper service to the people, unskilled or semi skilled lack of effective monitoring system. Local people do not get service effectively; general health support can only get from the health post. If people have got sick, unable to go to the hospital because of poverty and the inaccessibility of transportation in the mountain settlements. Like as Tsum, it is far from District head quarter and the capital if people have sick, either goes to subhealth post or goes to lama guru for the poor people. The person who have money, can charter helicopter and goes to the capital, Kathmandu for the treatment. If the people do not have these two options no alternate beside the surrender to the god or nature.

Old age people and other physically unable persons and children do not travel due the remoteness and lack of transport facilities. People can move by air if they are financial strong. That is the reality of remote people's health. Another burden for people is new climatic disease. Government need to effective monitoring and evaluation system. Provide quality service to the people, awarded to the health personnel. Health personnel do not interest more to go to the remote area. Government should provide sufficient facilities for them.

In the Tsum, one day the research team was looking for food and found a beautiful house. One middle age laddy welcomed to us. We ate rice and curry. During the preparing food, she showed the health report and asked to us about pregnancy and the condition of her. We were not health expert, she answered immediately wheather I was a doctor. I thought you are the doctor. However, we heard about her health story. She has already six children though ugh she is pregnant though pregnant. Now it has already six months she did not go for further follow up. She reported that "there is a sub health post but staffs were not regular. Many staff has changed within a year. "

Crops

Wheat, buckwheat, oil seed, potato, peach, maize are grown in the Tsum valley. Wheat is the main crops of Tsum people. Buckwheat and oilseed has been following crops. Others like potato takes 6 months to be matured likewise naked barley nine months and buckwheat takes 6 to 8 months and green vegetables are ready within four months and wheat can be ready for harvest within 11 months.

Crop rotation

Crop rotation system is a good practice for conserving soil fertility conservation, since people have been rotating crops for years. One of the respondents said that wheat has grown in one year and naked barley follows the next year, same way, buckwheat has planted only after every three years. A Ghyapo (called in Local language) care the crop production sincerely. Ghyapo, worship to the nature and save the crop by his spiritual power. People believe that the crop is safe for grown. Then

they do not go to the field after performed the rituals by Ghyapo. All believe that the crop is safe for grown. Now there is no Ghyapo in Tsum valley. According to respondents, young generation has not interested to follow the tradition. It is a typical indigenous belief system and which is more attached to the nature and also have knowledge to protect the nature.

Cropping system

People used to plough field three times at preparation phase, after dispense the fertilizer and in the last time before lay down the crop seed. Now people do not follow the normal tradition. They do the work just for work, not much love to the work, they said.

Compensation system

When cattle did destroy the someone's crops in the farm then Gyapo find out the cattle's owner and do fine it. The owner of the animals is supposed to pay compensation to the crop owner. People come to the field and decide how much compensation has to pay. Now there is no new Ghyapo. People do not follow that works because they are not interested to be Ghyapo now. Another reason is not more youths have interested to do the agriculture. Many farmers have left the agriculture in Tsum valley**.**

Vegetation

The cool temperature region east of the shiyar khola, a route to Chhekampar is a dense forest, whereas the south facing slopes are open, steppe meadows. The east side of the shiyar khola, facing north has characterized by dense tall forests, as is common in the area. The dense forest has enclosed the trail on route to chhekampar and starts from the confluence of the Buddi Gandaki and the shiyar khola near chumchelung. The temperature and sub alpine vegetation include an abandunce of chirpine (pinus rocburghii), Juniper (laryx Himalayan), blue pine (pinus wallichiana), spruce (picea smithiana), chestnut (castanopsis indica) and walnut (Juglans regia). At the elevation of 3500 meter there are patches of birch (Betula utilis). Many areas

possess trees such as maple (Acer caesium), cotton wood (populus ciliata), cedar (cedrus deodara) and cypress(Juniperus communis). In the ravine area, there are patches of alder (Alnus nepalnesis) and on the ridge area, rhododendron (rhododendron arboretum) and Himalaya bamboo (Aramdianaria falcata). Other plants encountered along the way are cinnamon (cinnamomum zeylanicum), lokta(Daphne bholua), fern(Droypteris fillix-max), yellow raspberry(Rubus ellipticus) andIndian cassia(cinnamomum tamala). There are approximately 2000 species of plants, 11 types of forests and over 50 species of medicinal plants, (IUCN,1992). Yarchagumba is the biggest income sources of people's. Another plant, patches of birch (Betula utilis). Bhojpatra has in most endangered in Tsum valley, according to respondents, after one to two years patches of birch (Betula utilis). Bhojpatra will be vanishing. It is the main source of firewood of Tsum people. Therefore, there will be problem in livelihood of people in future due to lack of fire wood. So, alternatives have to manage in Tsum valley.

There are no facilities of toilet in all households and not proper drinking water supply. People do not take bathe regularly because there is very cold. The research period was in April-May the researcher felt very cold and did not take bathe. Coincidently, there was the time of celebrating a Shakya dhawa in Tsum valley. All people have taken shower and wear new clothe seen clear and beautiful.

Food habit

Many respondents have reported that there is big change about the local food consumption. Some of local foods like Saatu, Khole, Jimmu, tolo have left consumed by the people. People have changed in their food habit. Sonam, 34 from chhekampar said, people eat four times in a day in the old culture. They consumed potatoes, Tibeaten tea (buttered and salted), chhyang (local beer brewed from corn or millet), rakshi(local wine), Dhindo(porridge), gruel and Tolo (a kind of food found in the forest), saatu (wheatflour), Chamba (also flour of wheat) and Roti (a flat bread made of buckwheat or wheat). Now instead of these old foods, they eat chaowmin, thukpa, biscuit, mo:mo, rice and drink three in one coffee imported from Tibetan milk tea. They have breakfast in the morning. Lunch includes porridge and vegetable curry.

For dinner, they eat porridge, roti and rice (rice is occasionally not by all) with curry and beans. At night they eat light food with Tibeaten tea or chhyang.

They frequently drink rakshi or chhayang (local wine made by millet). They are non vegetarian but do not slaughter animals or sacrifice them at the alternate and everybody in the village maintains this religious tradition. Dietary habits are simple and fixed. Porridge and rakshi are considered prestigious food items and are always serve as a way of extending of hospitality to guests and friends. It was the previous schedule of Tsum people now it has changed and they drink tea or coffee in the morning and eat light breakfast in the morning. For Lunch rice and vegetable curry and bread, porridge or thukpa, mo:mo or noodles for dinner but the researcher ate rice and potato curry all over the visited period. There was no found any green vegetables. But due to the time of off season, it was the end of May.

Dukpa Rimpoche Nwang khenrab (Reincarnate Guru) said, people consume modern foods but sometimes it comes with date expired and also chemical mixed. It affects on health. There was never heard about this kind of disease diabetes and heart patient in the past in Tsum. Sometimes, rain fall also seems like black, plastic and other things has not managed properly, so the environment is going worse than before.

Food sufficiency

The nature of food sufficiency in chhekampar VDC has 60 percent of the households have enough grains produced from their fields for only six months of the year. For the rest of the year they have to buy food stuffs from outside. Only 30 percent of the households said that they have food sufficient for nine to twelve months of the year, during food shortages time grains bring from the south or from Tibet. . (IUCN, report). The respondent said there is worse than before about the food sufficiency because many farmers have left crop production in the valley. Howerver, purchasing power has been increased because of Yarchgumba business, one of the respondent added.

Vegetation composition

We therefore expect changes in snow cover to cause the vegetation composition to change over time, which could lead to changes in ecosystem structure and functioning. In many regions however, annual precipitation, and also winter precipitation are likely to increase in a warmer climate. The total amount of snowfall might be unchanged or even increased, even if it accounts for a lower percentage of the total rainfall. Due the erratic changes on snow fall all vegetation has been effected. Grassland has decline and its direct impact on livestock.

One of the respondent, young Treking guide of Chhekampar 25, said, in the Tsum valley, Animals breeding duration, Bird nesting, snowfall time has changed. Mountains have going to be black, there is no snow now. Range of waterfall has been changed, thickness, rapid speed and no long time raining.

Medicinal herbs

These are the medicinal herbs have been found in Tsum valley, like Kutkee , Kumaki ,Timur , Jimmu, Chiretta, padamchal, pach aunle, gurjo, amla, silajit, dhupi, nirmashi and Mushroom and caterpillar fungus (yarchagumba local name) (These are most essentials for medicine.

Yarchagumba (cordyceps sinensis)

Yarchagumpa (cordyceps sinensis) a strange plant that grows out of the anterior end of a yarchagumba is found in the alpine region of the Himalayas and is regarded to be a tonic for humans. It is available in the alpine pastures above shiyar khola. Local people believe that killing a yarchagumba plant is like murdering a lama. Only shepherds collect this plant but since five to seven years. More people have to move the yarchagumba collection. It is considered aphrodisiac and has a good market in Tibet, Nepal, Taiwan, HongKong and Japan. Nepal has declared it is an endangered herb making its selling and buying illegal. This has promoted sale of the drug in Tibet rather than in Nepal.

Wild life

People are not allow to slaughter or hunt animals in the area. As a result, the population of wildlife such as blue sheep, Himalayan thar, deer and musk deer has increased. Wildlife in the Tsum valley is rich and diverse. There are 33 species of mammal, including the elusive Snow Leopard, musk deer, Ghoral, Himalayan Tahr and Blue sheep. There are also over 110 species of birds, 11 species of butterflies, and 3 species of reptiles. Rapid climate change will not give plants and animals enough time to adapt to the new situation. Biodiversity loss, besides the immediate impact on species, will affect the health, wellbeing and livelihoods of the people who rely on such resources.

Impacts on wild birds and animals

The birds like storks which live on fishes are not seen seeking meal in the paddy fields in rainy season. They are only found on the bank of the rivers. Similarly, birds like vultures are rarely found these days because they like to perch on branch of a kind of trees, this tree is very scarcely found in the forest. Farmers shared that Ghoral were abundantly found in wheat fields because they use to eat wheat grains, but nowadays they are rarely seen. So, these are common phenomena about the impact of climate change on wild birds. Similarly, the farmers shared that wild animals like deer, wild boar, blue sheep and hog deer used to come to their fields and severely damage their crops, but there are no any signs of these wild animals since the last 20 years.

Situation of using wood for fuel in the areas

Average fuel wood consumption of Tsum people as per households increases as one move from south 3874 kg to north 7790 kg in the region (Baskota and Sharma 1994). Generally, wood, twigs and crop residues are the main sources of fuel for rural people. In Chhekampar, dung cakes are also used as fuel in the winter. Dung cakes do not used in the summer because it is windy season and they produce heavy smoke in the house. It supports to increase green house gas emissions and also increase the

forest degradation. A respondent said he collected the wood for fuel four times in a day. Now people can collect wood once a day.

People cannot collect wood from nearby forest because it was already finished. When Manaslu Conservation Area Project (MCAP) protect the forest of Tsum, people have cut the trees illegally, there is finished all the big trees in the forest. One of the respondents, we used to two hands for measures trees' width. There is not that type of big tree now. Pine wood used by people for fuel wood, so it is decreasing day to day. A respondent added, in a Bhong ward no.2, people collect firewood from the kabuliayati forest. Other remain wards have under the community forestry. There is in Lamagaun has still save more community forestry. There are 47 forests under the community in a Lamagaun.

Tourism

Tourism is the main source of mountain people. There is potential for tourism in Tsum valley. The area is beautiful and known as the non-violence area throughout the century. Many ancient religious Gumba have seen there. One of the respondents who is a trekking guide said, some youths have taken training on tourism business. They started a home stay business it is essential for the development. It can create the employment for the youths. According to trekking guide, there is negative impact has found in the valley, environment has been worsen due to thrown everywhere plastics, bottles and other utensils which used by tourist. However, tourism can be good for future.

Hunger (natural hazards)

There was food shortage in Chumchet due to the long drought. It's been distributed food and cash to 310 households by Arc Nepal In 2009. A respondent said, it was rich than upper chum in the past year but now have to face the hunger. It is bad for us. Chumchet has more affected by erratic rainfall and snowfall in the years. There has been faced wind storm in 2011 and destroyed many houses rooftops in Chumchet.

Avalanches

In the Tsum valley there is no more experiences on avalanches. Once heavy landslide had experienced in Chumchet and lost some livestock and damaged some houses. But there is a tree has still safe in the landslide area, a senior citizen of valley did guess that tree could be 1100 years old and the tree is possible to be safe due the spiritual power.

Non Violence area

Following points have been written in Tsum valley ancient documents.

- No slaughter (do not sacrifice animal)
- No hunting
- Khoriya na kholne (do not destroy the forest)
- Dadelo na lagaune(do not fire in the Jungle)
- Bhir mauri ko honey na khadne(do not hunter honey)
- Katmar garne ko haat ma pani bech bikhan nagarne(do not sale the animals who kill it)

People's perception on impacts of climate change (Findings of Focus group discussion)

Respondents agreed that there had been changes in climatic conditions in Tsum valley of Gorkha District, Nepal. There is shift in the present snow fall seasons and intensity as compared to the past 20 to 25 years. Respondents added that winter months are extremely cold while summer seasons are warmer that was common in November, December currently being experienced in later. There has been a paradigm shift regarding local climate which are obviously related to global warming and climate change.

In Tsum there is a belief that a leaf of tree has changed color, when leaf has been going yellow then people known the time of farming and they start their farming. Now it has shifting onwards. During the focus group discussion, local aged

people shared their perception as, wheat of Tsum is most nutritious and weighty than other areas. It is high in the nutritious than the modern foods. Modern foods like, biscuit and noodles, instant noodles makes people more hunger. One of the female respondents explained her opinion like this, I feel, time has running fast than before and do not have enough time for taking rest. We did relax in the past.

Respondent said, in this time snow has fallen in April- May. It can damage the yarchagumba. It is not time for snowfall in general. Usually the snow had fallen in November to January and freeze during the long period. Farmers got benefit from the snow throughout the year. Vegetation had grown and pastureland covered by grasses. Melting ice used for crop production in April, May. Untimely snowfall, damages the immature buckwheat plants and have to re-spread of its seed in the field. All top of the mountains had covered by snow in the previous years but it is going to black now. There is no ice, no grass in the mountains. Water resources have shrunken and people have to walk 2 hours for bringing the drinking water.

In depth interview: Climate change, in my own experience

Sonam Lama 34, engineer

People have rights to move anywhere. People move from rural to urban and under developed to developed areas and it is the general trend of migration in the world. Lama said, if people move to outside from their origin places, rarely come back to the origin place. But Tsum, a sacred Himalayan pilgrimage valley situated in the Gorkha region of Nepal and the Tsum valley was only opened to trekkers late in 2008 and very few foreigners have set foot in this magical region close to the Tibetan border. It has more opportunity for its development. Governments have to support for its development and migrated people have to think about the future of Tsum. People accept the modernize culture easily but it destroy our environment, health and on any other things.

Globalization and modernization has making people more mechanical and materialistic. Tsum people have changed their consumption habit. They leave to eat

local food. People had experience the snow fall has to come up to peoples' knees. It shows that the thickness of snow. But now they hardly find in a feet. Agriculture has been decreased due to crop disease and also the changes of snow fall pattern in the valley. Last year, Massive windy storm destroyed the buildings and schools.

Dhesangmo Lama, 86 chhekampar

She said that there was extreme cold within six to seven months. People could not walk around due to heavy snow fall, if they tried to walk snow come to their knees. Way of lifestyle has been completely changed in the village. It was very difficult to survive the people. People were much unknown in that time.

Chho Chiring Lama 54, Chumchet

Lama said, there had big tress in the forest. A single man could not measure the width of tress by using the both hands. In present, I never have seen this kind of trees in the forest. All mountains had enough ice and we felt relax. But within some years, snow-cap, mountains have been going uncovered. How it becomes? The scientist may have answer, he added. According to the respondent, there is no re-plantation have implemented and snow melting has increased. Crop disease has been seen more in Chumchet VDC.

Guru Drukpa Rimpoche 67, (Nwang Khenrab) Chhekampar

Rimpoche said, "environment has been disturbed due to negligence of tourists. There is seen plastic and bottles in the area. Modern foods displaced the local foods. Sometime people use the date expired foods. The diseases have to face by people it is never heard in the past like, diabetes. Joint pain etc. Rain water is not clean. It is polluted. "

Chiring phinjo Lama 49, Chhekam health worker

Respondents explained due to deforestation problem has increased for collecting the fire wood. Mushroom was collected from the forest but now there is

not in forest. In the forest, mushroom is not got enough, the young people migration trend has slowly increased even they admire their birthplace. Respondent remembered the history like as, there was made especial clothes for the winter season. People had skill to preserve the foods for winter season, dried vegetables and wild mushroom had used in off seasons. More than half population of this valley has been out of villages. People were self independent in the time of father, after some years, all are dependent to other just happened opposite.

Lama Serap 60, Godabari

Respondent has own gumba in Kahmandu Godabari and 22 Gumbas are under his own responsibility in Tsum valley. He remembered, there was extreme cold when he was 10 to 11 years old. There was hardly seen sun till to seven months. All people have to wear leather cloths. Big trees had broken due to heavy snow fall. The places Filim, Dhodang had covered by ice. There had continuous snowfall till to three weeks in chhekam. People believed on spiritual power. They thought it is against of religion the herbal collection and its business. If someone did that would loss the essence of place. Now, there has gradually increased warmer than before. Many people have collected the yarchagumba and sale it. People have left their sincerity and much evidence has seen. Extreme wind spirit, landslide, hunger, deforestation, crop diseases and heavy changes on snowfall and rain fall. People have less time for performing religion.

Adaptation practices

In this researcher area, people have been explored the new income sources that is yarchgumba collection. Yak dung use for fuel wood. Do not use chemical fertilizer in the crop production. People migrate to out of valley during winter season to be safe, each year people have migrated during winter. They all stay in out of valley during the winter season to safe by extreme cool. Some households have using improved stove, dry vegetable storage for future uses, vegetable gardening, tourism, home stay, culture program preservation these all activities shown Tsumbas have adaptation practiced already in this valley. Some has given below in details.

Community-based adaptation

There is no more found the community-based adaptation practices whatever people are suffering from climate change. Their traditional practices have been working whatever it is. People preserve dry vegetables for their future uses. Yak dung, use as fuel in the shortage of firewood. People make it dry and store for future uses. There is traditional system as people have to go out of valley during winter season and will come back to village in Summer. Summer is the best season for Yarchagumba collection of Tsum people.

Social networks

Indigenous and traditional peoples highly rely on social networks. They often maintain social and economic ties between different groups of peoples and in many places, they still support systems of food and labour sharing including exchange, reciprocity, barter or local markets. Such exchange practices have a role to play as adaptation strategies to environmental variability and stress. In the indigenous, peoples belong to the word's most vulnerable and marginalized communities. Many of them-of historical social, political and economic denial and exclusion-have beenpushed to the least fertile and most fragile lands where living conditions are harsh and challenging and where they struggle to survive.

As a result of their marginalization and exclusion, indigenous and traditional peoples often do have very limited access to education, health care, information, technologies, power, resources and national or international aid. With exceptions, they have very limited access to power and decision-making. Therefore, social networks have to make strong for their future access. In the study area, there is found some social network between community and other NGOs,but needs to improve among the Government and national and international concern parties.

One of the respondent said that Tsum welfare committee has planned to expand it into near future. He added, some beautiful programs have conducted like, save the environment, home stay and cultural program as for preserve the culture and develop the tourism. Another step would be to stop deforestation and save the forest.

The purpose of the current report is to help bridge the knowledge gap in understanding the present and future impacts of climate change on traditional and indigenous peoples. Human groups located in areas exposed to severe impacts of climate change are often diverse in terms of cultural backgrounds. Many of them have preserved traditional knowledge about agriculture and the use of medicinal plants. In the past many of these communities have been exposed to different kinds of environmental changes and have developed coping strategies to face these phenomena.

One respondent , said, when he was 11 year old, there was heavy snow fall happened. People used to firewood to make snow melting and give it to yak for drink. He added, when insects destroy the crops, Labrang (A person has indigenous knowledge and can save crops) starts to chant the mantra then the insects do not destroy the crops. These peoples may therefore have to offer valuable knowledge to learn from for future adaptation to and mitigation of climate change. However, while there is a growing knowledge about the impacts of climate change and understanding about the potential impacts of climate change on livelihoods and cultures of indigenous and traditional communities is split. Furthermore, there is a lack of recognition of the importance which traditional people may play in their own future adaptation to climate change.

In Tsum, people are collecting the yarchagumba regularly since seven to eight years. Respondents said there is not recorded income all the individual's who collect the yarchagumba but their income has three to four lakhs minimum within two months. Most of the people from chekampar have involved to collect, results many farmers have left the farming. They earned more from it than the crop production. Internal tourism has developed; seven youths have skills and knowledge about the tourism. They are trained. Tsum valley home stay has been started the tourism

business in the area. People have skill to make dry vegetable to consume it during off season. There is started vegetable gardening concept, in the Nile, there is seen vegetable gardening practice where have grown garlic, cabbage and onion.

In Chumling**,** it is the main entrance of the Tsum valley and located in lower chum, a respondent has a hotel. He said it is the good business for him. According to the number of tourist has increased. People have changed their consumption pattern. It means accepted the modern culture. It is also a adjustment capacity of people. Slowly they are adapted the all changes here in Tsum, for example people use goldstar shoes instead of Docha, Chinese jacket instead of Bakkhu. They use Tibet made bakkhu financial cheap and it is because of time consume.

Labrang a practitioner of spiritual power

Livelihood adaptations to environmental change are not novel or "special", but have taken place throughout history. Natural-resource-dependent communities have been continuously adapting their livelihoods to a wide variety of external disturbances and stresses in order to survive. However, climate change creates additional risks to which these communities are exposed, and the intensity of future climate change impacts may be outside the range of risks that they have experienced and adapted to in the past. According to Tsum Welfare president said, the intensity of impacts such as draught, hunger, wind storm, crop disease and irregular of snow fall is likely to increase. People keep some grain for to use in next year. Certain skill they have for preserve the food. Rotten barly flour mostly used with Tibetan tea. Labrang Lama use of his mantra to run away insects from the crops. There are three types of labrang lama in Tsum one is for save crops from insects another is for ritual and third one control the nature to the favor of man. Yak and cattle herds are rotated according to weather summer winter some have changed due to change season they move or transfer their herd.

Vegetable gardening

Increased production of vegetables would also improve the dietetic habits of the people. Production of vegetables is possible in this area and introduction to improved varieties of vegetables seeds and storage facilities could bring significant improvements to the area. Although all of these possibilities are equally important for the overall socio- economic development of the region, priorities must be position considering the limited resources available in the area. Since smaller investments and an equitable distribution of benefits are most important in the beginning, we think that ecotourism should be given the top priority in the development of the area.

Climate change resilience and mitigation

UNFCCC, IPCC, COP and KYOTO have announced alternative ideas like plantation, wind energy, renewal clean energy to reduce the carbon emissions. Wind energy and green forest program would be relevance for Nepal. Climate science has measured the level of carbon dioxide increased in Nepal. In this regards, the Tsum valley people may be practice wind energy and green forest program.

Alternatives

Alternative planning can be the use of bio-gas, smokeless stove and wind energy. In the context of agriculture production, explore the local seed and preserve it, soil test, promote the concept of kitchen gardening. Preserve the foods through by providing knowledge on food security and human health. Indigenous people have knowledge on how to preserve it. Have to save the environment, aware to people about environment, promote internal tourism, youth program, indigenous knowledge and skills. Less use of firewood, animal dung, pinewood, and more use solar energy, smoke less stove and biogas, etc.

Results and findings by the use of historical time line tools.

Based on given below table, there is found changes between present and past regarding climate change. Change on snow fall season, decreasing pastureland, livestock, crop production and also increasing migration trend.

Following details of information about the Tsum people within 20 years onwards. The information has collected by historical time (PRA) discussions.

Topic	**Past scenario**	**Present scenario**	**Differences**	**Implication**
Occupation	Agriculture/knitting (female)/ Trade to Tibet for salt,wool, arametic leaf trading.	Agriculture/yarchagumba collection/Tourism	Medicinal herbs collection/less interested to the agriculture	Local production decreased/Agricultural system has endanger/unemployment increased/ migration increased in Tsum valley
Population	Did not found exactly data but depends on Government records.	500 hhs/census of 2011 Govt. did not recognized about the Tsum people neither Siyar nor Tsumba. But census 2001 illustrated the population of	People are not satisfied with the Government data. Unfortunately, Government	Government overlooked their identity. Therefore, Tsumba has been forced to be in protest their identity**.** 11 ethnic groups included

	In 1992 IUCN report	Chhekampar and Chumchet VDC of Grokha district in the census record.	census 2011 did not recognize their identity either Siyar or Tsumba.	Tsumba, raised their voice to the Government for their identities.
Education	There was no school, Before 2026 B.S. people spoke their own language only.	There are three primary school in Tsum valley	Youth can speak Nepali (National language) many youth have studied higher education in Government school and colleges.	Somehow, increased the access of Tsum People to the Government level. Some youth developed the idea of Tsum people's development. For example, set up Tsum home stay**,** trekking guide etc.
Dresses	Docha, Angdup,Pangkep,	Women: Angdup,Pangkep, Miteel,	(Youth do not wear traditional dress) people	Traditional local skill has endanger, effect on cultural value, would decreased in

	miteel, Bakkhu, Wool paint and wool cap	Man : Bakkhu,jacket, Sports shoes, wool Bakkhu, cap,	bought their dresses from Tibet due to cheap and easy access.	cultural respect,
Festivals	Losar, Dhachyang,Saka Dawa ,Narag and Faning, Gumba Puja Lhosar (Tibetan New year) festivals in the Nepali month of Falgun, which is the first month of Tibeaten calender.	Losar, Dhachyang,Saka Dawa ,Narag Mane Tupser and Faning	Decreased in a days, (people do not have enough time to celebrate all the festivals)	Difficult to protect the traditional culture, new generation do not follow the culture thoroughly, would be time consuming
Food types	Dhindo, Khole, Phaper roti, satu, chamba, pakthu, wild food tolo,	Rice, Instant noodles, Mo Mo, thukpa, dhindo, phaper gahun ko roti, Drinks: chhyang, local	Local food displaced by imported food. People more eat	People have to increase their purchasing power because imported foods are more expensive than local foods.

	Jhanjo, paareel, Tibeaten tea,	wine, bear, tibeten tea, coffee, milk tea, chamba	modern food than local food.	People have to eat date expired foods due to unaware of health and also cause of remoteness.
Food habit/consumption pattern	Khole early in the morning (winter season), Tibeaten tea (salt and butter of Yak mixed) when sunrise, after breakfast went to forest for herding and for lunch five to six time had food in a day.	Early in the morning milk tea, black tea, less drink tibeaten tea, three in one coffee, chhyang, Chau chau, biscuit for breakfast, lunch time rice, lentils, vegetable curry(potato), roti Thukpa, bear , chhyang, rice is most consume food ,	Types of food have increased and more consumed than before, modern foods have dominant to the local foods.	Imported food is expensive than local due to transportation cost, people's purchasing power has increased by force,
Crops	Wheat, Buckwheat, pea, Oil seed, Potato and maize	Wheat, Buckwheat, pea, Oil seed, Potato and maize, naked barley, new seed of maize in lower	Cabbage, green vegetables, less motivated to agriculture, more	Positive implication: new crops green vegetables can grown, climate favor to new crop farming, income source

		Tsum, new seed of oil seed in Upper Tsum,	focus to collect the yarchagumba	increased, people can adapt to the climate change impact. Agricultural traditional system has endanger.
Vegetables and Fruits	Potato, raddish, Root raddish, Garlic, pea and buckwheat leaf fruits. Peach and walnut	Potato, raddish, carrot, cabbage, onion, cauli flower, apple, peach and walnut	Some new vegetables have grown in Tsum valley.	People's can taste different and new in their regular foods.
Farming system and time	October and November are the planting season of wheat and harvested on July and August. Many time prepared the land and laydown fertilizer and then drop the seed on prepared	Season is not changed but effect the snow fall changed on its maturity. Do not follow the proper process to do farming. Especially the preparation of land.time has little bit changed due to snow fall change.	Buckwheat and other vegetables have grown in Tsum valley are Cauli, carrot and green vegetables.	Production has decreased. People are de-motivated to do farming. Food scarcity has been increased. Youth are migrated.

	land.			
Crop disease	Rarely found the disease, one of the diseases have shown into the wheat crops. The "Labarang " lama guru control it by worship the nature.	Especially damaged the wheat since five to seven years. Insect destroy the root and crop has become black, nyabu a local name of the disease, wheat production has decreased by this type of disease in Chumchet. Lower Tsum (people are unknown about that disease and never try to eradicate it)	Disease found in the crops more than past years.	Crop production decreased, difficult to the livelihood. 2063 people felt scarcity of food. Many lama gurus and NGO supply the foods and other essential goods to the Lower Tsum.
Plant and Vegetation **(medicinal herbs)**	Bhojpatra, bhote salla,salla, three types of rhododendrons Medicinal herbs:	Bhojpatra, bhote salla,Pine, Kutkee , Kumaki ,Timur, Chiretta, padamchal, pach aunle, gurjo, amla, silajit, dhupi, nirmashi and	bhojpatra endanger, rhododendraon has also jimmu do not have	Ecological effect and income source decreased,

	Kutkee , Kumaki ,Timur ,Jimmu,Chiretta, padamchal, pach aunle, gurjo, amla, silajit, dhupi, nirmashi and Mushroom and yarchagumpa **(**cordyceps sinensis**)** people did not collect the yarchagumpa	yarchagumpa **(**cordyceps sinensis**)**	use for trade,panchaule also in endanger	
Snowfall	October to March usually ten months. High thickness near to knee, long time freezing	December to March, not regular, shift in May also. Snow melting soon	Time shifted melting fast	Effect on agriculture people have to be engage in alternative income source, they find out the yarchagumba collection, youth migration has increased

Water resources	River, well five water spring in phurbe, people brought water from river	Drinking water piping system has river, well, now remain one,	Some source have shrunken	
Livestock	yak,nak, , sheep, chhyangra and horse	yak,jomo, and horse	Sheep are endanger	Income source has been going down. Animal husbandry has decreased in Tsum valley
Migration	less	increased		Human labour crisis, productive age people has migrated
Traditional belief	Mule is not good for environment and also for crops because it brings diseases people's perception. Do not move the aircraft			

	around up keymolung places and snow capped mountain there is ganesh himal which is god, once people seen a helicopter round there so many changes has become, snow fall, rain fall, wind storm, agriculture decreased etc. labarang control the disease of crops and they have power to control the nature activities. For example lama pray the nature and wish			

	do not rain,			
Marriage	Arranged	Own and arranged		
Rainfall status	Slow range, long time,	Little, short duration, windy		Crop production decreased,
Deforestation	Fire wood used, pine wood used as for fuel,	Fire wood and many house building deforestation has increased		People spend more time to collect the fire wood; forest is being empty due to degradation.
Crop production status	During April, May Buckwheat has been grown but there is changed in regular system due to change in snow fall time. In that time Snow fall cold by snow and snowmelt faster in that time, very short period,	Since three to four years wheat and naked barely production has affected by disease in Chumchet VDC,lower Tsum. Crops grown pattern has also being differences some are long and some are not growing fast.	Monkeys are never seen before in Tsum but now many monkeys can see and they destroying the crops.	

	within a night and day totally damage the crops by hot and cold. put down seed again.			
Treatment	Amchi, lama,	Amchi, lama, sub health	Sub health post	
Unnatural Changes	In chumchet, Usually Snow fall had two to three times in winter season,	In chumchet..This year have fallen three times in a year		
wind spirit	Never felt in the past	This year wind speed destroyed damaged roof of school and house, crop had draught.		
Snow fall Changes	April, May this is the period of yarchagumba collection do not	But this year we have snow fall so it damage the yarchabgumba also, although snow fall is		

	time for snow fall	good for wheat.		
Draught and **hunger**		Arc Nepal supported food stuff to the chumchet in 2009, 15 to 20 lakhs due to hunger. To reduce the food scarcity. 310 hhs has distributed in Chumchet.		

Chapter summary

Analysis of available information is crucial in assisting national governments and the donor community to best target policies, and to make interventions and strategies climate-sensitive. Climate change did impact to the Tsum people's livelihood. Community perception on climate change communities had stressed on delayed and erratic rainfall and prolong drought it has caused the water stressed. Besides that, they shared their experience of upward shifting of snow line. Early maturity of some crops and new cropping opportunity along with increased incident of insect-pest were also shared by farmers during the study.

There is lot of sectors in Tsum valley that people have felt impact of climate change effects. So it is easy to collect the information and related data. It will be a guide for the new generation for the study of climate change effects in improving the protected areas in mountains, improve ecological connectivity, retain permeable landscapes, reduce anthropogenic stresses, protect key ecosystem features, restore ecosystems and species. In relation to all of these guidelines, the availability of information from earth observation in combination with the collected data and flexibility in management approaches will be critical to maintaining biodiversity and ecological resilience in mountains in a changing climate. Beyond these issues, many places have been suffered by climate in Nepal.

In the end, the adverse consequences of climate change in the study area are, people have more influenced by imported foods and displaced the local foods. Majority of people have facing problems to keep the livestock due to decreases the pastureland and grasses. Decreases the agriculture production and people have shifted to the herbal collection business. People reported, more than 50 percent have migrated out to Tsum for seeking job, education, business. The snow fall has been shifting up earlier. Snow is the main sources of irrigation for agriculture and others like grassland and vegetations.

CHAPTER-VI
RESULTS AND DISCUSSIONS

Introduction

In the previous chapter, researcher presented the findings of the study, when researcher made appointment with respondents to accumulate information then researcher made dialogue in different themes. An open discussion and interaction was conducted through interview techniques to gather personal experiences, opinions, beliefs of the students which helped to draw implications for future action on indigenous adaptation practices for mitigation. In this connection, Patton (1990) also emphasized on people's response. According to Patton, "What people say is a major source of qualitative data, whether information is obtained verbally through an interview or in written form through document analysis or survey responses". Reasons in selecting the group interview and interaction techniques through interview guide approach matched the view of a Patton (1990). And in conclusion researcher accomplished these points. Based on the findings, different themes have been emerged. This section explains the discussion of the findings.

According to the findings of research, agricultural production has been decreased in Tsum valley. New type of disease has seen in the crops. People have seen more diverted towards the new business like herbal collection where as less in agriculture. Many youth are migrated to the capital for seeking Jobs and further education. Many hhs have been settled in Kathmandu. Irrigation and drinking water problem has been increased. People have changed their timing for worship and celebrating the festivals. Natural resources have been shrinking like water resources. Snow fall timing has been changed, did not fall in regular time and season. Mountains are going to less covered by snow. Since 5 to 6 years, rain fall has seen irregular. Mule has been used for transportation by Tsum people. Pasture land has been dried. People's way of dressing has changed. Research shows, most of the people wear the Chinese jacket instead of traditional dress (Bakkhu). Chumchet vdc is endangering by economically than Chhekampar.

There is no change of education system in Tsum valley. People have practiced the teaching of Buddhism. Almost girls and boys have gone to the Gumba(Monastry) from this valley. The Rachen Monastry, there is still 80 nuns are living and practiced the Buddhist education. Mu Gumba(Monastry) is another ancient monastry of this valley. There are around 30 monks have practiced Buddhism. It is the traditional system of Tsum. More facilities can be available except food stuffs in the Monastery. The practinoer have opportunity to go further career either be monk, nuns or further study.

One of the respondent said this system (indicating, Current Education system of Government) is not suitable for us (Tsumba). The reasons, People can study up to 5 classes in Government schools. The medium of study is mainly Napali and English. People have problem to understand Nepali language also (National language). Government has provision to teach the mother language in the primary level though it is not implemented yet. One of the youth respondent said, tsumba could get hardly job due to language barrier in the Government level. He added, in the case of Government school study, there is no option either leaving the village for further education or quit the study after that. But in Gumba, there is easy for study and gets the money along with foods and shelter etc.Therefore most of the children have gone to the Gumba(Monastry) for their study.

Finalley, education system should improve the mother language teaching system should be effective have to establish the effective way of teaching in rural area. Health, education and transportation should be access in this type of remote area of Nepal.

In this valley, researcher have seen some practices followed by people to adapt the impact of climate change. It seems good practices in the local level. The sinier citizen a respondent of research has positive opinion about climate change impact. Based on him, people have planted new green vegetables in this valley. As he mentioned cabbage, reddish, and onion, garlic are new grown vegetables. Home stay services has been started by youth in the Chhekampar VDC. This is new option of income generating activities in this valley. New type of disease has been seen in crops

especially damaged the wheat. This disease affected more in Chumchet than Chhekampar VDC. People do not have any idea for control it. Respondent reported that Labrang (spiritual practitioner) can chased the insects from the crops by use their spiritual power but this is the new diseases Labrang cannot do anything for that. There is multi problem has been faced by Tsum framers for the crop production. Wild animals have also destroyed their production. The researcher has seen monkeys in this valley. Respondent said monkeys are never seen before in this valley. Whatever there are various causes have seen the decreased of agriculture production. Respondent said natural hazards like wind spirit, landslide, thunder, draught has been increased than previous years.

Climate change will change the fragile ecosystems of the Himalayas. As it warms up, vegetation and wildlife will move to higher altitudes. This change will upset the ecosystem balance and seriously endanger the survival of many plant and animal species. Lack of proper environment some species of vegetation can be ruin. In this regards, a medicinal herbs cannot seen in the valley. It means, bio-diversity has in endangered. People are less interested to the animal husbandry. Many herds of livestock have been decline. The reason is changing the snow fall pattern and decreasing pasture land. it's all impact shown the imbalance of ecosystem.

Consumption behavior of people has been changed. Majority of People consume new imported foods. Though, it is costly than local traditional foods. People used wheat rotten flour, porridge made by buckwheat, potato, Tibetan tea and other typical local foods but now they eat rice, plastic covered junk foods like biscuit and instant noodles. Drink three in one coffee, can juice etc.

In Tsum valley People's lifestyle has been changed. People get Chinese jacket, Tibetan Bakkhu. Meetel, Angdep and new branded shoes instead of Docha (local made traditional shoes). These all clothes have made in village in the past. People were busy in agriculture and livestock occupation. They got time hardly for visit freely. But now around fifty percent are in out migration and seasonal migration. Most of the youth are in outside the valley, they will come back to the village during the season of Yarchagumba (catarpillar fungus) collection.

During the field study, some of the gaps were identified even though there has seems some effort. Whatever, there is need to implement the effectiveness of existing government mechanism, technical back stopping for farmers, proper distribution of technical human resources, information system in farming, demand driven analysis, strong research and extension in agriculture, quality inputs, and sufficient irrigation facilities were found to be major issues regarding to climate change and people's livelihood. Though, no one practices on Rainwater harvesting, Supplementary irrigation, and change in Traditional farming system. In fact, participants are very curious and eager to know and share their experiences regarding climate change.

Impacts of climate change were discussed and realized through the group-based approaches by separating each group concerning the priority-wised impacts on agriculture, forestry, ecology, health, biodiversity and others. Obviously, this study has able to create the awareness for the community people in order to safeguard and fight against climate change in future. Based on above discussion following issues have necessary to rise for its further development.

Local market Promotion

People produce more agro farming but no one can sale it because of inaccessible market. The transportation cost made it expensive. Though people bought the modern foods like rice, lentils and noodles etc. But they can't sell their local product might be unaware of nutritious food. If promote and expand the local market people can motivate to product the local foods and medicinal herbal products. Besides these, due to change their life style, they want to buy and consume modern foods and clothes as well.

Local market promotion would be useful and comfortable for especially old age people. It creates employment and out migration can be decrease. Youth can be interested to the agriculture and other business. Small trade is already practice in the valley but it is based on individual business. There is not any formal market and trading system. So, need to promote the local market for easy access of goods.

People's livelihood

Diversified livelihood systems allow indigenous and traditional communities to draw on various sources of food and income and in doing so, spreading the risks of vulnerability to climate change. Diverse crops and varieties reduce the risk of crop failure. In this regards, people have own livelihood system and more depended on agriculture production. But now there has been changed. During the research, respondents said main resource is snow. If the snow fall has been occurred on time all things can be corrected. People can use the snow as for irrigation.

Snow fall required to grow vegetation on time. Animal needs sufficient plants and grasses. But the lack of enough irrigation crop production can be decreased, pasture land also be decline. It's all impacted on people's livelihood. If the climate for agriculture is becoming more and more variable and unpredictable, there may necessary to change the traditional people supplement their subsistence livelihoods in regard to agricultural income activities. In March 2008, the UN Human Rights Council agreed to conduct a study on the affects of climate change on human rights, especially livelihoods. Maldives hopes the findings will inform the global negotiation process.

There is a general consensus that greenhouse gas emissions are contributing to global warming, but none on how or by how much have to reduce by them. Around the world "climate refugees" is controversial because of the sheer numbers of people likely to be affected. As the impact of climate change intensifies, estimates of the number of people displaced by natural disasters or rising sea levels have varied from 50 million in 2010, to hundreds of million or even one billion by 2050.

Availability of banking and subsidies facilities in agriculture

Insufficiency of income, assets or wealth is one of the most important determining factors of socio-economic vulnerability of indigenous and traditional peoples. For many of them subsistence agriculture as well as hunting and gathering remains the core of the household economy, and food consumption is therefore both

the driving force as well as the outcome of indigenous livelihood systems. They often have very limited additional income from cash crops or other activities, and are highly dependent on natural resources. Climate change induced hazards could have overwhelming impacts on indigenous and traditional peoples' lives and livelihoods. It impacts on economic development. In the study area, people have faced the low product of crops, pasture land decline and high cost of goods and services.

Therefore, the impact of climate change induced poverty and inequality. It impacts direct to the economic development of people. If there is provided subsidies for crop production by the government to use effective technology and also for the medicinal herbal collection and preserve its essence, people can improve their economic condition. The rural area has lack of banks and financial institutions, such as insurance companies and credit institutions. Bank operation in urban area obviously enjoys greater sponsorship than those in the rural areas. They have problem to saving and investment.

In rural area, there is personal money borrowing system but interest rate is high than banking system. When they interested to saving some money, it takes time so they are in problem of saving and investment. Yarchgumba has being a most important source of income but have to think about its sustainability. There is already seen the problem in the growth of these plants due to untimely changes of snow fall. Therefore alternatives have to practice for the future. Bank loan and other financial institutions would support for that further program. Tourism and medicinal herbal business can be suitable for this valley.

Promote local food and preserve its value

During the focus group discussion local aged people shared their perception; the crop wheat of Tsum is most nutritious and weighty than other areas. It is high in the nutritious than the modern foods. We did not use chemical fertilizer. The product takes long period to be mature. Modern foods like, biscuit and noodles), makes people more hunger. They added their opinion again, time has running fast than before and do not have enough time for taking rest. We did much relax in the past.

Respondents added, Potato, raddish, round raddish, turnip, carrot and cabbage had in the past. Now many green vegetables can product in Tsum valley. However, local vegetables and foods can adjust in to new environment. New modern and hybrid seeds cannot be sustainable. We have to promote our local seeds and vegetables.

The forest is the source of products such as wild potato, wild arum (Karkalo), Bamboo shoots, Lemon Leaves and Bananas. People's activities support to maintain of biodiversity, environmental balance, food security and traditional livelihood system. Women spend a lot time for processing their food, more than the men. They used to process wild fruits, nuts and chestnut, yellow raspberry, cardamom etc. A nettle, bamboo shoot, a particular kind of fern, asparagus and wild yam gathers by themselves from the forests which can be used as food.

The researcher observed and seen the communities are also doing as much as they can do to mitigate the impact of climate change. Farmers have changed the cropping calendar and have adopted other many copping practices. Mulching for moisture conservation in land, using dry nursery for millet, replacing cereals by vegetables, using stress tolerant varieties, use of local knowledge to overcome the insect-pests like use of Artemisia vulgacies (Nepali word Titepati) liquid in some cases, sprinkler irrigation was also found in dry season by some farmer.

Tourism and bio- diversity

An impact on climate change in biodiversity is likely to have a number of impacts from ecosystem to species level. In the study area, impacts of climate change on biodiversity were clearly viewed according to the group discussion and key informants' response. As per their response, in one hand, birds diversity were decreased as compare to earlier years whereas in the other hand, introduction of new bird species were very few and going to be disappear day by day. The most obvious impact is the effect that flooding and temperature changes have definitely affected the ecosystem, allowing some ecosystems to expand into new areas, while others diminish in size. As well as shifting ecosystem boundaries, these changes will also

cause changes in natural habitat an outcome which will have a knock-on effect on species survival.

One of the respondent trekking guide of Chhekampar said, in the Tsum valley, animals breeding duration, bird nesting, snow fall time has changed. Flowering time change for example, Rhododendron has been blossom in February whereas it has blossom in April -May in the past. All mountains are going to be black, there is no snow now. Range of water fall has change, thickness, rapid speed and no long time raining. This means tourism business can be unfavorable for the Tsum people. How to protect the bio- diversity of this valley? Important question has been raise to the concern bodies.

Preserve and protect the culture, religion, and customs

The potential impacts of climate change on the livelihoods and cultures of indigenous and traditional communities remain poorly known issues. The goals of the IUCN report on Indigenous Peoples and Climate Change are: to improve understanding of the potential impacts of climate change on vulnerable communities and cultures and their associated ecosystems; To identify further research required to reduce the risks of climate change; and to develop appropriate adaptation and mitigation measures, particularly in areas with high risk of socio-cultural impacts.

In the research area there is exist Buddhist culture. Many ancient traditions have been practiced by the people. Most of the male are lama guru and daughters are Buddhist nun. It is known as holy places. Honesty, laborious and open heart is the main quality of the peoples. They believe on truth. They have own culture and system for their livelihood. Ghyapo system is a effective system for crop production. People have no violence practice in an area throughout the years. Every full moon day and black moon day, women organize the meeting and perform the rituals together. Polyandry practice still there but in less than before. In this valley, there is certain custom like, first son have to manage the households system, second have to look after the animals and last or young son have to care parents.

Some seniors have shaman knowledge like Labrang and Ghyapo. They have special knowledge. But new generation are not interested to Ghyapo and labrang, a respondent added. Another respondent said, there is a lot of good things as for manner of eating, crop production, time seeing but no one ready for learn it. In this context, there is need to preserve all the good things and good system for sustainable future.

People know the time for farming by seeing "chi" (seeing the leaf of trees) local language. When time comes it becomes yellow and people known the time is for being planting. If there was thundering during the May to June, people understood the difficult time has gone and will come summer. This summer will be comfortable for them.

About the migration, those who leave the villages they were disrespected and people said person do not have capacity to live in village. There is a popular sentence people used to "the person is village leaver " it means the person would be less capable in the community. Therefore people did not leave the village in the past, but within some years migration rate has increased in this valley. Another believes was if there seen landslide and rapid wind spirit, someone(women) having pregnant illegally.

Globalization and consumption rights: vice versa to the development of Tsum valley.

Due to globalization, people explore the new market and opportunities. By increases new idea and broad minded, knowledge and skill have expand comparatively. In modernization era, people have influenced by new technology and scientific investigation. Therefore, they are interested to experience and taste it. As a human being people have to right to move anywhere in the world. This is the concept of globalization and modernization. Migrated people have knowledge and skills to adjust in new place, communication and relationship skills. The migration, whether seasonal or long-term, is a key strategy of adaptation for many households. The pull factor of migration is the more income, employment and comfortable lifestyle. It means purchasing power suppose to be high than before and also change the consumption behavior of person.

Many villagers have migrated in the capital and live in rented apartments. People use apartments mostly in winter season. Some have bought land and constructed building in Kathmandu, Gorkha and Pokhara. The people especially from chhekampar have a high geographically mobility compared to that of chumchet village. They are still active in trade with Tibet and during the off season, they go to south for trade. Many people have seen in overseas and in India. They used to sell medicinal herbs, salt, leather, wool and aromatic garlic leaf.

Human being needs to nutritious and hygienic foods for survive. It is the food right of human. Whatever, poverty and inequality is there. In this regards, Tsum people have changed their life style and consumption behavior. They started to consume more imported foods than local foods. This is the controversial between migration and development. However, we have to accept as like there is two part of single coin in the context of development and people's livelihood.

Rotation cropping system: Indigenous practices

They are trying to develop seeds and increase the use of plants which can withstand droughts and floods. They are also diversifying their food sources not just to rely on the staples which they are used to but to use other wild food plants and other diverse cultivated crops. Many research describe about the indigenous peoples, particularly the women, are developing and diversifying the rice varieties they plant and are working harder to increase soil fertility through the practice of rotational agriculture, composting and use of organic fertilizers and nitrogen-fixing crops like legumes. By protecting and sustainably managing the forests and ensuring soil fertility through organic methods, indigenous peoples who still persist in doing traditional agriculture and agro forestry practices are contributing significantly to mitigation.

There is a need to enhance and replicate these indigenous systems and practices, wherever these are appropriate, and to protect and respect the land, resource and territorial rights of indigenous peoples because these are key factors in increasing their contributions to solution of the climate change crisis.

Rotational agriculture or shifting cultivation is an indigenous agricultural practice of Tsum people. It is a system of resource management and knowledge of land use and cultivation, soil types and fertility and climatic variations. Green manure, crop rotation, composting, fallow periods and agro forestry increase the production of biomass and enhance soil fertility and organic matter content. But in Tsum there is a criterion for use of forest. They have ancient documents about the forest uses.

Most Asian indigenous peoples who live in mountains, tropical forests and hills practice rotational agriculture and this has ensured their survival for generations. Aside from conserving biological diversity, these agro ecosystems are also the basis for the diverse cultures of indigenous peoples. Many indigenous crops are culture crops. Most of the traditional rituals of indigenous peoples are linked with the agricultural cycle linked with these crops. Among the Jagoi in Sarawak, Malaysia, for example, their Cosmo- vision acknowledges one source of all life, God or Topak, who brought forth the entire world composed of the scene in unseen. Spirits (*ieng*) live in the forests. Similarly in the Tsum valley, there is system to protect the crops and make a favorable weather during a special occasion. Ghyapo care and protect the crops and Labrang control the many unnecessary evils. Likewise, lama guru can control the unsuitable weather. They all use their spiritual power and believe the nature.

Management of alternative energy (Solutions and alternatives)

Here, the researcher presents the world scenario of climate change impact in brief. As per adjusted the problem could not bear all the time if it is very much deadly. There is a limitation of human capacity which can be replicate the inequality. In 2003, temperature has been increased more than the last fifty years. Thousand of seniors have died others are risk induced people. One year later heavy storm floods in Japan. Katrina was very dangerous in 2005, learned that, almost rich countries of the world could not bear the climate disaster. In OECD countries 68 million people had affected by the climate change. Forty million in East Asia and South Asia, ten million in Sub Sahara Africa by draught and two million affected by flood.

In 2007, there is another incident had occurred due to change in monsoon. In East Asia,China three million had displaced. More than fourteen million from South Asia, India displaced by the flood and storm. In Bangladesh, Pakisthan ,India and in Nepal included one thousands had died. In 2007, 43000 people had displaced in Jakarta by heavy floods due to hurricane in. In 2005 people of Africa and developing country have been affected by draught.

Due to climate change, women and children are more affected in the world. There are big social differences have seen in Gwatemala between Indigenous people and non Indigenous. Malnutrition has been increased two times more in Indigenous people due to climate impact. During the storm grain has been finished and could not preserve (UN human development report 2008).

Globally, snow is a crucial factor in arctic and alpine ecosystems. Its effects on ecosystems is not restricted to the winter season, during which it determines soil surface temperatures and frost depth, but it also affects the timing and amount of water and nutrient release in spring, and defines the start and length of the summer growing season. Global change is likely to affect high latitudes and altitudes most (ACIA, 2004; IPCC, 2001). In this context, Tsum valley has been more affected by the changes of snow fall pattern. So need to explore the alternative solutions further development. Tsum people have practiced some indigenous knowledge. Their belief is chemical fertilizer do not use along with compost. It would be harmful. It means they do not use chemical fertilizer and produce organic foods. They have crop rotation system; it is the indigenous practice and effective. Ghyapo (especial person) look after the crop production and manage carefully. But the natural induced hazards snow fall changes impacted their livelihood. They are not responsible, though have to adapt it.

People need more fire wood due to very cold place and no accessible natural gas and smoke less stove. Unfortunately, a kind of tree from whose bark come out pieces of papers one after another Betula utilis (local name bhojpatra)has in endangered. It is more useful for fire wood as people had used. Another idea, People made dung cake from the animal dung and store it for further uses as fire wood. This is the adaptation practices of local communities. People do not use modern

material like cement, rud for building, use only wood and stone. People are believed in Buddhism. They have very old documents about the nature protection. According to the documents people do not have slaughter animals, preserve the forest. When government implements the Manaslu Conservation Area Project (MCAP) in this valley, forest are under the MCAP. Some are religious forest and it is under the Gumba. When the forest has gone to under the MCAP , deforestation has increased. People used to it more for their uses. Any institutions do not conduct the re-plantation program in this valley. Obviously, there is increased deforestation.

After all these discussion, solar energy, smokeless stove and bio-gas, rain water harvesting can be alternative uses for people. Whatever people have to get easy access of transportation, goods and services, government subsidies for bio-gas, solar energy and smoke less stove for its development. Otherwise, there is potential to be climatic refugee, for example Simjung VDC of Mustang district.

On the other hand, people living in marginal lands have long been exposed to many kinds of environmental changes and have developed strategies for coping with these phenomena. They have valuable knowledge about adapting to climate change, but the magnitude of future hazards may exceed their adaptive capacity, especially given their current conditions of marginalization.

Chapter summary

This chapter has mention research discussion there were different topic like local market promotion, globalization and migration, rotational cropping and indigenous practices, indigenous people and their culture, solutions and alternatives, tourism and bio- diversity, banking and subsidies.

CHAPTER-VII
SUMMARY, CONCLUSIONS & IMPLICATIONS

Introduction

On in the previous chapter researcher described relation between climate change and socio -economic sector of study area, in this chapter presented research summary, conclusion and implication.

Summary

Researcher visited the all villages of the study area during the field research; the researcher got in study area there is no changed the way of living those who are not move out but some changes found to the migrated people. They are unknown about the climate change and its impacts. During the research, researcher used normal term based on their understanding. There is no good education, health, transportation, shopping for market, not enough water resources; Snow fall time has changed, no systematic animal herds system, there is no enough seed for plantation, and pharmacy.

There is no any opportunity for living in village, due to these real ground region young generation has been migrating in different country to built their good future. This study consists in seven chapters. The first chapter contains setting of the study, research problem; purpose of the study, research question and chapter summary.

Chapter two provides a comprehensive literature review. Chapter three discusses the research design, tools of data collection and methodology and research procedures in detail. Chapter four, provides general information of the study area. The main empirical findings are analyzed in chapter five. Chapter six contains the research discussion and chapter seven present relations between climate change and socio- economic impact, finding and conclusion of the study along with policy implication.

Conclusion

This study mainly discussed the impact of climate change on people's socio -economic condition of Tsum valley. Along with analyzed the adaption practices for mitigate to climate change impacts in the community levels. The research also explored the issue of general information of mountain people's livelihood, discussed on adverse consequences of climate change on Tsum people's livelihood. It emphasized on their efficiency and effectiveness concerning the stakeholder's for long term development in the agricultural sectors. A holistic representation of local stockholder's observation has been maintained through the research discussion and findings.

On this basis groundwork, I drew key concluding remarks highlighting the peoples' perspectives. Livelihood of rural people has been depending on agriculture and animal husbandry. However, in study area people have shifted to the yarchagumba collection since six to seven years. Farming in rural area almost base on traditional approach, whatever this research revolved around in rural mountain people socio-economic condition. Some key stakeholders in this procedure needed to be habituated to know about detail.

Awareness raising, capacity building and small scale mitigation works are needed in this valley. This will automatically help to fight against climate change for local people. There are 22 highly disaster affected districts are in Nepal. Every year local people have been facing the flood –based disaster which is dangerous and there have been huge loss of life and property. Now, the Tsum people have facing early snow melting problem since seven to eight years.

As per the present situations, local people said "we can not say how become it, but scientist might say, added, we do not have any experience that governments has helped NGOs and community in the field. As per respondent's survey, agriculture has been seen the highest impacts followed by animal husbandry, biodiversity, water level and drinking water, ecology and environment, food habit and cultural changes and out migration of people in Tsum valley, Gorkha District of Nepal. Almost all the

categories have been marked as higher impacts on climate change in Chumchet VDC. Local people have initiated to change the cropping patterns, use local seeds and initiate the community based disaster management in order to cope with the adverse situation of climate called as climate change.

Implications

In fact, we all accept the reality of present situation of mountain people livelihood due to climate change which cannot be lead without strong policies of the government. The volume of GDP is low. Agricultural sector contributes nearly 39 percent in total GDP production. Government is not taking effective initiatives and steps for the management and development of agriculture and farming. 95 percent of the total rural populations are directly dependent upon agriculture. Since 81 percent of the total population in the country are dependent upon agriculture, agricultural sector should be enlisted in priority list of government along which effective initiatives and action of government is essential.

Implications on Stakeholders

The study area represents the rural mountain area of Nepal. People's livelihood depends on agriculture and livestock. Due to the global warming, climate has changed most of the himalayan range in the world. Whereas Nepal also one of the Himalayan country. Unpredictable rainfall and untimely snow fall has affect on crop production and animal husbandry in the mountain region. The study area, Tsum valley has experienced since seven to eight years. Lower Tsum has severe crop disease in a wheat crop since three to four years. But they don,t know how it become. Local people are unknown about the climate change and its impact. One of the respondent (Buddhist Priest) 50 from Lower Tsum, said, "How become change? Farmers follow the same technique and same system that they did in previous year." Since three to four years wheat and naked barley has decreased and damaged by disease in lower Chum. In October and November, there was heavy snow fall. This was the normal way. Now it has changed and in April-May people experienced

snowfall. There is one evidence have experienced heavy snow fall in February, 2007 also. So there is change in snowfall time. We are innocent on that issue.

A chairperson of Tsum Welfare Committee said Tsum people had celebrated many festivals and cultural programs in the previous years. Now it has changed, people cut the number of days also. Young generation could not attend all the cultural programs. He thought people are more aware about the education, business and other economic activities and they are busy. Tsum people have own typical dress and ornaments. Women had many dress weave skill and prepared by themselves. Now it has changed. People wear most of their dress made by Tibetans.

The reason, it is cheap and easily available in the market and raw materials also have scarce in the Tsum Valley. The old aged people have only made by local people dress now. The curiosity arises; the Tsum valley has being warmer more than in the past or human tolerance capacity has increased. One of the respondent Sonam said now the man he who wear the chinese shoes like Goldstar, he had wear the Docha (the shoes made by local people) in the past.

Regarding the research findings, local stakeholders need to initiate on these issues.

- People need to aware about the climate change and its consequences.
- Participate to training, workshops, seminars regarding to climate change.
- They do not know what are the responsible factors that they did in the past which added to increase climate change impact. They have to know the human-induced factors are more responsible to global warming.
- People have to understand what are the traditional measures have adapted and much indigenous knowledge are already applied to protect the nature.
- Government program should be focus in local level and local communities have to understand on that issue.
- Find out the alternatives on agriculture and livestock problem solving by them.
- The country have an evidence of upper Mustang, one of the villages Simjung is in resettling process. WWF Nepal has supported to the village for its

resettle. If people are not aware, there is high potential to increased number of climate refugee in near future. Government and Local people of mountains have to aware the future potentials.

- Government has to launch the effective program regarding climate change. Lack of proper policy and program do not mitigate the measures.
- Government program has driven by urban areas. Lack of proper information rural as well mountain people has look over by others.
- Remoteness is the cause of inaccessibility of government programs and facilities in the rural mountain. In the study are, Tsum is 47 km far from the District headquarter of Gorkha. It takes five to seven days from the District headquarter. Road and Transportation is the beginning of development.
- There are no transportation facilities. Mule is the means of transportation from Gorkha bazaar to Tsum valley. Yak and Horse are the local means of transportation of Tsum valley. Local market need to promote for exchange goods. People have to pay more because of remoteness.
- Tsum valley, there is no slaughter or people do not sacrifice the animals. Horse, yak and sheep are domestic animals. In a year four hundreds yak has been died. People are still in shock. They are unknown about the reason. Tsum Welfare committee member Dawa said, it was the April, may the time of evidence. I think one of the reasons is change in snowfall time. Snow fall has shift to April, May, during these period yak has less hair on their body. Their body affect by too much cold. Whereas in the normal time for snow fall October, November they have thick hair on their body and they are protected. Dawa add his opinion when Yak and yak shake their body snow fall down, so protect their body by the thick hair. But in changed time due to thin hair cold affect the yak. However do not know the exact reason of die.
- Due to the global warming there is heavy snow melting felt in the Himalayan region. Avalanches and glacier lake outburst force to Landslide or flooding, people's livelihood can be in risk in the mountain areas. Alternatives measures have to adapt for mitigation to climate change,
- People have monograph farming practice in the study area. Need to farm the multiple crop production to conserve the soil productivity.

- Farm cash crops, Increase medicinal herbs business and develop the concept of kitchen gardening are the future adaptation measures for mitigation to climate change impacts.
- Preserve green vegetable for the next year and preserve crop seed by the use of bio plants Asuro, Titepati, Timur. These are the example of indigenous knowledge and technology which is already practiced in the local level. Government has to support to enhance the indigenous knowledge and technology.
- Seed subsidy and Farmer insurance program support to increase the interest for agriculture. Now Tsum people are less interested to the agriculture.

Government need to disseminate the program to the targeted group then result could better.

- So need to initiate by the local people themselves. Establish the effective communication centre. It helps people to be updated about the developed world.
- In the local level communities everybody has different expertise and practiced idea. By the help of social network reduce the deforestation. Join hand together to protect the concept of save the nature and participate to sharing and exchange of knowledge.
- Ministry of Agriculture has the program for development of Agriculture sector. Every year distribute the budget for each sector. But implementation has become less lack of effective monitoring and evaluation. In the rural area governments' many program have to be implemented.
- People found the disease in the crop production since three to four years but never try to check their crop to the agricultural expert. It is difficult to say either they are unknown or government responsible personnel ignored to monitoring of agriculture sector to the mountain.
- Need to establish the Agriculture Development Division in to the local levels,it has implemented only to the District level at present.

- There are many issues have seen in the mountain areas related to the people's livelihood. People have less opportunity to create their income. Government need to focus on that issue.
- Local people's involvement has necessary to the income generating program to increase their purchasing power. Consumption varities have increased compare to the past year experience.
- There is no Bank and other financial institutions for exchange money. People need to go to the District headquarter Gorkha Bazaar to solve their financial problem. It is far, takes five to six days to reach there.
- Livestock is the second main occupation for mountain people. The impact of untimely snow fall and decreased the grassland, animal husbandry has in endanger in the mountain. They have experience, once four hundreds yak has died. This is another reason for financial crisis of the mountain people's. They are unaware about the animal health. The researcher did not see the any veterinary office in the area.
- Protect the pasture land and to plant new grasses in the field. People are dependent on the natural pasture land, whereas deforestation has increased day by day.
- Global warming is the hot cake of world people's. There are many policies and programs have designed to this sector. For example, Carbon tax is a policy to control the green house gas emission. The industrial companies or countries have to pay tax to the country as the compensation of carbon production in the environment.
- Solar energy, wind energy can be the alternative adaptation practice to mitigate climate change in the mountain area. Local people have to aware about on that renewal energy program of Nepal Government.
- Forest is a source of food also as for example arum, kurilo, wild potato, taro, Tolo (Local name of Tsum people) is a wild food, most people used to eat in Tsum. So need to protect the forest food also.
- People have to be aware about the adaptation measures

- Use of maximum fire wood forest has in degradation. Few people have access to use the natural gas for making food. It is necessary to think for the future program of Tum Valley, how to reduce the use of firewood in the area and develop the forest management system.
- Migration is seems high in the Tsum Valley. Youth are migrating as seasonal. Yarchagumba is a major business for them. Since seven to eight years they are collecting regular. In the time of collecting that medicinal herbs they come back to Tsum valley and after complete it back to the capital for its business. Some are engage in the tourism sector and rest of the time mostly spends in the Kathmandu. Therefore, the productive human labour hardly find in the area. In the research period the researcher found the youth the reason that time was yarchagumba collection and second was the festival Shyakya dhawa organized by Tsum Welfare Committee. How to possible the development of tsum valley without the presence of productive human labour? question has arise.
- Old age people are wish to come to the Tsum valley from the urban, whereas most people are out migrated from the valley.
- Tourism business is possible for the socio economic development of tsum people. But Local people's initiative and support of government has necessary to be associated.
- Innovative Income generation program have to explore in the area to reduce the poverty. For example, hotel business, organic food shop, cash crop farming, medicinal herbs shop etc.
- Yarchagumba is high income source of people, but it is announced illegal by the government. Most people left the agriculture and have shifted to the business of yarchagumba. How to associate between Government and local people for its business. Although it is an unsustainable business. Local people says, its growth has depends on climate change.
- There is not enough drinking water resource some resources have shrunken. Rain water harvesting might be useful for alternative uses and also irrigate to the kitchen gardening.

Policy makers

When people educated then many things can understand and express their experiences easily. Regarding the climate change issue people need to educate.

Globalization and its implication need to understand.

People accepted all modern culture but don't know what the implication of its practices is.

For example people sale their local products like wheat, millet and maize and buy the rice from urban areas, one of the lady said I eat local product but my school going children do not like eat porridge and bread, so I bought rice for them. People need to know how the local products can be nutritious than other food. Many people have recommended the junk food for children. But the many research describe local foods have more healthy than junk food.

Recommendation

Enhance capacity of Tsum communities to adaptation and mitigate climate change. Reinforce indigenous women's traditional knowledge on mitigation and adaptation and facilitate the transfer of this knowledge to the younger generations. This includes knowledge on traditional forest management, sustainable agriculture, pastoralist and rehabilitation. Facilitate direct access to adaptation funds and technologies for climate change adaptation at the local, national, regional and global levels.

Enhance adaptive capacities and livelihood including enhancement of our traditional agricultural practices and systems, agro- forestry and the development and promotion of ecological agricultural practices adapted to climate change impact to develop the access of diverse seed varieties for food. Stakeholders have to take part in various climate change seminars which has helped to enlarge knowledge in climatic zone. Lacking knowledge may not enhance new technique for development. This results unemployment and unemployment creates negative ideas and thoughts in

a person's mind. Finally, management of agriculture sector takings through a critical path and to successfully walkover this is essential to study the influence of limiting forces and enabling forces. Maximizing enabling forces through promoting community involvement in agricultural management and the feeling of ownership may result into fruition. This is another area to be researched.

Training to Youth Clubs, Eco-Club, Women groups etc fall under this sector. Critical knowledge gaps that impede effective adaptation decisions should be identified and plans for new collaborations of stakeholder and scientific organizations that target the identified gaps should be developed and promoted for follow-up action;

Traditional Indigenous knowledge which has been used by communities should be recognize and promote it. Indigenous people have spiritual connection to the forest. They accept as God goddess and use leaves of plant for several cultural ceremonies. Indigenous people have own customary law. Tsum people have also their own customary law. Based on their law people cannot deforest the tree. Respondents said when government take over the forest as by name Manaslu Conservation Area Project (MCAP), deforestation have been increased indirectly. Now the situation become very danger, the tree used for fire wood "Bhojpatra" has completely finished. Need to explore the alternative of Bhojpatra. People have to move far from their village to collect the fire wood. Therefore, government should provide the subsidy for Bio-gas as well as smoke less stove. Transportation cost might be high because of remote place. So, need to subsidies for agriculture seeds, equipment and considering the transportation cost.

Policy plays vital role to reduce the adverse climate change in both local and national levels. Avoided deforestation, promoted a forestation and reforestation, biodiversity –friendly and climate-friendly energy, capacity building and community engagement and bio fuels and agro energy expansion should be considered and implemented as a policy level recommendation.

Promoting livelihoods through the value chain development. In spite of the challenges resulting from rapid change in the Hindu Kush Himalayas, opportunities

are also emerging. With increased urbanization comes a demand for position, organic and high-value mountain products. Traditional livelihoods and other economic activities of indigenous peoples are also adversely impacted by climate change.

In Malaysia, for example, rubber tapping has been a source of cash for many indigenous peoples in Sarawak and Sabah. Latex is tapped when the leaves of the rubber tree are shed around August and September. With the changes in weather, leaves shed as early as January and thus there is less latex gathered which means less income. Other fruit trees like durian and *engkabang* (also known as ilipe nut) are indigenous species in Sarawak and these are sources of cash and food. Bumper crop harvests from these trees have decreased significantly because of weather changes.5 Clove production, a major source of cash, amongst the indigenous peoples of Lombok in Indonesia dropped by 40 per cent in 2007. This is due to temperature rise. Pest resurgence has also led to a decrease in cacao and banana production in Indonesia.

In Nepal, it was observed that the phenomenal decrease of available water adversely affected crop production and the changes in the agricultural patterns and quality of agricultural crops. Peas and Rhodendron are flowering much earlier and the apples are less sweet than they used to be. There are unknown insects invading the high mountain communities, because of increased temperatures, causing diseases which were not there before. Tourism, which is a main source of livelihood for many indigenous peoples, has decreased in recent years because of the accidents caused by avalanches and landslides. The increasing scarcity of freshwater because of droughts, water salinization, the privatization and commercialization of water, as well as the unequal distribution of water due to government regulations (e.g., piping of water for the use of big hotels for the tourism industry) all lead to difficult situations for indigenous peoples. Their right to water is being violated and their capacity to adapt to climate change is further compromised. Water conflicts are becoming more frequent in indigenous territories.

Asian indigenous women are much more vulnerable to climate change impacts compared to the men because they are often the subsistence producers and are heavily reliant on the quality and quantity of natural resources. They are the main caregivers, water and food providers and yet they have the least access to land, education and

health facilities, technologies and agricultural technical assistance and inputs, and disaster relief services, infrastructure development and credit assistance. Many of them suffer from discrimination in their own indigenous societies, in the dominant society and in the labour market. Under the Tsum valley there is same problem has been faced by women. Water has to collect from far resources of water. they have to go very far for firewood collection.

The Himalayan glaciers are the lifeline for around two billion people in Nepal, India, China and the Mekong region who rely on glacier-dependent rivers such as the Ganges, Brahmaputra, Indus, Mekong, Yellow and Yangtze Rivers. They face acute and long-term shortages of water because of the melting of the glaciers and the vanishing snow peaks.

Their traditional water management systems lack government support. Examples of how they are adapting to water scarcity due to climate change impacts will be deforestation which contributes 20 per cent of greenhouse gas emissions, was identified as a major problem in almost all the countries. Most nation-states passed forest laws which legitimized the ownership and control of State forests, including those found in indigenous peoples territories.

Forests have been and are still used for patronage politics which is a key driver of deforestation. Officials in the government granted forest concessions to their cronies and families to log and to establish monoculture plantations. Many conflicts in indigenous peoples' territories in Asia have been conflicts over the ownership and use of forests. Because of indigenous peoples' struggles to protect their territories and to stop deforestation, most of the remaining rainforests and secondary forests in Asian countries are found in indigenous peoples' territories. A concern was raised on how indigenous peoples' traditional agro- forestry and agro ecosystem practices, such as shifting cultivation or swidden farming, are being singled out as drivers of deforestation.

Recommendation for further research

Nepal is a mountain country. Much land has covered by mountain.Tourism is the main source of income for mountain people and remain source is agriculture and animal husbandry. Due to Global warming, snow melting has been increased in the mountains. Ice has used for irrigation in the mountain farming. When climate change occurred snow fall time has changed, then there is no stock water for the farming.

Tsum valley people have experiences this kind of impact. People's Livelihood has been changed. Many people had left their agriculture occupation and livestock has been decreased, out migration has been increased. This is the findings of my research. Various issues did not covered due to time constrain and limitation of the study. However I have some realization during my study. The realizations are what is the condition of tree line shifting in Tsum valley during 20 years back? How can measure the Snow line changes? How can say the temperature has changed or not? How to measure the effectiveness of Indigenous adaptation practices of climate change? How people livelihood could be the safe and sustainable? There is no single research is found to address this concern. I suggest conducting a research on this issue. This kind of study would be baseline for the government further development of the study area and also could be replicate other similar places. In Nepal, there are seven valley including Tsum valley. These are known as holly places.

Finally**,** this study has been identified the factors, impacts and mitigation measures of climate change in Tsum valley people. The findings of research as factors, mitigation measures could be used for comparative study to other places and also need for further study. This study will be relevant to the present worldwide scenario of climate change impacts. There is no alternative but have to reduce the consumption, low the nutrition and recommend to further study on snow line shifting in the mountain region.

References

Warner, K. and van der Geest, K. (2013).'Loss and damage from climate change: local-level evidence from nine vulnerable countries', *Int. J. Global Warming*, Vol. 5,No. 4, pp.367–386)

Houghton J T, Ding Y H, Griggs D G, *et al*. Climate Change 2001: The Scientific Basis [M]. Cambridge, UK: Cambridge University Press, 2001

Bajracharya, Shrestha, A.B. & Rajbhandari, L. (2007). *Glacial Lake Outburst Floods in the Sagarmatha Region. Hazard Assessment Using GIS and Hydrodynamic Modeling. Mountain Research and Development*, 27:336–344.

Chhetri N. , Pa. Chaudhary, P. R. Tiwari and Ram Baran Yadaw (2012). *Institutional and technologial innovation: Understanding agricultural adaptation to climate change in Nepal.* Applied Geography 33: 142-150.

CARE Nepal /LI-BIRD. (2009). *Climate Change Impacts on Livelihoods of Poor andVulnerable Communities and Biodiversity Conservation:* A Case Study in Banke, Bardia, Dhading and Rasuwa Districts of Nepal. CARE Nepal, Kathmandu, Nepal.

Chapagain B. K. R. Subedi, and N. S. Paudel (2009). Exploring local knowledge of climate change: some reflections. *Journal of Forest and Livelihood*, 8(1):106-110.

Government of Nepal (GoN) 2004. Kathmandu: Ministry of Population and Environment, Government of Nepal.

Initial National Communication to the COP of UNFCCC.

Gurung G. B., D. Pradhananga, D., Karmacharya, J. Subedi, A. K. Gurung, and S. Shrestha (2010). Impact of climate change – voices of people: Based on field observations, information and interactions with the communities in Nepal. Practical Action, Kathmandu, Nepal, 2010.

Government of Nepal (GoN) 2004. Initial national communication to the conferences of the parties of the United Nations Framework Convention on Climate Change. July 2004.

Ministry of Population and Environment, Government of Nepal.

Immerzeel W.W., van Beek, L. P. H. & Bierkens, M. F. P. (2010). Climate change will affect the Asian Towers. Science, 328, 1382–1385.

Pradhan, NS; Khadgi, VR; Schipper, L; Kaur, N; Geoghegan, T (2012) Role of Policy and Institutions in Local Adaptation to Climate Change – Case studies on responses to too much and too little water in the Hindu Kush Himalayas. International Center for Integrated Mountain Development. (ICIMOD)Nepal.

Chaudhary P. and K. S. Bawa (2011). Local Perceptions of Climate Change validated by scientific evidence in the Himalayas. *Biol. Lett.*, published online, 27 April 2011; doi: 098/rsbl.2011.0269.

Creswell John W. (2011). *Research Design, Qualitative, Quantitative, and Mixed Methods Approaches,* New Delhi: SAGE Publication.

WB. (2008). *World Development Report: Agriculture for Development,* Washington D.C. The World Bank.

Gurung N. (2006). Cause of Laprak landslide in Gorkha district and Nepane landslide in Kaski district of Nepal and their remedial measures. In Proceedings of Geo-disaster, infrastructure management and protection of World Heritage Sites. Novermber 2006.

Nepal Engineering College, Changunarayan, Bhaktapur, Nepal (pp: 25-26).

(IUCN, 2011) http://iucnnepal.org

Shrestha, S. and A. Shrestha. (2010). Gender perspective: integrating energy resource use into climate change adaptation. A research report submitted to National Adaptation Program of Action (NAPA) Project office, Ministry of Environment, Singha Durbar, Kathmandu, Nepal.

Shrestha, A. B. and L. P. Devkota (2010). Climate change in the Eastern Himalayas: observed trends and model projections. In Climate Change Impact and Vulnerability in the Eastern Himalayas– Technical Report 1, ICIMOD, Kathmandu.

Shrestha, U. B. and Bawa, K., (2009). Wide spread climate change in the Himalayas and associated changes in local ecosystems Forthcoming.

SOHAM (2006). News letter. SOHAM-Nepal (Society of Hydrologists and Meteorologists-Nepal).6 (2).

Thapa, K., G.B. Sharma, B.B. Tamang, P. Limbu, B. Ranabhat, R.C. Khanal, B. Joshi, and A.(202). Research and Development.

Shrestha, (2012). Regional Project on Shifting Cultivation (RPSC): Promoting Innovative

Policy and Development Options for Improving Shifting Cultivation in the Eastern

Himalayas-Land Use Option and Extension Approaches in Shifting Cultivation System of Nepal. Local Initiatives for Biodiversity, Research Downloaded on 8/24/13 Retrived on 24/82013.(CARE/LI-BIRD , 2009 **),** http://dx.doi.org/10.5772/50608

ACIA (2004). *Impacts of a Warming Arctic: Arctic Climate Impact Assessment* . Arctic Climate Impact Assessment. Cambridge University Press, Cambridge, United Kingdom.

(ICIMOD Annual REPORT 2012 downloaded 8/24/2013)

Lama, Sonam (2012), Impacts of North South Transit Route Development on Architectural Heritage of Sacred Sites: The Case of Tsum Beyul Kyimolung, central Himalaya, Gorkha, District, Nepal

Lama, Sonam (2007). Technical School for Rural Community Development-TSRCD, Tsum Valley, Gorkha, District, Thesis for the Bachelor degree of Architecture, Pokhara University, Nepal Engineering College

Lama, Sonam (2011). Tourism Enterprise for Community Development-te4cd, Funding Proposal for the Interdisciplinary Masters in International Cooperation and Urban Development, Technical University Darmstadt, Germany

Sharma K. 2006. Hydrologic extremities of South-West Nepal in 2006. In Proceedings of

International Symposium on Geo-disaster, infrastructure management and protection of World Heritage Sites. November 2006. Nepal Engineering College Changunarayan, Bhaktapur, Nepal (pp: 224-230).

Sharma E., N. Chettri, K. Tse-ring, A. B, Shrestha, F. Jing, P. Mool and M. Eriksson (2009). Climate Change impacts and vulnerability in the Eastern Himalayas, ICIMOD, Kathmandu.

Birkmann, J. (2011) 'First- and second-order adaptation to natural hazards and extreme events in the context of climate change', *Natural Hazards*, Vol. 58, No. 2, pp.811–840.

Brida, A.B., Owiyo, T. and Sokona, Y. (2013) 'Loss and damage from the double blow of flood and drought in Mozambique', *International Journal of Global Warming*.

Great Himalaya Trail: Preparatory Study, Tsum Valley, Gorkha, Nepal (2008). International Center for Integrated Mountain Development

Bhandari, Bishnu (1997). Prospects for Tourism in Chhekampar. Kathmandu: IUCN Nepal

Lamichhane B. R. and K. D. Awasthi (2009). Changing climate in a mountain sub-watershed in Nepal. Journal of Forest and Livelihood, 8(1):99-105

Maplecroft (2011). Climate change vulnerability index 2011.

http://www.washingtonpost.com/wpsrv/nation/green/pdfs/ClimateChangeVulnerabilityIndex2011.pdf [retrieved on 31 March 2012]

MOE. (2010). National Adaptation Programme of Action (NAPA) to Climate Change.Ministry of Environment, Government of Nepal. http://www.napanepal.gov.np/pdf_reports/NAPA_Report.pdf

Intergovernmental Panel on Climate Change (IPCC) (2007a) *Climate Change 2007: The Physical Science Basis, Summary for Policy Makers*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge and New York.

Intergovernmental Panel on Climate Change (IPCC) (2007b) *Climate Change 2007: Climate Change Impacts, Adaptation and Vulnerability, Summary for Policy Makers*, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge and New York.

Intergovernmental Panel on Climate Change (IPCC) (2012) *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, a Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge and New York.

Kusters, K. and Wangdi, N. (2013) *'The costs of adaptation: Changes in water availability and farmers'* responses in Punakha district, Bhutan', *International Journal of Global Warming*.

Thornton, P.K., Jones, P.G., Ericksen, P.J. and Challinor, A.J. (2011) 'Agriculture and food systems in Sub-Saharan Africa in a 4°C world', *Philosophical Transactions of the Royal Society A*, Vol. 369, No. 1934, pp.117–136.

Preston, B.L., Dow, K. and Berkhout, F. (2013) 'The climate adaptation frontier', *Sustainability*, Vol. 5, No. 3, pp. 1011–1035.

Rabbani, G., Rahman, A. and Mainuddin, K. (2013) 'Salinity induced loss and damage to farming households in coastal Bangladesh', *International Journal of Global Warming*.

Adger, W. N., Kelly, P. M., Ninh, N. H., and Thanh, N. C.: 2001, `Property Rights, Institutions and Coastal Management-Coastal Resources under Doi Moi', in Adger, W. N., Kelly, P. M., and Ninh, N. H. (eds.),Living with Environmental Change: Social Vulnerability, Adaptation and Resilience in Vietnam, Routledge, London, in press.

Van der Geest, K. and Dietz, T. (2004) 'A literature survey about risk and vulnerability in drylands, with a focus on the Sahel', in Dietz, T., Rueben, R. and Verhagen, J. (Eds.): *The Impact of Climate Change on Drylands*, Kluwer, Dordrecht, pp.117–146.

IPCC, (2001). Climate Change Synthesis Report. A Contribution of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Watson, R.T. and the Core Writing Team (eds.)]. Cambridge University Press, Cambridge, United Kingdom, and New York, NY, USA, 398 pp.

Miller, D. (1998). Fields of Grass- Portraits of the Pastoral Landscape and Nomads of the Tibetan Plateau and Himalayas. Nepal: International Center for Integrated Mountain Development (ICIMOD).

Qiu, GW; Hao, YX; Wang, SL (2001) 'The impacts of climate change on the interlock area of farming-pastoral region and its climatic potential productivity in Northern China'.*Arid Zone Research* 18: 23-28.

Schwartz, M. D., R. Ahas, and A. Aasa. (2006). Onset of spring starting earlier across the Northern Hemisphere. *Global Change Biology* 12:343–351.

Shrestha KL (2005). Global Change Impact Assessment for Himalayan Mountain Regions for Environmental Management and Sustainable Development. *Global Environmental Research, 9(1):69-81.*

Shrestha NM and Balla MK, 2011.Temporal change detection of Lumding Tsho glacial lake in Dudh-Koshi basin, Nepal. *Journal of Environmental Research and Development*, 5(3A): 795-800.

Wigley, T. M. L. 2005.The Climate Change Commitment. *Science*, 307: 1766-1769.

Wilkes, A (2008) Towards mainstreaming climate change in grassland management policies and practices on the Tibetan Plateau, Working Paper No. 67. Beijing: World Agro-forestry Centre, ICRAF-China.

Wilkes, A. (2008). Towards mainstreaming climate change in grassland management: policies and practices on the Tibetan Plateau. Working paper no. 67. World Agro-forestry Centre, Nairobi.

Zhong, C; He, XR; Li, HX (2003). Application of remote sensing technology to grassland degradation assessment in Naqu, Tibetan plateau'. *Remote Sensing Technology and Application* 18(2): 99-102. Dec.9/2013

Dirnbock, T; Dullinger, S; Grabherr, G (2003). 'A regional impact assessment of climate and land-use change on alpine vegetation'. *Journal of Biogeography* 30: 401–417.

Hasnain, S. I. (2000). Status of the Glacier Research in the HKH region. 2000, ICIMOD, Kathmandu, Nepal

Li, BL; Zhou, CH (2001) 'Climatic variation and desertification in West Sandy Land of Northeast China Plain'.*Journal of Natural Resources* 16:234-239.

Immerzeel WW, Van Beek LPH, Bierkens MFP (2010) Climate change will affect the Asian water towers. Science 328: 1382–1385.

IPCC (2007) Contribution of working group I to the fourth assessment report of the intergovernmental panel on climate change. In: fourth assessment report of the intergovernmental panel on climate change. In: Solomon S, Qin D, Manning M, Chen Z, Marquis M, et al., editor. Cambridge Univ Press, Cambridge, UK.

Kantipur, (2066:5) *Strange Climate Beyond Himalaya* 8th Shrawn.

Nagarik, (2066:5). *Risk of Desertification Beyond the Himalaya,* 8th Shrawn, Thursday.

Sapkota, T. P. (2064). *Melting Himalaya Contemporary Problem: One Slogan with various importance'***,** Basnet S.K. (Ed.). Kathmandu: Hamro Sampada.

Sedhai, R. (2064). *Climate change and its impact on tourism development of Nepal,* Basnet K. (Ed.). Kathmandu: Hamro Sampada

UNFCCC, (2007). *Climate Change: Impacts, Vulnerabilities and Adaptation in Developing Countries,* www.unfccc.org.

Impact of Climate Change on Livelihood and Biodiversity in Rural Communities *(A Case Study of SiddhiGanesh and Nepane Community Forestry User Groups of Sindhupalchwok District of Nepal)* Submitted By Digambar Singh Dahal

Examination Roll No. 2468, Central Department of Rural Development Kirtipur, Kathmandu, November, 2011.

Downloaded Dec.9/2013 http://www.defra.gov.uk/statistics/foodfarm/enviro/climate/

Kahn, A.J. (1969). *Theory and Practice in Social Planning*. New York: Russell Sage.

Adams RM, Hurd BH, Stephanie L and Leary N (1998). Effects of global climate change on agriculture:an interpretative review, *Clim Res*, 11: 19–30.

Sharma E, Chettri N, Tsering K, Shrestha AB, Fang J, et al. (2009) Climate change impacts and vulnerability in the Eastern Himalayas. ICIMOD, Kathmandu, Nepal.

Chaudhary P, Bawa KS (2011) Local perceptions of climate change validated byscientific evidence in the Himalayas. Bio Lett 7: 767–770.

Shrestha AB, Wake CP, Mayewski PA, Dibb JE (1999) Maximum temperature trends in the Himalaya and its vicinity: An analysis based on temperature records from Nepal for the period 1971–94. J Clim 12: 2775–2786.

Liu X, Chen B (2000) Climatic warming in the Tibetan Plateau during recent decades. Int J Climatol 20: 1729–1742.

Shrestha A.B., Wake, C.P., Mayewski, P.A. & Dibb, J.E. (1999). Maximum Temperature Trends in the Himalaya and its Vicinity: An Analysis Based on Temperature Records from Nepal for the Period 1971–94. *Journal of Climate*, 12: 2775–2786.

NOAA (2011). *Ocean and Coastal Resource Management in Your State: States and Territories Working With NOAA on Ocean and Coastal Management*.

Ives J. D. (1986).Glacial Lake Outburst Floods and Risk Engineering in the Himalaya, ICIMOD, Kathmandu, p. 42.

Agrawala S. and M. Berg (2002). Development and climate change project: concept paper on scope and criteria for case study section, COM/ENV/EPOC/DCD/DAC/Final, Paris OECD.

Baidya S. K., M. L. Shrestha and M. M. Sheikh (2008). Trends in daily climatic extremes of temperature and precipitation in Nepal.

Chaudhary p. and K. Aryal (2009). Global warming in Nepal: challenges and policy imperatives. Journal of Forest and Livelihood, 8: 4-13.

Chaudhary P., S. Rai, S. Wangdi, A. Mao, N. Rehman, S. Chettri and K. S. Bawa (2011).

Consistency of local perceptions of climate change in the Kangchenjunga Himalaya landscape. *Current Science*, 101: 504-513

Kelkar, Ulka and Suruchi Bhadwal (2007). "South Asian Regional Study on Climate Change Impacts and Adaptation: Implications for Human Development."

Regmi, Bimal R. and Adhikari, A. (2007). "Climate Change and Human Development—Risk and Vulnerability in a Warming World. Country Case Study Nepal."

Sullivan, Rory. 2007. "Australia Country Study."

Trigoso Rubio, Erika. (2007). "Climate Change Impacts and Adaptation in Peru: the Case of Puno and Piura Bhadwal, Suruchi and Sreeja Nair (2007). "India Case Study." Tata Energy Resources Institute (TERI), Mumbai.

Chaudhry, Peter and Greet Ruysschaert (2007). "Climate Change and Human Development in Viet Nam."

Hulme, Mike and Nicola Sheard. (1999a). "Climate Change Scenarios for Australia." Climatic Research Unit, Norwich. [http://www.cru. uea.ac.uk/~mikeh/research/australia.pdf]. August 2007.

Mills, Evan(2006). "The Role of NAIC in Responding to Climate Change." Testimony to the National Association of Insurance Commissioners. University of California, Berkeley.

Winkler, Harald and Andrew Marquard. (2007). "Energy Development and Climate Change: Decarbonising Growth in South Africa."

Perry, Michael, Adrianne Dulio, Samantha Artiga, Adele Shartzer and David Rousseau (2006). "Voices of the Storm. Health Experiences of Low-Income Katrina Survivors." Henry J. Kaiser Foundation, California.

Raworth, Kate. (2007a). "Adapting to Climate Change. What's Needed in Poor Countries and Who Should Pay." Oxfam Briefi ng Paper No.104. Oxfam International, Oxford.

Smith, Joseph and David Shearman (2006). *Climate Change Litigation.Analysing the Law, Scientifi c Evidence and Impacts on the Environment, Health and Property.* Presidian Legal Publications, Adelaide.

Smithsonian National Air and Space Museum (1999). "Apollo to the Moon." [http://www.nasm.si.edu/exhibitions/attm/attm.html].September 2007.

1 Available at http://www.ehs.unu.edu and **http://www.lossanddamage.net**. Retrived on February 2013

2 (**www.climatechange.cn**) retrived on June 2012

3 at **www.climatechange.cn** 8 Adv. Clim. Change Res., 2007, 3 (Suppl.): 6J11 *Lin Erda et al.*: *China's National Assessment Report on Climate Change* (II) Available online at **www.climatechange.cn** retrived on 2013

4 (**www.climate4life.org**) (WDR, 2008).(Abdalla, 2009). (Tandan, 2066), retrived on 2012

5 (**www.who.int**) retrived on July 2013

6.**http://dx.doi.org/10.5772/50608** retrived on January 2013

(van der Geest, 2004; Birkmann, 2011). Available at http://www.ehs.unu.edu and http://www. lossanddamage.net.

Available online at www.climatechange.cn **(“**India Energy Outlook, KPMG, 2006 / RET Outlook” Based on MNES website).

(Gaire Damodar, Suvedi Mukti and Amatya Jyotshna 2008). (www.who.int.

Climate change adaptation practices in USA,: *Int. J. Global Warming, Vol. 5, No. 4, 2013* 367

(UNDP, HDI, 2008). HD Report, 2008).retrived on 8/10/2013

Appendix-I

Questionnaire (Qualitative)

Letter of consent

I kindly inform you that this questionnaire is prepare to manage with a research problem to fulfill the basic requirement of Master of Philosophy in Economics. I expect your information will definitely add values in my research purpose; the purity of research findings is strictly based on the correctness of information provided by the respondent. So, request you to contribute first hand information based on your own knowledge, observation and experiences or fact though you have most valuable time.

I would like to assure that all the information that you provide will be strictly used only for the research purpose. I value the privacy regarding information at the maximum extent.

Signature

General Information

Introduction:

Name of Respondent: ..... Age: .....

Education: ..... Occupation: .....

District: ..... ward: ..... Sex: M/F

Marital status: (Married/Unmarried/Divorcee/Single)

Personal Information:

1. What is your name?
2. How old are you now?
3. For how many years do you/your forefathers live here?
4. How many people/family members do you have?
5. What is your profession, or income source?
6. How much do you survive from your income source?
7. Do you have any other income sources?

A. Study Information:

1. Do you see the impacts of climate change in this valley?
2. How much do you see?
3. Rainfall decreased highly or moderately? Snow fall has changed?
4. The water level of the well or pond decreased or not,
5. If so, how much?
6. The sources of water decreased highly or moderately?
7. Trees and grassland decreased or not
8. How is the condition of deforestation and degradation in this valley?
9. What people use for fuel? Wood or any?
10. Cattle or ship farming decreased or not
11. How is the agricultural production?

12. Do you have any experiences the crops damage by insect or any kind of diseases in this valley?
13. The structure of landscape changed or not due to the drought or landslide
14. How is the cultural practice during these periods? Is there any changes have done within 20 years? Such as, dress, local foods and festivals,
15. aspect How is the impact is the cultural much impacted on wild animals
16. If more, on what animals or birds, etc
17. Did your cultural assets hampered by the climate change?
18. If so, how much and how many, in which way ?
19. Due to the climate change your life style has changed?
20. How much changed? With bad? How do you survive ahead?
21. What is the traditional adaptation practices in this valley
22. What about education, health and people migration?
23. What are the employment opportunities for people?
24. How are business conditions?
25. Do the changes in income sources?
26. How is tourism sector?
27. What types of adverse consequences have found in Tsum valley?
28. What are your thinking/or planning to survive your live despite the climate changes?
29. If possible, could you tell me your struggling ways/to fight against the negative impacts of climate change in your life? Or your suggestions.
30. Do you have community alliances and plans to fight against the negative impacts of climate change in your valley?

Thank you !

जलवायु परिवर्तनका कारणले चुम उपत्यकाबासीको सामाजिक, आर्थिक अवस्थामा परेको प्रभाव वारे अध्ययन

(वैशाख ७-२२, २०६९)

सिंघानियाँ युनिभर्सिटि राजस्थान इण्डिया

विधावारिधि अध्ययन

यहाँहरुको सहि र तथ्यगत सुचनाको आधारमा उक्त अध्ययन सम्पन्न गरिनेछ । प्राप्त सुचनाको यस अध्ययन प्रयोजन बाहेक अन्य ठाउँमा विना अनुमति उपयोग गरिने छैन ।

क. व्यक्तिगत जानकारी

१. नाम : .....ठेगाना.....शिक्षा.....

उमेर : .....विवाहित/अविवाहित.. परिवार संख्या.....महिला.....
पुरुष.....

काठमाण्डौ बसेको वर्ष..... हालको पेशा वा व्यवसाय..... आम्दानीको श्रोत.....

ख. चुम उपत्यकाको बारेमा जानकारी

२. कति वर्ष देखि तपाई वा तपाईको परिवार चुम उपत्यकामा बसोबास गरिरहनुभएको छ ?

३. चुम उपत्यकामा तपाई के गर्नुहुन्थ्यो ? पेशा/व्यवसाय.....

४. तपाई वा तपाईको परिवारको आम्दानीको श्रोत के हो ?

५. उक्त आम्दानीवाट परिवारमा कति समयसम्म खान पुग्छ ?

६. यि बाहेक अरु आम्दानीको श्रोतहरु के के छन् ?

ग. अध्ययनसँग सम्वन्धित जानकारी

१. तपाईले यस उपत्यकामा जलवायु परिवर्तनको के कस्तो असर देख्नुभएको छ ?

२. छ भने उक्त असर कतिसम्म देख्नुभएको छ ?

३. वर्षात्को अवस्था कस्तो छ ? धेरै, ठिकै, धेरै कम

४. पानी पधेंरो, कुवा आदिमा पानीको सतह घटेको छ छैन ?

५. यदि घटेको छ भने कति .....?

६. पानीको श्रोत धेरै घटेको छ वा ठिकै ..... सिंचाईको व्यवस्था कस्तो छ ?

७. रुख विरुवा, घाँसेमैदान घटेको छ वा छैन ?

८. घरपालुवा जनावर, भेडा पालन घट्यो वा छैन ?

९. कृषि तथा खेतीपातीमा के फरक परेको छ ?

१०. यदि फरक परेको छ भने कुन बालीमा के फरक परेको छ ?

११. खडेरी वा पहिरोले जमिनको संरचनामा परिवर्तन भएको छ वा छैन ?

१२. जंगली जनावरमा कस्तो असर परेको छ ?

१३. यदि छ भने कुन जानवर वा कुन पंक्षीमा बढि असर परेको छ ?

१४. जलवायु परिवर्तनको कारणले तपाईहरुको साँस्कृतिक सम्पदा (चाडपर्व, नाचगान, लगाउने लुगा, खाना आदिमा कस्तो असर परेको छ ?

१५.यदि छ भने कति छ वा के के मा र कुन तरिकावाट असर परेको छ ?

१६. जलवायु परिवर्तनका कारणले तपाईको जीवनशैली वा रहनसहनमा के परिवर्तन आएको छ ?

१७. छ भने कस्तो के परिवर्तन भयो ? यदि नकरात्मक असर परेको छ भने अव के गर्ने उपाय सोच्नु भएको छ ?

१८. जलवायु परिवर्तनको यस्तो अवस्थामा भविस्यमा आफ्नो जिवनशैली, रहनसहन, खेतीपाती गर्नेबारे के योजना बनाउनु भएकोछ ?

१९. यदि यो संभव छ भने जलवायु परिवर्तनको नकरात्मक प्रभावको विरुद्ध पनि लड्न सक्ने तपाईको तरिका वा सल्लाह बताउन सक्नुहुन्छ ?

२०. यस उपत्यकामा जलवायु परिवर्तनको नकरात्मक असर विरुद्ध लड्ने तपाईहरुको कुनै सामुदायिक एलाइन्स वा योजना छ ?

२१. काठमाण्डौमा बसोबास गर्ने चुमबासीहरुले जलवायु परिवर्तनको प्रभावका कारण आफ्नो जन्मस्थल अर्थात् चुमउपत्यकामा परेको प्रभाव बारेमा के प्रयास गरेको छ ?

२२. मौसम वा जलवायु परिवर्तन भएकै कारण मानिसहरुले गाँउ छोडेर गएको कुनै घटना छन् ? यो क्रम कस्तो छ ?

(PRA) ऐतिहासिक समय रेखा का लागि प्रश्नहरु

क. व्यक्तिगत जानकारी

१. नाम : .....ठेगाना.....शिक्षा.....

उमेर : .....विवाहित/अविवाहित.. परिवार संख्या.....महिला..... पुरुष.....

काठमाण्डौ बसेको वर्ष..... पेशा वा व्यवसाय..... आम्दानीको श्रोत.....

२. कति वर्ष देखि तपाई वा तपाईको परिवार चुम उपत्यकामा बसोबास गरिरहनुभएको छ ?

३. चुम उपत्यकामा तपाई के गर्नुहुन्थ्यो ? पेशा/व्यवसाय.....

ख. तलका हरेक प्रश्नहरुको जवाफ २० वर्ष अघिको चुम्भ्याली र २० वर्ष पछि अहिलेको चुम्भ्यालीको बारेमा देखिएको फरकको आधारमा दिनुहोला ।

४.पहिले चुम्को जनसंख्या : .....महिला.....पुरुष.....घरधुरी संख्या.....

अहिले चुम्को जनसंख्या : .....महिला.....पुरुष.....घरधुरी संख्या.....

५.पहिले शिक्षाको अवस्था : साक्षर.....महिला.....पुरुष.....५ कक्षा सम्म पढेको.....

अहिले शिक्षाको अवस्था : साक्षर.....महिला.....पुरुष.....५ कक्षा सम्म पढेको.....

सो भन्दा माथि.....महिला.....पुरुष.....

६. पहिले चुम्बासिहरु के पोशाक लगाउँथे :
महिला.....पुरुष.....
.....

अहिले

महिला.....पुरुष.....

.

७.पहिले मान्ने चाडपर्वहरु.....

.....

अहिले मान्ने

चाडपर्वहरु.....

८.पहिलेका मुख्य खानेकुराहरु

.....

अहिलेका मुख्य खानेकुराहरु

.....

९.पहिले लगाइने अन्नबालीहरु.....

अहिले लगाइने अन्नबालीहरु.....

१०.पहिलेको खेतीगर्ने

तरिका.....

अहिलेको खेतीगर्ने

तरिका.....

११.पहिलेको खेतीगर्ने समय वा

महिना.....

अहिलेको खेतीगर्ने समय वा

महिना.....

१२.पहिलेको अन्नबालीमा लाग्ने रोगहरु

.....

अहिलेको अन्नबालीमा लाग्ने

रोगहरु.....

१३.पहिले पाइने रुखविरुवाहरु.....

अहिले पाइने रुखविरुवाहरु

.....

१४.पहिलेको हिँउ पर्ने

समय.....

अहिलेको हिँउ पर्ने

समय.....

१५. पहिले पालिने

पशुपालन.....अहिले.....

१६. पहिले बसाइँ सरेर जाने

संख्या.महिला.....पुरुष.....अहिले.महिला.....पुरुष.....

१७. पहिले पिउने पानीको श्रोत के

थियो.....अहिले.....

१८. पहिले लगाइने

सागसब्जीहरु.....अहिले.....

१९. पहिले हुने फलफुलहरु.....अहिले हुने

फलफुलहरु.....

२०. पहिले मानिस बिरामी हुँदा उपचार .....गरिन्थ्यो ।

अहिले .....गरिन्छ ।

२१.पहिलेको बिहेवारी गर्ने चलन

.....अहिले.....

सहयोगको लागि धन्यबाद ।