Local Adaptation Practices of Local People towards Climate Change in Mid-Hills of Nepal

A Case Study of Thotnekhola CFUG, Sarangkot VDC, Kaski, Nepal

A Thesis Submitted to
The Central Department of Rural Development,
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DECLARATION

I hereby declare that the thesis entitled **Local Adaptation Practices of Local People towards Climate Change in Mid-Hills of Nepal: A Case Study of Thotnekhola CFUG, Sarangkot VDC, Kaski, Nepal** submitted to the Central Department of Rural Development, Tribhuvan University, is entirely my original work prepared under the guidance and supervision of my supervisor. I have made due acknowledgements to all ideas and information borrowed from different sources in the course of preparing this thesis. The results of this thesis have not been presented or submitted anywhere else for the award of any degree or for any other purposes. I assure that no part of the content of this thesis has been published in any form before.

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02-12-2073 BS

RECOMMENDATION LETTER

The thesis entitled **Local Adaptation Practices of Local People towards Climate Change in Mid-Hills of Nepal: A Case Study of Thotnekhola CFUG, Sarangkot VDC, Kaski, Nepal** has been prepared by **Mr. Pavindra Shahi** under my guidance and supervision. I hereby forward this thesis to the evaluation committee for final evaluation and approval.

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Date: 22-03-2017 AD

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APPROVAL LETTER

The thesis entitled **Local Adaptation Practices of Local People towards Climate Change in Mid-Hills of Nepal: A Case Study of Thotnekhola CFUG, Sarangkot VDC, Kaski, Nepal** submitted by **Mr. Pavindra Shahi** in partial fulfillment of the requirements for the Master's Degree (M.A.) in Rural Development has been evaluated and approved by the evaluation committee.

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Mr. Pavindra Shahi
CDRD, Kirtipur Campus, March, 2017

ABSTRACT

Study of **Local Adaptation Practices of Local People towards Climate Change in Mid-Hills of Nepal: A Case Study of Thotnekhola CFUG, Sarangkot VDC, Kaski, Nepal** was conducted in Thotnekhola CFUG of Kaski district. The general objective of the study was to assess the adaptation practices and problems occurred during applying it at the local level. The specific objectives were to analyze the situation of Climate Change (in terms of temperature and rainfall), to explore the adaptation measures (in agriculture) used by people and to examine the problems of applied adaptation measures faced by people (with reference to CAPA).

In this study area, out of 153 HHs of the CFUG, 52 HHs were selected with the method of stratified random sampling for the study. And data were collected from field survey using household survey questionnaire, FGD, KII and direct observation tools then tabulate this data and make report through analysis.

Regarding the experience on CC of local inhabitants, 100% respondents have experienced increasing temperature and 94% respondents have experienced unusual rainfall events or decreasing.

Local people are practicing adaptation measures such as plantation and bioengineering against Landslide and Flood, water pond (*Kuwa*) conservation, rain water and kitchen water harvest, crop variety & sowing time change, soil fertility improvement, bedding, agroforestry and technology change against Drought and seed save and occupation change against Hailstone. Only 42% respondents believed on the CAPA can address the problems induced by CC. Like this, only 6 % respondents felt that the CAPA is implemented perfectly and also agreed to the causes of ineffective of CAPA implementation were political instability (35 %), lack of required fund (33 %), non-realistic plan (22 %) and lack of skilled manpower (10 %).

Most of respondents facing problem during practicing adaptation measures against flood, landslide, drought and hailstone was technical problem among financial, technical, material and skilled manpower problems.

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ACRONYMS/ABBREVIATIONS

A.D.	:	After death
ADB	:	Asian Development Bank
AFO	:	Assistant Forest Officer
B.Sc.	:	Bachelor in Science
CAPRi	:	Collective Action and Property Rights
CAPA	:	Community based adaptation plan of action
CARE	:	Cooperative for Assistance and Relief Everywhere
CBOs	:	Community-based organization
CC	:	Climate Change
CDKN	:	Climate and Development Knowledge Network
CDRC	:	Central Department of Rural Development
CFUG	:	Community Forest User Group
CO_2	:	Carbon dioxide
COPs	:	Conference of the Parties
CSOs	:	Civil society organizations
DCEP	:	District Climate and Energy Plan
DFID	:	Department for International Development
DFO	:	District Forest Office
EC	:	European Commission
etc.	:	et cetera
EU	:	European Union
FAO	:	Food and Agriculture Organization
FECOFUN	:	Federation of Community Forestry Users, Nepal
FGD	:	Focus group discussion
GESI	:	Gender and Social Inclusion
GHGs	:	Greenhouse Gases
GLOF	:	Glacial lake outburst flood
GoN	:	Government of Nepal
HHs	:	Households
HMGN	:	His Majesty's Government
ICAO	:	International Civil Aviation Organization
ICIMOD	:	International Centre for Integrated Mountain Development

IOF	:	Institute of Forestry
IPCC	:	Intergovernmental Panel on Climate Change
KII	:	Key informant interview
LAPA	:	Local Adaptation Plan for Action
LDCF	:	Least Developed Countries Fund
MoE	:	Ministry of Environment
NAPA	:	National Adaptation Programme of Action
NGOs	:	Non-governmental Organizations
NRC	:	National Research Council
NTNC	:	National Trust for Nature Conservation
^{o}C	:	Degree Celsius
OECD	:	Organisation for Economic Co-operation and Development
OP	:	Operational Plan
PPCR	:	Pilot Programme for Climate Resilience
R.D.	:	Rural Development
SALT	:	Slopping Agriculture Land Technology
SNC	:	Second National Communication
SPSS	:	Statistical Package for Social Science
TAR	:	Third Assessment Report
TNA	:	Technology Needs Assessment
TU	:	Tribhuvan University
UN	:	United Nations
UNFCCC	:	United Nations Framework Convention on Climate Change
USAID	:	United States Agency for International Development
VDC	:	Village development committee
WFP	:	World Food Program
WWF	:	World Wildlife Fund

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Climate change is a change in the statistical distribution of weather patterns when that change lasts for an extended period of time (i.e., decades to millions of years). CC may refer to a change in average weather conditions, or in the time variation of weather around longer-term average conditions (i.e., more or fewer extreme weather events). (Wikipedia)

CC is caused by factors such as biotic processes, variations in solar radiation received by Earth, plate tectonics, and volcanic eruptions. Certain human activities have also been identified as significant causes of recent climate change, often referred to as global warming (Wikipedia). Anthropogenic greenhouse gas emissions have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever. This has led to atmospheric concentrations of carbon dioxide, methane and nitrous oxide that are unprecedented in at least the last 800,000 years. Their effects, together with those of other anthropogenic drivers, have been detected throughout the climate system and are extremely likely to have been the dominant cause of the observed warming since the mid-20th century (IPCC, 2014).

Climate change is now recognized as one of the most serious challenges facing the world – its people, the environment and its economies (EC, 2008). It is evidence that the average temperatures are increasing, and extreme weather patterns resulted in unprecedented extent and/or frequency of drought, flooding and storm events and these developments are projected to intensify (Meehl and Tebaldi, 2004; Tebaldi et al., 2006, UNFCCC 2007). The most studied climate variable in the context of CC is temperature. Its average value has increased by approximately 0.6 ºC from the end of the nineteenth century. The warmest decade since data have been registered was the 1990s. Average rainfall in the subtropical belt has decreased. Precipitation in the tropics has increased slowly, but a measure of the increase has not been apparent in recent decades. Monitoring data show that the sea level has risen by about 1 to 2 mm per year, with a

mean value of 1.5 mm/year. The best estimates indicate that the Earth could warm by 3° C by 2100. Even if countries reduce their greenhouse gas emissions, the Earth will continue to warm (UNFCCC, 2007).

Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. The period from 1983 to 2012 was likely the warmest 30-year period of the last 1400 years in the Northern Hemisphere, where such assessment is possible (medium confidence). The globally averaged combined land and ocean surface temperature data as calculated by a linear trend show a warming of 0.85 [0.65 to 1.06] °C2 over the period 1880 to 2012, when multiple independently produced datasets exist (IPCC 2014).

CC and its impact on natural and social system are critical issues of equity. Though developing countries have very nominal contribution to the climate change incidences, they face greater negative impacts due to their location towards CC risk and exposure, lower level of capability to resist the impacts and more vulnerable from the incidences (Schneider and et all , 2007) .

Nepal is one of the world's poorest country, with very few industrial emissions but vulnerable to the effects of CC. Nepal is one of the ten most vulnerable developing countries because of its geography, poor physical infrastructure and the low level of development of its social sectors (OECD, 2003). The temperature of the Nepal is increasing rapidly than other countries. Between 1977 and 1994, Nepal's average temperature rose at a rate of 0.03-0.06 Celsius per annum, with a higher rate in the mountains than in lowlands (Shrestha et al. 1999). Also, the evidences show that there is increase of 0.08 degree Celsius per annum in the mountainous region and 0.04 degree Celsius per annum in Terai region of the country. Another report of the Government of Nepal, based on an analysis of the temperatures recorded between 1981 and 1998, shows an increase of it 0.41 degree Celsius per decade (HMGN 2004). Although the analysis is based on data for a relatively short period, it shows that Nepal is warming at a significantly higher rate compared to the global average of 0.74 degree Celsius, recorded in the twentieth century (IPCC 2007). Meanwhile the evidences show considerable convergence on continued warming in the nation , with country averaged mean temperature increases of 1.2°C and 3°C projected by 2050 and 2100 AD (OECD, 2003). In addition to increase in annual averages, extreme temperatures have been observed in

recent years. Both days and nights are becoming warmer, while cool days and nights are becoming less frequent (Baidya et al. 2008). The precipitation extremes show increasing trend in intense precipitation events at most of the stations (Baidya et al. 2008).

Nepal is vulnerable to several types of CC induced natural disasters, including droughts, floods, landslides, windstorms, hailstorms, cold waves, disease epidemics, glacial lake outburst flood (GLOF), fires and earthquakes. The middle Hills are mainly prone to landslides and hailstorms while the Terai region is prone to floods and fire. Windstorms, thunderbolts (lightning strikes) and heavy snowfall also affect many areas of the country on a regular basis, causing loss of human lives and considerable damage to the standing crops (WFP, 2007).

Since the Third Assessment Report (IPCC, 2001), policy-makers and the scientific community have increasingly turned their attention to climate change impacts, vulnerabilities and associated risks that may be considered 'key' because of their magnitude, persistence and other characteristics (Schneider and et all, 2007). Then, the policies and practices have been focusing on the adaptation aspect to address the CC concentrating on reducing the impacts and vulnerability of people induced through its events. Then, vulnerability and adaptation assessments were identified as vital tools for developing countries to evaluate and implement responses to CC (UNFCCC, 2007). In the area and sectors where impact of the CC is critical, the adaptation strategy to respond the CC has proved very important. It can significantly reduce many potentially dangerous impacts of CC and reduce the risk of many key vulnerabilities (Schneider et all, 2007). Thus, adaptation to CC in developing countries is vital and has been highlighted by them as having a high or urgent priority (UNFCCC, 2007).

Globally, mitigation (reduction of greenhouse gas emissions and carbon sequestration) and adaptation (ways and means of reducing the impacts of, and vulnerability to CC) aspect are two major policy dialogue and practices has been undergoing to address the CC issues. According to the UNFCCC, there is a clear difference between mitigation and adaptation. Until recently, UNFCCC negotiations have focused primarily on mitigation; however, it is now clear that objectives of human well-being in the future should be addressed, stressing the importance of adaptation (European Commission, 2008). Also, there are arguments that adaptation to CC and mitigation are often linked together to provide greater benefit to the people (Bernier et al, 2009).

1.2 Statement of the Problem

The purpose of the study is to explore the present situation of CC, applied adaptation measures and problem faced during its implementation. CC is currently one of the greatest threats to environmental conservation and livelihood security. An increased emission of greenhouse gases into the atmosphere is further compounding these problems. The impact of CC can be seen in the study area where people's livelihoods are based on natural resource management like agriculture, livestock, forestry and water.

Changes in global climate pose a number of potential risks to mountain livelihood which ranges from agriculture, livestock, water resource, forest resources, health and sanitation and household assets. Agriculture, upon which society depends for the food, feed, and fiber that enable sustainable livelihoods, is one of the sectors that is most vulnerable to shifts in climate. Livelihoods of forest-based people are projected to be seriously challenged due to CC resulting in loss of land and land productivity. Events such as forest fires, floods, landslides and drought are prominent risks. Forest productivity is important for sustained economic development of communities and regions (NRC, 2010).

Large percentages of the populations of developing countries depend upon natural resources for their livelihoods and development (Ekpo et al., 2012). The adverse effects of CC are already evident in developing countries where population growth, lack of food security, and other socioeconomic factors exacerbate families' vulnerability to impacts.

Thotnekhola CFUG had prepared a CAPA for adaptation against the CC. Local people are facing problems during adopting it. At last, there are many adverse impact of CC in the study area which is not studied in detail here. However, this study has been tried to find out some question's answers which are as follows:

- What is the situation of climate change in the study area?
- What adaptation measures people are using to adapt with climate change?
- What problems people are facing during applying the adaptation measures?

The finding of the research will be directly beneficial to the farmers, researchers, policy makers and institutions identify their local knowledge and practices of livelihoods as a strategy for CC adaptation.

1.3 Objectives of the study

The general objective of the study was to assess the adaptation practices and problems occurred during applying it at the local level.

The specific objectives were:

- To analyze the situation of Climate Change (in terms of temperature and rainfall).
- To explore the adaptation measures (in agriculture) used by people.
- To examine the problems of applied adaptation measures faced by people (with reference to CAPA).

1.4 Significance of the Study

FAO, (2007) points out that agriculture, forestry and fishery are highly sensitive to CC and CC will have a serious impact on their production functions. Nepal covers 0.04% of the world population and its share on greenhouse gas emission is negligible however, Nepal is one of the most vulnerable countries from CC. Its temperature is increasing at alarming rate 0.06°c per annum more than the global average. This phenomenon of CC has directly affected the natural resources like land, water and forest resources. Those people who directly depend on these resources are becoming vulnerable day by day. Temperature observations in Nepal from (1977-1994) show a general warning trend. The temperature differences are most pronounced during the dry winter season, and least during the height of the monsoon. Analysis of recent climatic trends reveals a significant warming trend in recent decades, which has been even more pronounced at higher altitudes. CC scenarios for Nepal across multiple general circulation models meanwhile show considerable convergence on continued warming, with country averaged mean temperature increases of 1.2°C and 3°C projected by 2050 and 2100 (Shreshtha et al.1999).

The significance of this study is to find out the adaptation measures to adapt with CC in the study area. After completion of this study, it will be helpful for student to review literature and community forestry user group of the study area to know about the existing climatic situation of the community forest. The advocates of the local knowledge system presume that the local people of community have a better understanding and insights about the environment and resources surrounding them because of the observations over

years. They might be aware of the aspects of the natural system that a scientist could miss, and this is what has led to an increasing interest in integrating local knowledge with scientific knowledge. The study of present situation of CC, adaptation measures and problems faced during implementation of adaptation measures was not conducted before; this might be baseline for future.

1.5 Limitations of the Study

Every social research is bounded with the limitations. Time and money are the main constraints of research work. It is on academic research for the partial fulfillment of the requirements for the degree of Master of Arts in Rural Development. As the fresh researcher many hardships have been faced in the study. A micro-level study has been done in Thotnekhola Community Forestry of Kaski District. Despite, the various difficulties the study area has been viewed a "holistic approach" and its activities can be understood by an "interdisciplinary approach". However, the study cannot be free from its limitations, which can be shown in terms of some following points:

- The study was completed in the short time duration.
- This study depends upon the collection of the data through interview from the local people.
- The reliability of the data depends upon the local people's memory. However by employing the triangulation techniques were tried to ensure reliability.
- This generalization of this study may or may not be applicable to other parts of the areas. More intensive researches covering the large area should be conducted to generalize the whole Mid-Hills of Nepal.

1.6 Organization of the study

This research report is divided into five chapters to make the study easy, clear and to cover objectives. The first chapter deals with the introduction of the study, statement of the problem, objectives of the study, significance of the study, limitation of the study and organization of the study. The second chapter deals with the review of literature - related to the topic in various document, study reports and various other records in order to explore the issues regarding the topic. The third chapter describes about research methodology. It describes how the data have been collected from the study area for the

research purpose. The collected data have been analyzed using various software like Ms-Excel, SPSS etc. and presented in chapter five under the heading Data Presentation and Analysis. The last chapter summarizes the major findings with some conclusions and recommendations. After that references, questionnaire, checklist, list of key informants, are presented as appendix.

CHAPTER TWO

LITERATURE REVIEW

2.1 Climate Change

CC is increasingly becoming the most influential environmental pressure to human sustainability. A discussion started by a small group of people in 1960s in relation to increasing CO_2 emission to the atmosphere has now drawn global attention and the peoples are forced to take serious actions in curbing emission of CC causing agents, mitigate its impacts, prepare to cope with possible disasters, and adapt to the changes which are unavoidable. The effect of CC is expected to exacerbate through rise in temperature, water scarcities, weather variability and extreme events. CC is a natural process but the all these changes are side effects of human activities, particularly through the increase of carbon dioxide and other gases and aerosols put into the atmosphere. Many scientific studies have shown that it is impossible to stop impacts of CC, most importantly various known-unknown effects of GHGs, which are already emitted to the atmosphere and have life of many decades. These facts provide evidence that CC is a now seen as concern of every human being, which may need many decades and even centuries to stabilize or to return in harmless state (ICIMOD, 2009).

We chose global warming, sometimes known as the "greenhouse effect" or as "global climate change", it is widely recognized as one of the most important issues on the current international environmental agenda. IPCC (2007) concluded that the evidence for warming of the global climate is 'unequivocal' based on observed climate data across the world. Current projections estimate that the increase in global temperature by the end of this century will range from 1.8 - 4.0^0C, predominantly depending on the level of future greenhouse gas emissions. CC affects the entire globe. It is evidence that the average temperatures are increasing, and extreme weather events are frequent, and frequency of drought, flooding and storm events and other climate induced disaster are projected to intensify (UNFCCC 2007). These consequences of CC are evolving rapidly. Recent studies suggest that the impacts of CC may be even more severe and more rapid than those reported by the IPCC in 2007 (Practical Action, 2008). It is believed that most global warming is attributable to emissions of greenhouse gas that result from human

activities, in particular land use changes such as deforestation particularly from developing countries, and the burning of fossil fuels specifically from developed countries. As a result of global warming, frequency and intensity of extreme events, such as tropical cyclones (hurricanes and typhoons), floods, droughts and heavy precipitation events are occurring and rise even with relatively small average temperature increases (UNFCCC, 2007).

CC is the real threat across the world mainly in developing countries, and is an on-going and emerging challenge. There is a growing consensus that human activities are contributing to unprecedented warming of the earth's atmosphere. However, the cause of CC and its consequences are still debated among scientific community and yet to be a complex phenomenon to understand well. The nature and intensity of CC impacts in different sectors like agriculture, forestry, and human health might differ throughout the world. In most of the developing countries the issues of CC are overshadowed by immediate development priorities (Halsnae *et. al*, 2007). This may be due to poverty and as the government programmes focus on basic needs and sustaining livelihood.

Though, Nepal has negligible global share (0.025 %) in GHGs emission (MoPE, 2004), it is highly vulnerable to CC due to fragile landscape, poverty and diverse climate. Nepal is ranked as 4th most vulnerable country in the world by the CC Risk Atlas 2010 and top ten countries most likely to be impacted by global CC (WFP, 2009). More than 4,000 people died in Nepal over the last ten years in climate induced disasters, which caused economic losses of USD 5.34 billion. Every year more than 1 million people are directly impacted by climate-induced disasters such as drought, landslides and floods in the mid- and far-west Nepal. CC might induce similar events with increased frequency in the future (Uprety, 2011). Hence, the above evidences justified that Nepal is a climate vulnerable country and has to develop adaptive capacity.

According to IPCC (2001), there has been unprecedented warming trend during 20th Century, the current average global surface temperature of 15^{o}C is nearly 0.6^{o}C higher than it was 100 years ago, and most of these increase is due to human activities. IPCC estimated that the global temperature will most likely to increase by up to 3.5°C by 2100 (IPCC, 2007). And, over the last twenty-five years, the temperature in Nepal has also been increasing at the rate of 0.06^{o}C per year (GoN, 2008), and is projected that the

temperature will be increased by another 1.2 ^{o} C by 2030, 1.7 ^{o} C by 2050, and 3.^{O}C by 2100 (ADB, 2009).

The debate over CC has now reached a stage where all but most extreme contrarians accept that, whatever happens to future green-house gas emissions, we are now locked into inevitable changes to climate patterns. Studies show that Himalayan glaciers have been melting at unprecedented rates in recent decades. Most of the glacial lakes in the Himalaya have appeared within the last five decades, and the region has faced devastating consequences as a result of such floods (Bajracharya et al. 2006).

The average annual rainfall of Kaski district is around 3876 mm with fluctuating pattern for total of 29 years between 1985 and 2013 A.D. and the trend seems to be decreasing. Minimum average annual temperature of the district is the range of 0.5°C to 5.5°C. In last 29 years the yearly maximum average temperature has been varied from 33°C to 37.4°C with fluctuating pattern. The trend of maximum and minimum temperatures in recent years has been observed to be in increasing and decreasing respectively which shows some anomalies in climate status. (DCEP, Kaski 2016).

2.2 Adaptation Measures

In the TAR of IPCC, adaptation and vulnerability were defined, types of adaptation were identified, and the role of adaptive capacity was recognized (Smit et al., 2001). Notable developments that occurred since the TAR include insights on: a) actual adaptations to observed climate changes and variability; b) planned adaptations to CC in infrastructure design, coastal zone management, and other activities; c) the variable nature of vulnerability and adaptive capacity; and d) policy developments, under the UNFCCC and other international, national and local initiatives, that facilitate adaptation processes and action programmes (Adger et al., 2005; Tompkins et al., 2005; West and Gawith, 2005). Since, then the concept of adaptation has been focus on the CC responses. The concepts of it have been defined variously by different experts.

Adaptation is defined as adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2007).

Adaptation is processes through which societies make themselves better able to cope with an uncertain future. Adapting to climate change entails taking the right measures to reduce the negative effects of climate change (or exploit the positive ones) by making the appropriate adjustments and changes (UNFCCC, 2007).

Adaptation to CC encompasses broad term including vulnerability to CC risks and adaptive capacity of system to adjustment (Rodledo et all, 2005). In summary, the concept of adaptation includes following variables:

- It is adjustment of the system to climate change incidences
- It reduces the exposure to the climate change risks
- It promotes the resiliency of the system to negative impact
- It reduces negative impacts from climate change events and increase beneficial opportunities
- It removes or prevents mal-adaptation practices: Mal-adaptation refers to adaptation measures that do not succeed in reducing vulnerability but increase it instead (UNFCCC, 2007).
- It is decision making process for better alternatives to cope with negative impacts: Another important adaptation strategy is economic diversification within sectors to reduce dependence on climate-sensitive resources (UNFCCC, 2007).

Adaptation is necessary to deal with adverse climatic stresses and hazards and to take the opportunities such as new innovations, which can be both to current, actual or projected conditions (Smit *et al.* 1999). So, there are two broad components on adaptation: coping and adapting with adverse impacts happening at short and longer term and benefiting from the favorable situations. The ultimate goal of adaptation is to build long term resilience of communities so that they are capable of sustaining their livelihoods even in extreme shocks and stresses. However, the concept of adaptation as such is not new; life has come through different adjustments biologically and behaviorally and successful struggle for existence, modifications and survival of the fittest (Charles and Wallace 1859).

Locally and globally, both governments and non-governmental organizations respond to CC. Some of these efforts focus on mitigating the effects of CC while others aid societies

in adapting their life styles to changes in their environment. Most policy responses in the late 20th and early 21st century either did not focus on the social effects of CC or did not consider gender in these efforts (Roehr, 2007).

The approaches include strategies within agriculture such as raising awareness of CC, community based climate monitoring and forecasting, changing planting dates, crop varieties, or cropping patterns and implementing water harvesting or irrigation schemes are some adaptation approaches in agriculture to reduce the impacts of CC (CAPRi, 2010). Successful adaptation not only depends on governments but also on the active and sustained engagement of stakeholders including national, regional, multilateral and international organizations, the public and private sectors, civil society and other relevant stakeholders.

Adaptation is associated with planned action, either anticipating a threat or averting its impacts and infers some measure of progress or consistency of response (FAO, 2007). Adaptation is not simply a matter of designing projects or putting together lists of measures to reduce the impacts of CC. Adaptations contribute to the fitness and survival of individuals. It is generally agreed that effective adaptation strategies should reduce present vulnerability as well as future vulnerability to CC. 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. Many actions that facilitate adaptation to CC are undertaken to deal with current extreme events.

In recent years, adaptation has become a key focus of the scientific and policy-making communities and is now a major area of discussion in the multilateral CC process (NAPA/MOE, 2010). Nepal considers NAPA as a solid foundation for the implementation of most urgent and immediate adaptation options. The Government of Nepal will make every effort to implement the prioritized adaptation actions effectively with enhance participation of stakeholders and climate vulnerable people (MOE, 2010). In these context, preparation and implementation of local level plan is very crucial. Adaptation to the adverse effects of CC is vital in order to reduce the impacts of CC that are happening now and increase resilience to future impacts. Adaptation involves actions that communities and individuals can undertake in response to changing systems.

Significant co-benefits, synergies and trade-offs exist between adaptation and mitigation and among different adaptation responses; interactions occur both within and across regions and sectors (very high confidence). For example, investments in crop varieties adapted to CC can increase the capacity to cope with drought, and public health measures to address vector-borne diseases can enhance the capacity of health systems to address other challenges. Similarly, locating infrastructure away from low-lying coastal areas helps settlements and eco-systems adapt to sea level rise while also protecting against tsunamis. However, some adaptation options may have adverse side effects that imply real or perceived trade-offs with other adaptation objectives (Table 2.1 for examples), mitigation objectives or broader development goals. For example, while protection of ecosystems can assist adaptation to CC and enhance carbon storage, increased use of air conditioning to maintain thermal comfort in buildings or the use of desalination to enhance water resource security can increase energy demand, and therefore, GHG emissions (IPCC 2014).

USAID funded a five years (2011-2016) Hariyo Ban Programme had implemented by four core partners: WWF, CARE, NTNC, and FECOFUN in kaski district. It worked on three core interwoven components – biodiversity conservation, sustainable landscapes and CC adaptation – with livelihoods, governance, and GESI as cross cutting themes. This Hariyo Ban programme is implementing in Kaski district for upcoming five years (2017-2021)
(http://www.wwfnepal.org/hariyobanprogram/hariyo_ban_program_publications/?292733/Hariyo-Ban-Program-I-Factsheet#).

Table 2.1: Examples of potential trade-offs associated with an illustrative set of adaptation options that could be implemented by actors to achieve specific management objectives

Sector	Actor's adaptation objective	Adaptation option	Real or perceived trade-off
Agriculture	Enhance drought and pest resistance; enhance yields	Biotechnology and genetically modified crops	Perceived risk to public health and safety; ecological risks associated with introduction of new genetic variants to natural environments
	Provide financial safety net for farmers to ensure continuation of farming	Subsidized drought assistance; crop insurance	Creates moral hazard and distributional inequalities if not appropriately administered
	Maintain or enhance crop yields; suppress opportunistic agricultural pests and invasive species	Increased use of chemical fertilizer and pesticides	Increased discharge of nutrients and chemical pollution to the environment; adverse impacts of pesticide use on non-target species; increased emissions of greenhouse gases; increased human
Biodiversity	Enhance capacity for natural adaptation and migration to changing climatic conditions	Migration corridors; expansion of	Unknown efficacy; concerns over property rights regarding land acquisition; governance challenges
	Enhance regulatory protections for species potentially at risk due to climate and non-climatic changes	Protection of critical habitat for vulnerable species	Addresses secondary rather than primary pressures on species; concerns over property rights; regulatory barriers to regional economic development
	Facilitate conservation of valued species by shifting populations to alternative areas as the climate changes	Assisted migration	Difficult to predict ultimate success of assisted migration; possible adverse impacts on indigenous flora and fauna from introduction of species into new ecological regions
Coasts	Provide near-term protection to financial assets from inundation	Sea walls	High direct and opportunity costs; equity concerns; ecological impacts to coastal wetlands
	Allow natural coastal and ecological processes to proceed; reduce long-term risk to property and assets	Managed retreat	Undermines private property rights; significant governance challenges associated with implementation
	Preserve public health and safety; minimize property damage and risk of stranded assets	Migration out of low-lying areas	Loss of sense of place and cultural identity; erosion of kinship and familial ties; impacts to receiving communities
Water resources management	Increase water resource reliability and drought resilience	Desalination	Ecological risk of saline discharge; high energy demand and associated carbon emissions; creates disincentives for
	Maximize efficiency of water management and use; increase flexibility	Water trading	Undermines public good/social aspects of water
	Enhance efficiency of available water	Water recycling/reuse	Perceived risk to public health and safety

Source: IPCC (2014) Synthesis Report

2.3 Climate Change Related Policies in Nepal

Nepal has been responded climate change policies in international and national level. Nepal signed the UNFCCC in Rio de Janeiro in June 1992. Since then, Nepal has been regularly participating in COPs and other subsidiary meetings. It also became party of Kyoto Protocol by submitting its instrument of Accession on September 16, 2005.

The Government of Nepal has approved NAPA in 2010, Climate Change Policy in 2011, and National Framework on LAPA in 2011 as major guiding policy instruments to mainstreaming CC activities in general, and CC adaptation in particular. Other activities are 'Strengthening Capacity for Managing Climate Change and the Environment', and are implementing PPCR. The Ministry is preparing the SNC report and Technology Action Plan under its TNA Project for submitting to UNFCCC. Similarly, in between 2007 and 2009, Nepal has prepared action plan related to capacity building under the National Capacity Needs Self-Assessment Project in particular the capacity enhancement for 3 Rio Conventions (UNFCCC, UN Convention to Combat Desertification and Convention on Biological Diversity). The Ministry is now engaged in implementing NAPA prioritized projects with support from DFID and EU, and LDCF. Similarly, CDKN has supported Nepal to implement knowledge generation and communication activities, climate negotiations and economic impact assessment of CC in key sectors. These programmes, projects and activities support to implement NAPA, LAPA and Climate Change Policy in broader sense.

2.4 Problems of Applying Adaptation Measures

Vulnerability to CC, GHG emission and the capacity for adaptation and mitigation are strongly influenced by livelihoods, lifestyles, behaviour and culture (medium evidence, medium agreement). Also, the social acceptability and/or effectiveness of climate polices are influenced by the extent to which they incentivize or depend on regionally appropriate change in lifestyles or behaviours.

For many regions and sectors, enhanced capacities to mitigate and adapt are part of the foundation essential for managing CC risks (high confidence). Improving institutions as well as coordination and cooperation in governance can help overcome regional constraints associated with mitigation, adaptation and disaster risk reduction (very high confidence).

Adaptation experience is accumulation acroos regions in the public and private sectors and within communities. There is increasing recognition of the value of social (including local and indigenous), institutional, and ecosystem-based measures and of the extent of constrains to adaptation, Adapration is becaming embedded in some planning process, with more limited implementation of responses (high confidence).

The need for adaptation along with associated challenges is expected to increase with CC (very high confidence). Adaptation options exist in all sectors and regions, with diverse potential and approached depending on their context in vulnerability reduction, disaster risk management or proactive adaptation plannig. Effective strategies and actions consider the potential for co-benefits and opportunities within wider strategic goals and development plans.

Adaptation and mitigation responses are underpinned by common enabling factors. These include effective institutions and governance, innovation and investments in environmentally sound technologies and infrastructure, sustainable livelihoods and behavioural and lifestyle choice.

Adaptation and mitigation are constrained by the inertia of global and regional trends in economic development, GHG emmissions, resource consumption, infrastructure and settlement patterns, institutional behaviour and technology (medium evidence, high agreement). Such inertia may limit the capacity to reduce GHG emmissions, remain below particular climate thresholds or avoid adverse impacts (Table 2.2). Some constraints may be overcome through new technologies, financial resources, increased institutional effectiveness and governance or changes in social and cultural attitueds and behaviours. (IPCC, 2014)

Table 2.2: Common factors that constrain the implementation of adaptation options

Constraining Factor	Potential Implications for Adaptation
Adverse externalities of population growth and urbanization	Increase exposure of human populations to climate variability and change as well as demands for, and pressures on, natural resources and ecosystem services
Deficits of knowledge, education and human capital	Reduce national, institutional and individual perceptions of the risks posed by CC as well as the costs and benefits of different adaptation options
Divergences in social and cultural attitudes, values and behaviours	Reduce societal consensus regarding climate risk and therefore demand for specific adaptation policies and measures
Challenges in governance and institutional arrangements	Reduce the ability to coordinate adaptation policies and measures and to deliver capacity to actors to plan and implement adaptation
Lack of access to national and international climate finance	Reduces the scale of investment in adaptation policies and measures and therefore their effectiveness
Inadequate technology	Reduces the range of available adaptation options as well as their effectiveness in reducing or avoiding risk from increasing rates or magnitudes of CC
Insufficient quality and/or quantity of natural resources	Reduce the coping range of actors, vulnerability to non-climatic factors and potential competition for resources that enhances vulnerability
Adaptation and development deficits	Increase vulnerability to current climate variability as well as future CC
Inequality	Places the impacts of CC and the burden of adaptation disproportionately on the most vulnerable and/or transfers them to future generations

Source: IPCC (2014) Synthesis Report

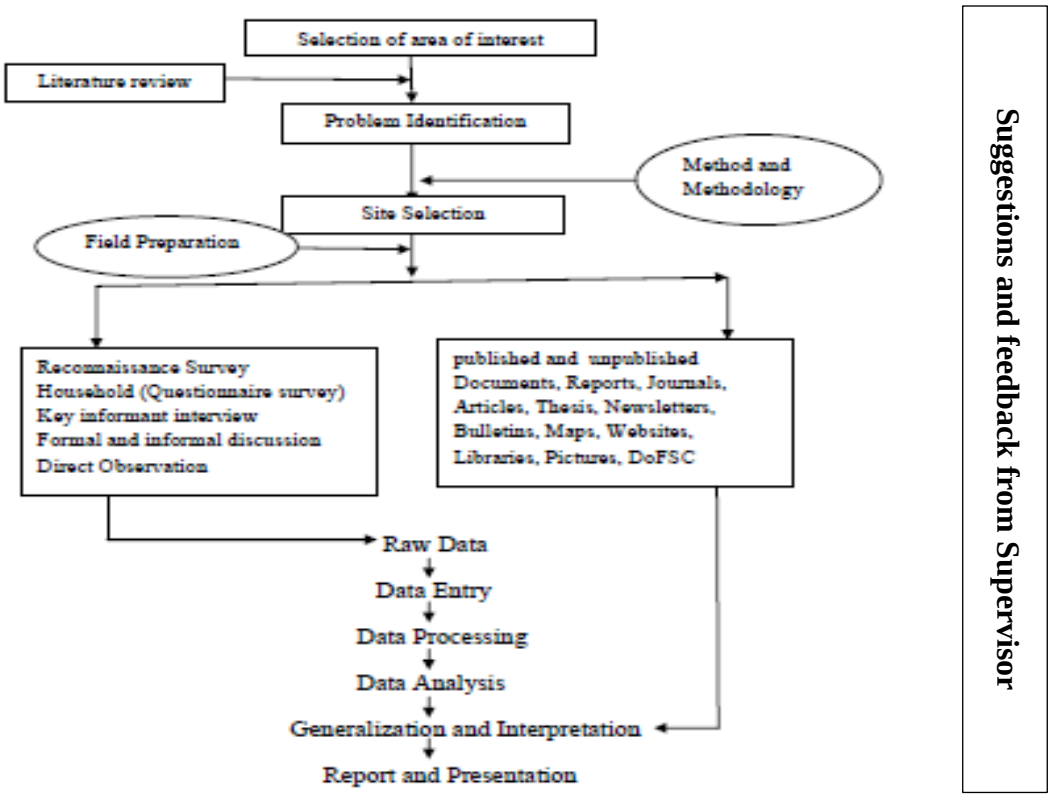
CHAPTER THREE

RESEARCH METHODOLOGY

This chapter deals briefly with the research methodology applied in the study. This is purely academic research based in social science. The major content of this chapter include: Research design, rational for the selection of the study area, nature and source of data, population sample and sampling procedure, techniques & tools of data collection and data analysis.

3.1 Research Design

First of all the interested area of study was selected. Then the literature about the study area was collected and problem was identified. Appropriate methods and methodology was identified and site was selected for doing the research. Then primary data was obtained from the field survey while secondary data were collected from published and unpublished literatures. Then data was analyzed using both primary and secondary data using statistical tools like SPSS and Ms-Excel. After interpretation was done after the analysis and report was prepared. Flow chart of Research Design is given below.



3.2 Rational for the selection of the study area

The selection of the study area is one of the critical issues while undertaking research work. The rationales for selecting this site are:

- Kaski district has been ranked as very high vulnerable in Temperature and Rainfall sub-indices and Ecological Sensitivity sub-indices by CC Vulnerability mapping for Nepal in 2010.
- The area is situated in the foot of Machhapuchre Himal and also lies within the area of Seti-River watershed where impacts of CC were considered to be serious but no similar study was conducted previously.
- CAPA of Thotnekhola CFUG has been prepared which helps in analysis of the problems of adaptation measures faced by people.

3.3 Nature and Sources of Data

To perform this research, required data were collected by two major approaches as secondary data and primary data collection. Secondary data were collected from Operational Plan, Constitution and CAPA of the respective CFUG, and other relevant published and unpublished documents of different organizations. Climatic Data of temperature and precipitation was obtained from Department of Hydrology and Meteorology. Furthermore, information was also collected from related websites and journals. Like this the primary data were collected from KII, FGD, HH survey and direct field observation.

3.4 Population Sample and Sampling Procedure

There are total 153 user members in the Thotnekhola CFUG. Stratified random sampling method was used for sample. In this sampling process, two key persons (Chairperson of CFUG and secretary of FECOFUN Kaski) of the Thotnekhola CFUG were involved with the researcher.

3.5 Techniques and Tools of Data Collection

In this study following tools were used for the purpose of data collection. This study is mainly based on the primary data.

3.5.1 Household Survey

Among the 153 HHs of the selected CFUGs, a total of 52 HHs (34%) representing different socioeconomic and ethnic composition was selected as sampled HHs for the HH survey. A semi-structured questionnaire (Annex 1) was developed and used for the household survey in order to gather information about people's perceptions towards CC and its impacts on agriculture and natural resources use and local adaptation measures practiced by HHs to adapt from CC. It also helps to know the problems faced by people during applying adaptation measures. Generally the middle age and oldest people were interested to respond the questionnaire in household interview. They were enthusiastic to share their experiences.

3.5.2 Focus Group Discussion

Focus group discussions were conducted to supplement and triangulate information gathered from the household interviews and other sources. A checklist for FGD (Annex 2) was used and 12 CFUG user members from different sex, education, ethnicity and occupations were selected for group discussions.

3.5.3 Key Informant Interview

Knowledgeable persons including chairperson of the CFUG and secretary of FECOFUN Kaski were selected as key informants and they were interviewed on the basis of a KII checklist (Annex 3) for situation of CC, its impacts, adaptation practices and problems during applying the adaptation measure.

3.5.4 Direct Field Observation

On the basis of a checklist (Annex 4), direct field observations and simultaneous discussion with the local people about bio-physical phenomena (landslide, water resources, and flood) were made by researcher through transect walk in order to observe the impacts of CC and local adaptation measures. Important observed information was noted.

3.5.5 Data Analysis

The primary and secondary data were analyzed both qualitatively and quantitatively. The data collected from HHs survey were then coded, categorized and fed into the computer

for analysis. The data were logically interpreted along with tables, charts and graphs. Frequency tables were generated for general information. SPSS and Microsoft- Excel work sheets were used to analyze the information. The recorded temperature and precipitation data of Sarangkot VDC nearby station from Pokhara airport were taken for the period of 30 years were obtained from Department of Hydrology and Meteorology was used for compare with result of this research.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

This chapter contains the results presented based on the objective of the study. And also this chapter is organized into five different sections (4.1) overview of the study area, (4.2) Socio-economic profile of the respondents, (4.3) situation of CC, (4.4) local adaptation measures and (4.5) problems faced by local people during applying adaptation activities. It also deals with the previous study linking with the result of this research.

4.1 Overview of the Study area

Sarangkot VDC is located in the center part of Kaski district near to Pokhara; a famous tourism city of Nepal, driving of half an hour from Pokhara which lies in western Nepal within 28°14′30″ north, 83°58′0″ east and 980 m - 1740 m above sea level, and thus there is a large variation in terms of forest types and agricultural potential within the VDC. In the area, all of the users practice farming of crops such as rice, millet, maize, wheat and potatoes, vegetables and fruits like this rearing livestock such as cattle, buffaloes, goats and poultry. Sale of crops and livestock products takes place within and outside of the community. Most of the HHs does agriculture for their livelihoods.

Table 4.1: Detail description of CFUG Household

Ethnicity	**Well-being ranking**				
	Ka	**Kha**	**Ga**	**Total No.**	**Total %**
Dalit	0	2	13	15	10
Janajati	1	20	38	59	39
Brahmin	13	20	18	51	33
Chhetri	2	11	13	26	17
Organization	1	1	0	2	1
Total No.	17	54	82	153	
Total %	11	35	54		

(Source: OP of Thotnekhola CFUG, F.Y 2071/072-2080/081)

HHs level data were collected from the Thotnekhola CFUG considering that their spatial and socioeconomic characteristics were representative of the VDC which lies in ward no.

9. The total area of the community forest is 81.5 ha. The tree species like Katus, Chilaune, Mauwa, Utis, Bagle, Nigalo are found in this community forest. The total number of HHs involve in CFUG is 153 (Table 4.1). The map of the study area is attached in Annex 5.

4.2 Socio-Economic Characteristics of the Respondents

The socio-economic characteristics of the respondent are presented in this section (Table 4.2). The total number of respondents taken here is 52. Among them, 48% of respondents were male and 52% of respondents were female. 37% of the respondents were Brahmin, 19% of the respondents were Chhetri, 35% of the respondents were Janajati and 10% of the respondents were Dalit.

Majority of the respondents are literate (83%) and 17% falls under illiterate. Among the literate, 38% of the respondents have primary level education, 23 % have higher education and 21% of the respondents have above higher education.

Most of the respondents have agriculture as their occupation which is 83% and respondents following non-agriculture occupation are 17%. According to operational plan of CFUG about well-being ranking (Ka, Kha and Ga), 21% of the respondents fall under 'Ka' category of Well Being Ranking, 31% fall under 'Kha' category and 48% fall under 'Ga' category.

Majority of the respondents (35%) have no any land except their house. Respondents having land less than 1 ropani is 10%. 29% of the respondents have 1-4 ropani land. Respondents' having more than 4 ropani land is 27%.

Table 4.2: Socio-economic characteristics of the respondents

Variables	Categories	No. of Respondents			% of Respondents
		Male	Female	Total	
Sex	Male			25	48
	Female			27	52
Age	< 40	6	10	16	31
	> 40	19	17	36	69
Ethnicity	Brahmin	12	7	19	37
	Chhetri	3	7	10	19
	Janajati	9	9	18	35
	Dalit	1	4	5	10
Education	Illiterate	3	6	9	17
	Primary	8	12	20	38
	Higher Secondary	7	5	12	23
	> Higher secondary	7	4	11	21
Occupation	Agriculture	22	21	43	83
	Non-agriculture	3	6	9	17
Well-being ranking (record of CFUG)	Ka			11	21
	Kha			16	31
	Ga			25	48
Land Size (in Ropani)	Nil			18	35
	< 1			5	10
	1-4			15	29
	> 4			14	27

(Source: Field Survey, 2017)

4.3 Situation of the Climate Change

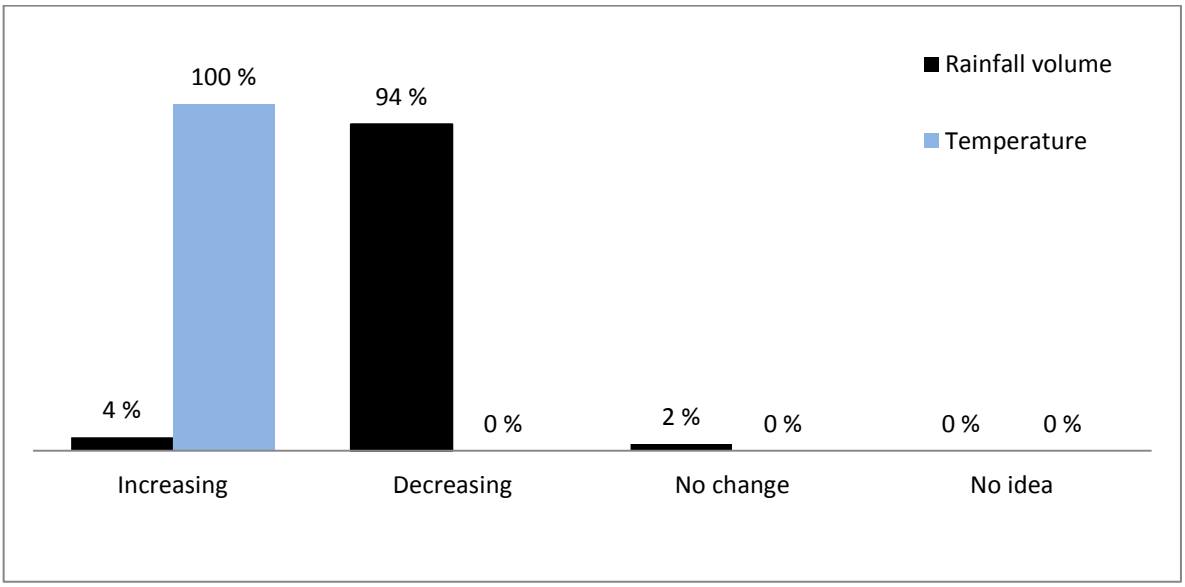
4.3.1 Change in Temperature and Rainfall Pattern

In this study, people have been asked whether they have felt any changes in temperature and rainfall pattern. Most of the respondents reported that there is change in the temperature and rainfall volume for the period of last 30 years.

Local people are experiencing the change in seasonal temperature compared to previous years. The figure 4.1 shows that all of the respondents (100%) said that there is increase in the temperature than the previous years and majority of the respondents (94%)

reported that there is decrease in the volume of rainfall than the previous years whereas 4% of the respondents said that there is increase in the volume of rainfall in compare to previous years. But 2% of the respondents felt no any change in rainfall volume.

Figure 4.1: Changes in temperature and rainfall volume

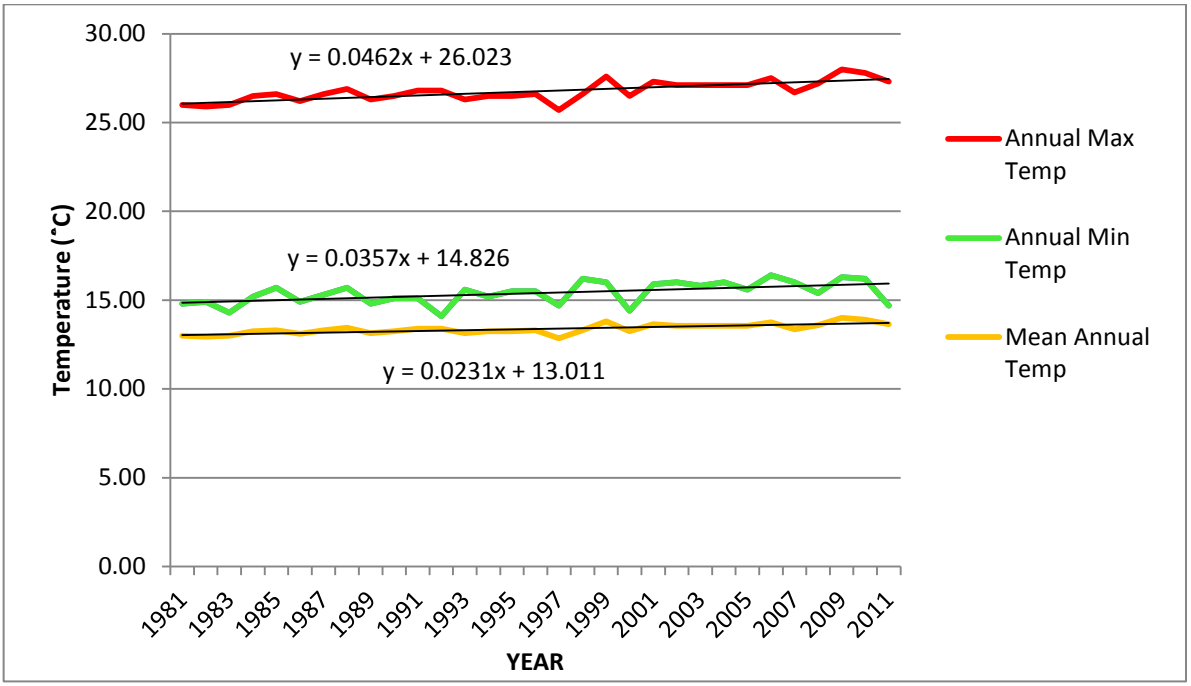


(Source: Field Survey, 2017)

This study shows that the temperature is in increasing trend and rainfall volume is in decreasing trend which matches with the meteorological data (Figure 4.2 and Figure 4.3 respectively).

The recorded data of weather station in Pokhara airport showed (Figure 4.2) that the Maximum, Mean and Minimum mean temperature increased at the rate 0.046^{o}C, 0.035^{o}C& 0.035 ^{o}CYr-1. The figure showed that the lowest maximum temperature was recorded 25.70 ^{o}C in 1997 and highest maximum temperature was 28.00 ^{o}C in 2009. Similarly, the minimum lowest temperature was recorded 14.10 ^{o}C in 1992 and minimum highest temperature was recorded 16.40 in 2006.

Figure 4.2: Temperature trend



(Source: Department of Hydrology and Meteorology, 2013)

The various studies conducted also showed the temperature is increasing in increasing trend ie According to Baral (2009), the perception of the respondents from Jyarukot VDC of the Myagdi District on the warming trend coincided with the local meteorological data which depicted that the mean annual temperature was increasing with the trend of 0.062 ºC.

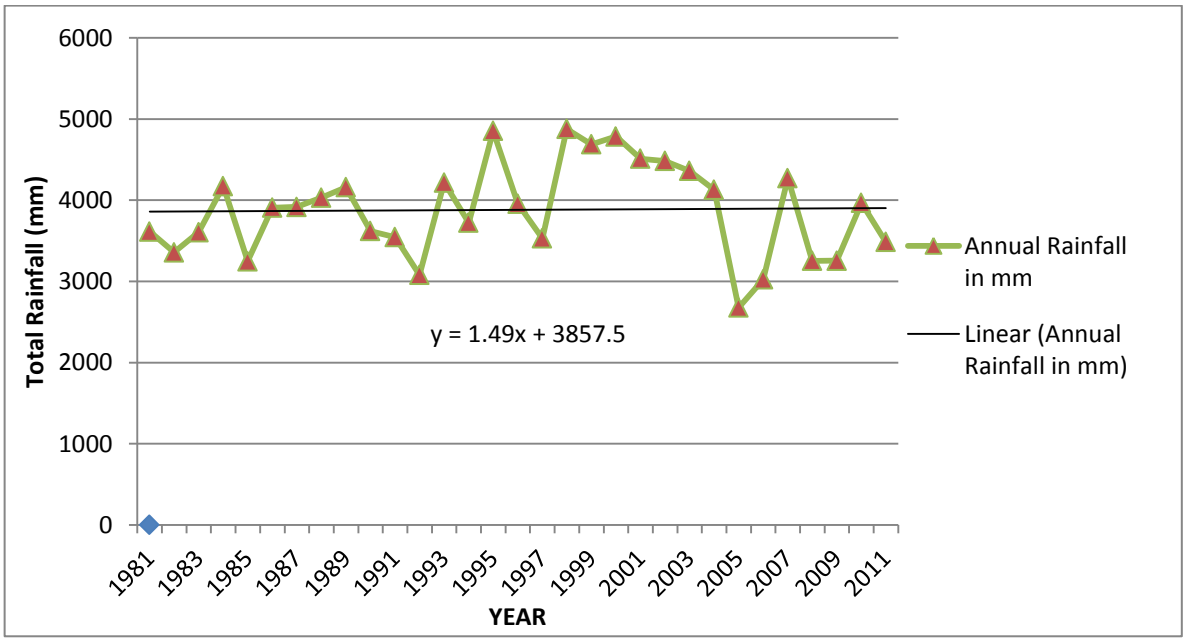
Shrestha (2014) also found in Chhosar VDC of Mustang district that the perception of local people coincide with recorded temperature trend ie increasing trend of mean annual maximum temperature, mean annual minimum temperature and mean annual temperature increased by 0.145, 0.141 and 0.136 ºC Yr-1. Tiwari et al. (2010) also found that During the period of 30 years (1979 - 2008) the mean annual temperature has increased by 0.03oCyr-1.

The findings are in line with Shrestha et. al (1999) who found an estimated increase in mean annual temperature by 0.06 degree centigrade during 1977 to 1994, and the National Adaptation Plan of action (NAPA, 2010) has projected the possible increase in temperature by 1.2 degree centigrade by 2030, 1.7 by 2050 and 3.0 by 2100 in Nepal.

(Hijioka et al. 2014) has described in IPCC annual report of Asia that increasing numbers of warm days and decreasing numbers of cold days have been observed with the

warming trend continually into the new millennium. Increasing annual mean temperature trends at the county scale in East and South Asia have been observed during the 20th century.

Figure 4.3: Rainfall Trend



(Source: Department of Hydrology and Meteorology, 2013)

The analysis of recorded rainfall data (Figure 4.3) found that the Precipitation is erratic and has shown increasing trend of 1.49 mm/year. The annual total rainfall was highly fluctuate that the lowest rainfall year was 2005 with only 2677.10 mm of annual rainfall and 1998 was the year with maximum (4879 mm) Annual rainfall.

Gauchan (2009) found that the precipitation trend in Lete VDC of Mustang District - erratic and increasing at the rate of 0.7 mm yr-1.

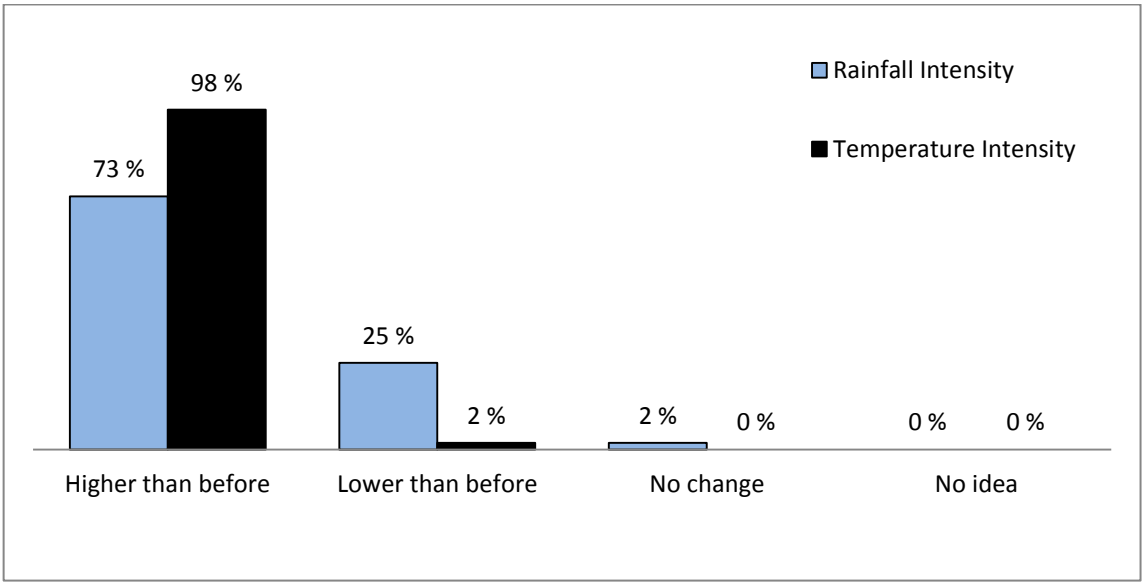
Similarly, Rapid study of Chitwan Annapurna Landscape (ChAL) conducted by WWF Nepal in 2013 found that 80% the communities have experienced an increase in water stress due to decrease in rainfall and delay by 15 to 20 days in monsoon arrival. Similarly, erratic rainfall and uneven distribution of rainfall were other common observation of local people.

4.3.2 Change in Temperature and Rainfall Intensity

The study shows that majority of the respondents (98%) said that there is higher intensity of temperature than previous years where as 2% of people responded that the intensity of

temperature is lower in compare to previous years. Respondents said that the incidence of rainfall is decreasing and they feel less cold during the winter than they used to do. In the past, before the winter sun was experienced mild and they can stay outside all day, but they feel that sun is so scorching hot in recent years. They also said that the heat in summer is increasing and winter is warmer. This evidence revels that local people agree that there is an increase in seasonal temperatures in the study sites. Figure 4.4 shows about the change in the intensity of temperature and rainfall.

Figure 4.4: Change in temperature and rainfall intensity



(Source: Field Survey, 2017)

In case of the rainfall intensity, 73 % of the people responded that there is higher intensity of rainfall than the previous years. 25% of the respondent said that there is lower intensity of rainfall than before and 2% responded that there is no any change in the rainfall intensity. Additionally all respondents reported rainfall variability with untimely, late monsoon start, no winter rain and high intensity pattern with short periods. They agreed on the shifting of the rainy season with the rainfall now starting only during the first week of July while it should start from about the third week of June. Similarly they observed that the winter precipitation season in this area was from January to March. However, it has now stopped during this period and the number of days is decreasing and the intensity is unpredictable even if it does happen.

4.4 Local Adaptation Measures against Climate Change

People were asked if they have applied any adaptation activity against the different problems of hazards induced by CC. Majority of the respondents (94%) said that they are applying adaptation activity whereas 6% of respondents said that they are not applying any adaptation activity.

The potential impacts of CC are distinctly observed, but local people are using very limited coping strategies to minimize the effect on their livelihood from CC impact. However, local people have been using some traditional methods of adoption for generations based on indigenous knowledge and innovations.

Among the people who are applying adaptation activities were again asked about the activities they are applying against the problem of hazard induced by CC. Following (Table 4.3) are the adaptation activities people were practicing for the problem induced by hazards.

Table 4.5: Adaptation practices in study area

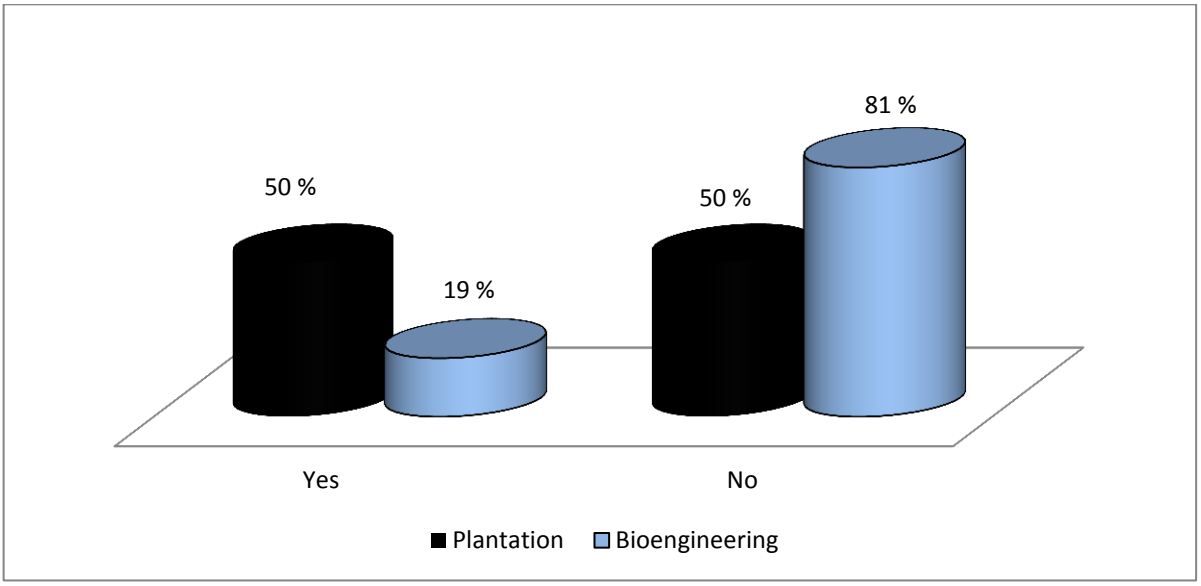
Hazard	Adaptation activities
Landslide and Flood	Plantation, Bioengineering
Drought	Water pond (*Kuwa*) conservation, rain water and kitchen water harvest, change technology, crop variety & sowing time, soil fertility improvement
Hailstone	seed save, occupation change, Bedding, Agroforestry

(Source: Field Survey, 2017)

4.5.1 Adaptation Measures against Landslide and Flood

Plantation and Bioengineering are practicing by local people as adaptation measures against landslide and flood (Figure 4.5). Among the total respondents, 50% and 19% are practicing plantation and bioengineering respectively. Like this, 50% and 81% responded that they are not practicing plantation and bioengineering respectively.

Figure 4.5: Adaptation measures against Landslide and Flood



(Source: Field Survey, 2017)

4.5.2 Adaptation Measures against Drought

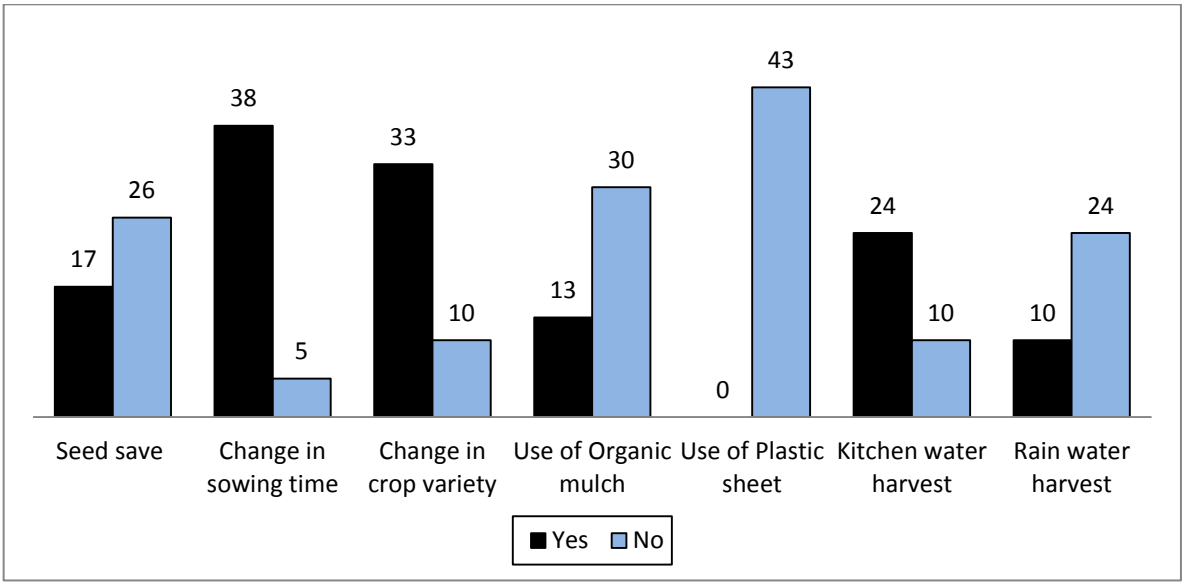
About 83% of the total respondents are involved in agriculture in this study area. Nowadays, their crop production is decreasing day by day due to drought.

Before 3 years, they had prepared a CAPA and they had planned some solutions for this problem which idea/adaptation activities are as saving seed, changing crop sowing time and variety, using organic mulch and plastic sheet, kitchen water harvest, rain water harvest, etc.

Figure 4.6 show that among the respondents are practicing adaptation activity for the problem induced by drought, the respondents 17 are saving seed, 38 are changing sowing time, 33 are changing crop variety, 13 are using organic mulch, 24 are harvesting kitchen water and 10 are harvesting rain water. But no one is using plastic sheet.

Like this soil fertility improvement is one option for increasing crop production. Among the total respondents having agriculture occupation, only 7 respondents are practicing soil fertility improvement as adaptation activity. The respondents practicing bedding, agroforestry and chemical fertilizer are 1, 1 and 5 respectively but no one is practicing SALT.

Figure 4.6: Adaptation measures against drought



(Source: Field Survey, 2017)

In my study area, it was found that people had changed the crop sowing time as well as crop variety. People used to sow rice before in *Asar* and now they are sowing in *Shrawan*. Similary, they used to sow maize in *Falgun* and now they are sowing in *Chaitra*. Like this, they have also changed the crop variety of rice from *Marsi* to *Jethobudo* and *Gurdi*. They are using local variety of maize nowadays.

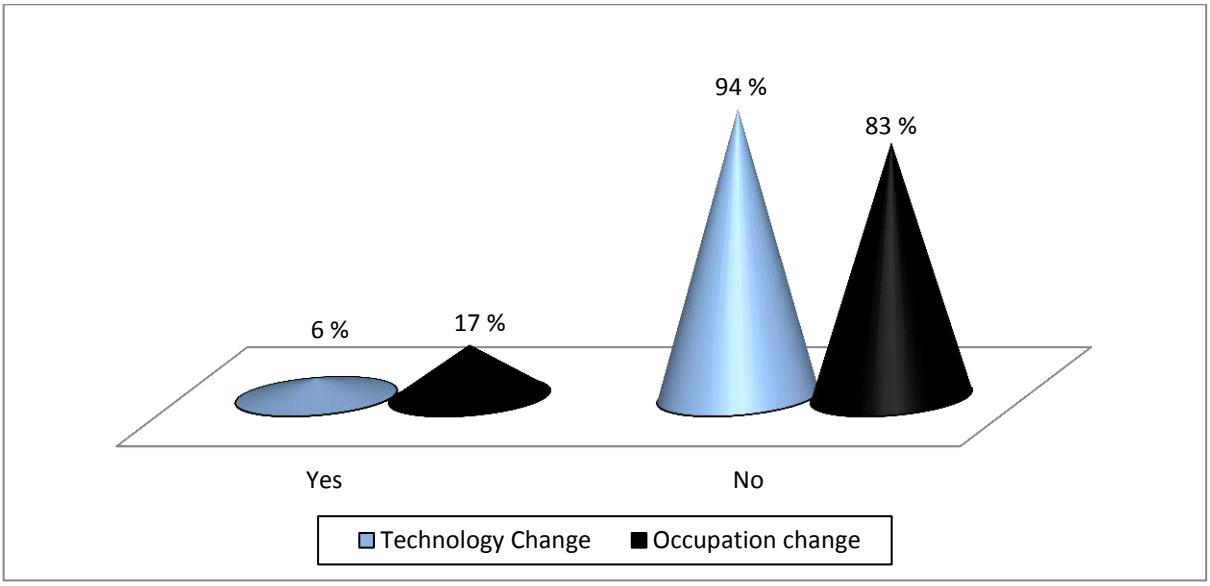
Bhatta (2011) found that decrease in water has decreased significantly affected irrigation in the local area; people have travelled farther way from previous source to get water. And the hybrid and improved varieties of crops are planted by displacing local varieties, because of lengthening of drought period, change in rainfall pattern which effects reducing the productivity of local varieties.

4.5.3 Adaptation Measures against Hailstone

According to the CAPA of the study area, some individuals were applying new technology amd change their occupation to secure their livelihood from the problems induced by CC.

Among the total respondents only 6% have changed the technology regarding agriculture and water management. Like this only 17% have changed their occupation from agriculture to hotel and abroad (Figure 4.7).

Figure 4.7: Adaptation practices against hailstone



(Source: Field Survey, 2017)

4.5 Problems of Adaptation Measures

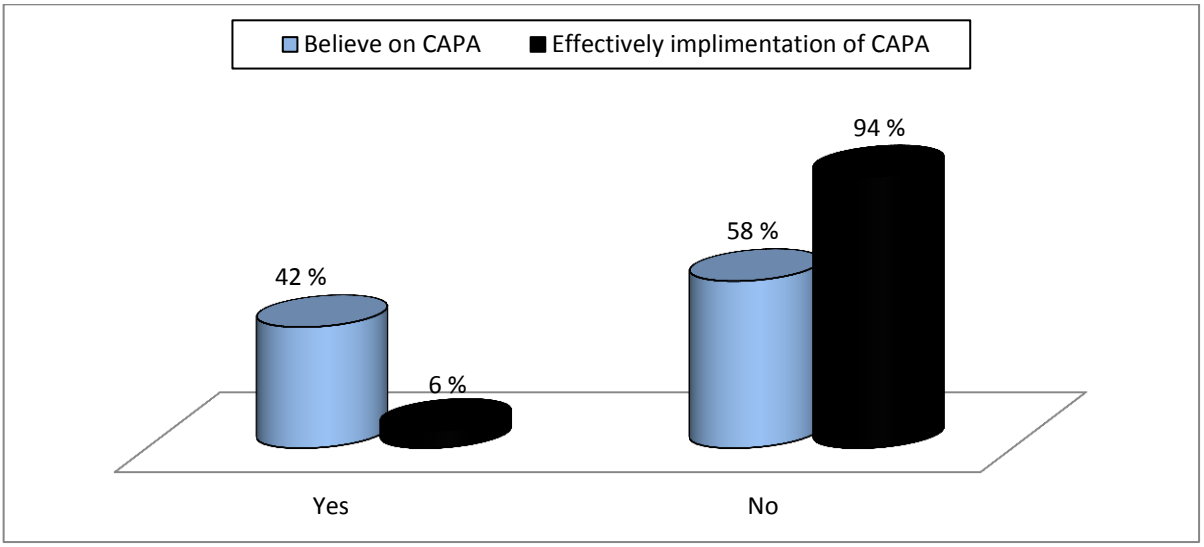
In my study, 54% have problem of information, 15% have problem of access, 29% have problem of governance and 2% have problem of idea to getting support from helping agencies. Like this, 34.6 % of the respondent said that local government should be responsible, 25 % responded national government should be responsible, 34.6% responded they themselves should be responsible and 5.8% said they have no idea regarding the responsible for addressing the CC induced problem.

This section is trying to identify the problems which have seen during applying those adaptation options. Identified problems of the study area are described here with data.

4.5.1 Perception towards CAPA and its implementation

Among the total respondents, majority of the respondents (58%) don't believe in CAPA whereas 42% of the respondents believe in CAPA. And 94 % of the respondents responded that the CAPA has not been implemented effectively but only 6% of respondents said that CAPA has been implemented effectively (Figure 4.8).

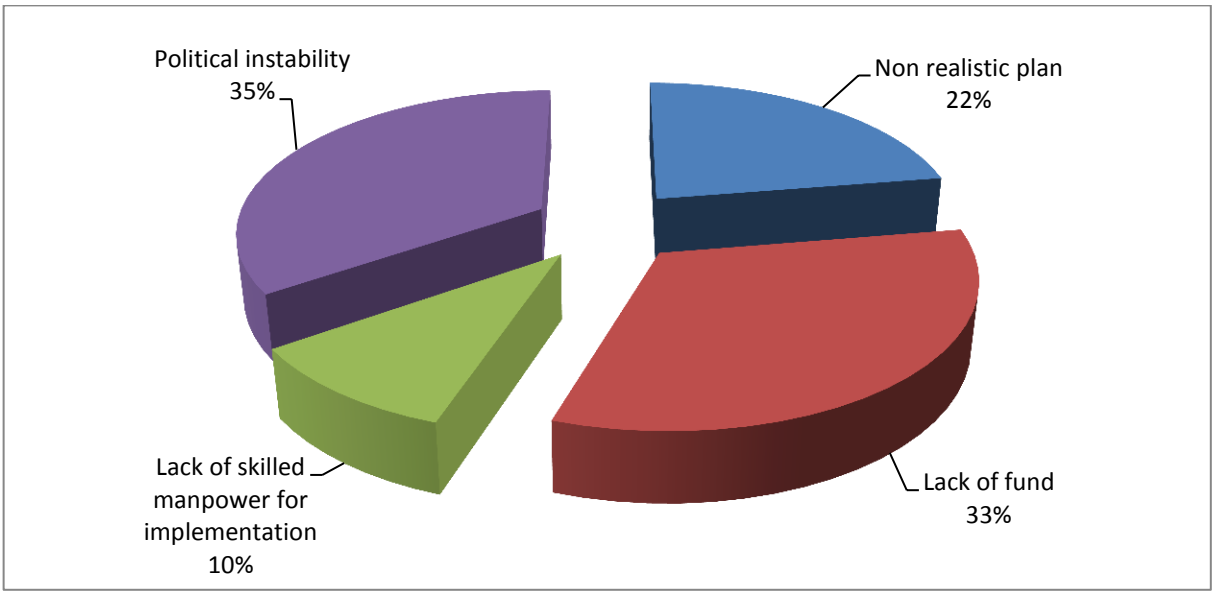
Figure 4.8: Believe in CAPA and its effectiveness of implementation



(Source: Field Survey, 2017)

Like this, among the respondents who have said that CAPA has not been effectively implemented were again asked for the reason behind ineffective implementation (Figure 4.9). Most of the respondents (35%) said due to political instability, 33% responded due to lack of fund, 22% responded that it is non-realistic plan and 10% responded due to lack of skilled manpower, CAPA has not been effectively implemented.

Figure 4.9: Reason for ineffective implementation of CAPA



(Source: Field Survey, 2017)

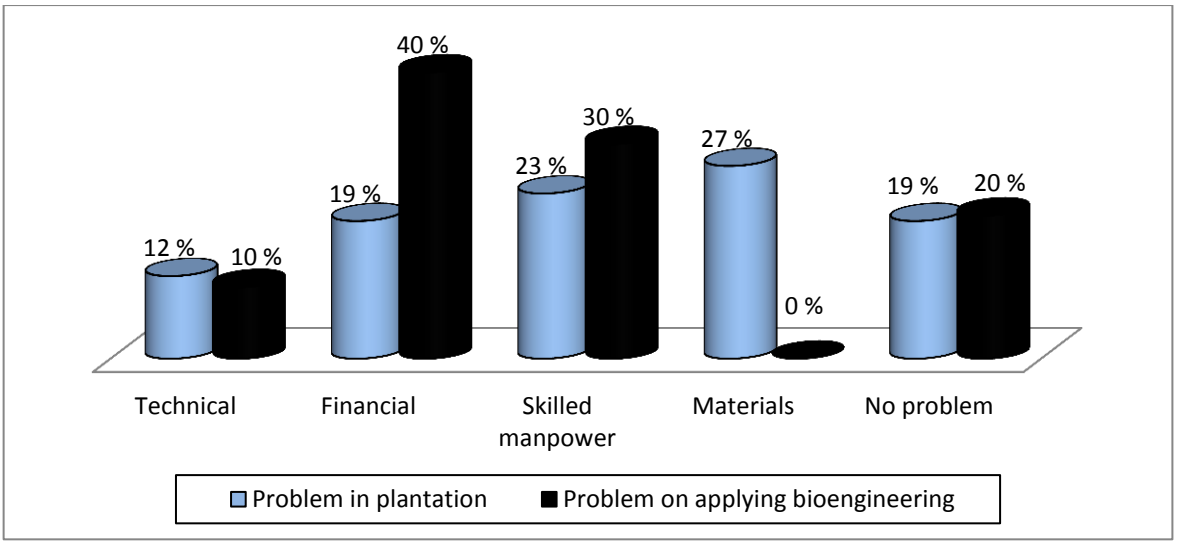
4.5.2 Problems of Adaptation Measures against Flood and Drought

In the study area, people who are practicing adaptation activities for landslide and flood hazards are facing different types of problems like technical, financial, material and skilled manpower.

The Figure 4.10 show that while practicing plantation, 12% people faced technical problem, 19% faced financial problem, 23% faced problem of skilled manpower and 27% have material problem. 19% said that they have no any problem in plantation.

Likewise, in bioengineering 10% faced technical problem, 40% faced financial problem and 30% faced skilled manpower problem. There is no any problem for 20% respondents while applying bioengineering.

Figure 4.10: Problems faced by people in plantation and bioengineering



(Source: Field Survey, 2017)

4.5.3 Problems of Adaptation Measures against Drought

4.5.3.1 Problems on agriculture

It was found that people of the study area had practiced different type of adaptation measures in agriculture (Figure 4.11). While practicing it, they had faced different problems like technical, financial, skilled manpower and material.

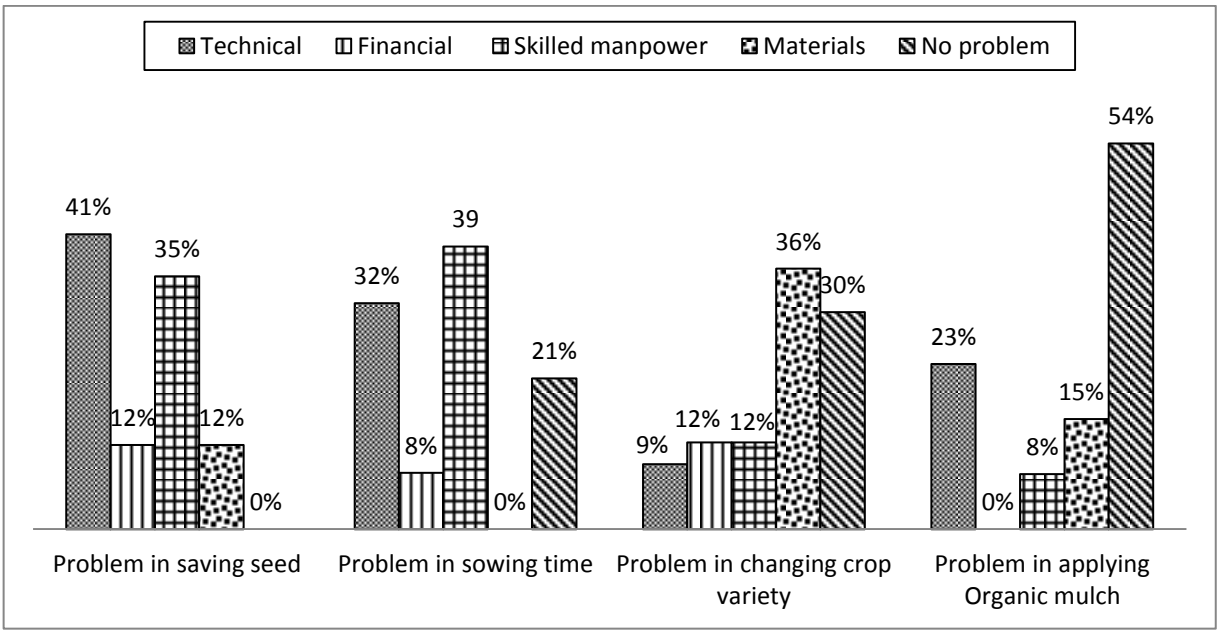
During saving seed, 41% of respondents faced technical problem, 12% of respondents faced financial problem, 35% of respondent faced skilled manpower problem and 12% of respondent faced material problem.

People of the study area also faced problem in sowing time. 32%, 8% and 39% of the respondents faced the problem of technical, financial and skilled manpower respectively. 21% of respondents responded that they have no any problem in sowing time. Change in rainfall season and change in ripening time of the crops are the main problems that people are facing due to which they have changed the sowing time of crops.

Changing crop variety is also one of the adaptation measures people are practicing in agriculture and they had faced different problem. 9%, 12%, 12% and 36% of respondents had faced technical, financial, skilled manpower and material problem respectively. 30% of respondents had no any problem in changing crop variety.

During applying organic mulch, 23% faced technical problem, 8% of respondents faced skilled manpower and 15% of respondents faced material problem. 54% of respondents faced no any problem.

Figure 4.11: Problems faced during applying agriculture related adaptation practices



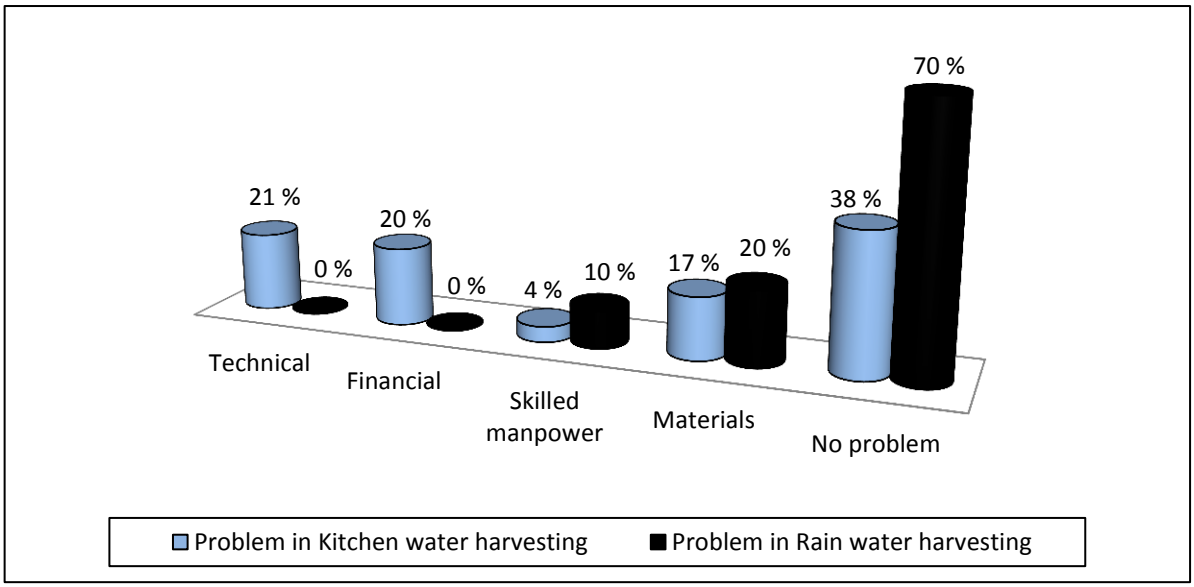
(Source: Field Survey, 2017)

4.5.3.2 Problems on water management

During rain water harvest, 21% of respondents faced technical problem, 20% faced financial problem, 4% faced skilled manpower problem and 17% faced material problem. 38% of respondents had no any problem during rain water harvest.

Like this, problem faced by the people in the study area during kitchen water harvest were skilled manpower and material problem. 10% of respondents faced problem of skilled manpower and 20% faced material problem. There was no problem of technical and financial for them. 70% of respondents responded that there was no any problem in kitchen water harvest.

Figure 4.12: Problems faced during applying water management related adaptation practices



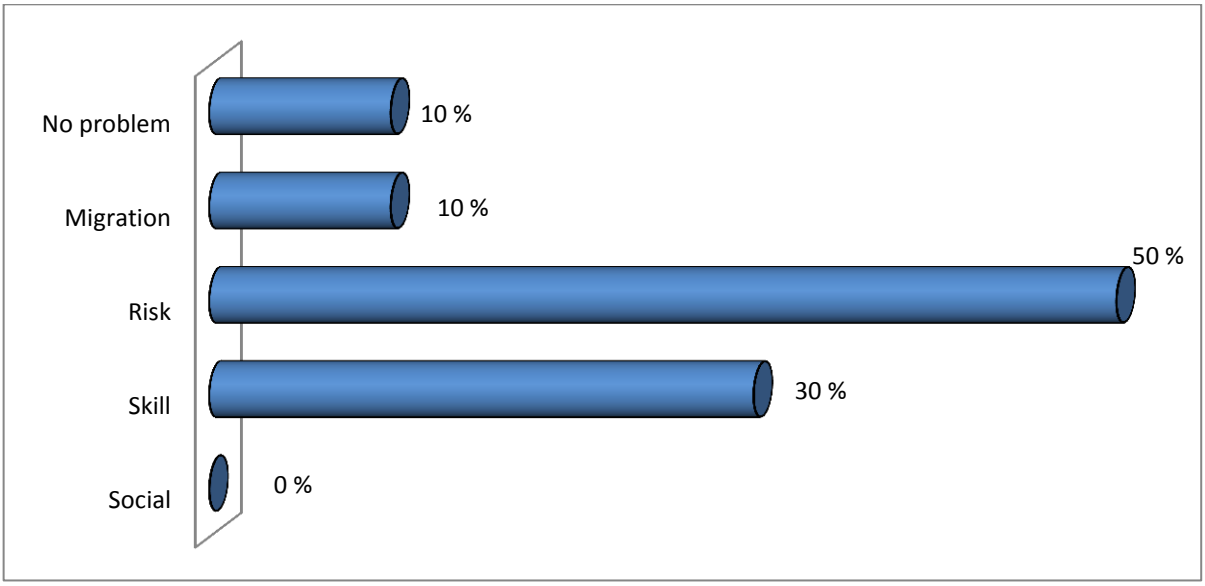
(Source: Field Survey, 2017)

4.5.4 Problems of Adaptation Measures against Hailstone

In my study area, all of the people who are adopting new technology are facing only technical problem. They didn't face any problem in financial, material and skilled manpower.

But in the context of adopt new occupation (Figure 4.13), majority of the respondents (50%) who has adopted new occupation have the problem of risk which is then followed by skill (30%) and 10% of the respondents have problem of migration. 10% of respondents have no any problem in adopting new occupation. In my study area, there is no any social problem in adopting new occupation.

Figure 4.13: Problems in changing occupation



(Source: Field Survey, 2017)

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

Study of Local Adaptation Practices of Local People towards Climate Change in Mid-Hills of Nepal: A Case Study of Thotnekhola CFUG, Sarangkot VDC, Kaski, Nepal was conducted in Thotnekhola CFUG of Kaski district. The general objective of the study was to assess the adaptation practices and problems occurred during applying it at the local level. The specific objectives were to analyze the situation of Climate Change (in terms of temperature and rainfall), to explore the adaptation measures (in agriculture) used by people and to examine the problems of applied adaptation measures faced by people (with reference to CAPA).

In this study area, out of 153 HHs of the CFUG, 52 HHs were selected with the method of stratified random sampling for the study. And data were collected from field survey using household survey questionnaire, FGD, KII and direct observation tools then tabulate this data and make report through analysis.

Regarding perception about CC, the study found that temperature was increased and rainfall volume was decrease than the previous 30 years were responded by 100% and 94% of people respectively but 2% of the people felt no any change in rainfall volume. 98% people for temperature and 73 % people for rainfall reported that the intensity of temperature and rainfall were increased but 2% responded that there is no any change in the rainfall intensity.

Adaptation measures were practicing by 94% of people of the study area. 50% and 19% people were practicing plantation and bio-engineering respectively as adaptation measures against flood and landslide. There were 17 individuals were saving seed, 38 were changing sowing time, 33 were changing crop variety, 13 were using organic mulch, 24 were harvesting kitchen water and 10 were harvesting rain water against drought. People were practicing bedding, agroforestry and chemical fertilizer against drought were 1,1 and 5 individuals respectively but no one is practicing SALT.

Problems faced by people while practicing adaptation measures were facing different type of problems like technical, financial, material and skilled manpower. People practicing plantation were found to have 12% technical, 19% financial, 27% material problems and 23% have problem of skilled manpower as well as 19% said that they have no any problem in plantation. In bioengineering, 10%, 40%, 20% and 30% of people faced technical, financial, no any problem and manpower problems. 100% respondents have technical problem in changing the technology. Like this, 50%, 30%, 10% and 10% of the people have risk, skill, no any problem and migration problems respectively and no any social problem for adopting new occupation. During saving seed, 41%, 12%, 35% and 12% of respondents had faced the problems of technical, financial, skilled manpower and material respectively. 32%, 8% and 39% of the respondents had faced the problem of technical, financial and skilled manpower respectively and 21% of people responded that they have no any problem in sowing time change. 9%, 12%, 12% and 36% of respondents had faced technical, financial, skilled manpower and material problem respectively and 30% of respondents had no any problem in change crop variety. During applying organic mulch, 23%, 8% and 15% faced technical, skilled manpower and material problems but 54% of respondents faced no any problem. 21%, 4% and 17% people faced technical, problem and skilled manpower problems respectively but 38% people had no any problem during rain water harvest. There was no problem of technical and financial problems in kitchen water harvest but 10% and 20% people faced skilled manpower and material problems respectively and 70% people have no any problem.

Only 42% of people believed in CAPA and 94 % people realized that CAPA has not been implemented effectively. The reasons of ineffective implementation of CAPA were political instability, lack of fund, non-realistic plan and lack of skilled manpower were responded by 35%, 33%, 22% and 10% of the people respectively.

5.2 Conclusion

People of the study area were aware about the CC. All people of the study area were realized the temperature was increased and rainfall volume was decreased. And the intensity of both temperature and rainfall was increased. People have been suffering from different problems induced by natural hazards as Landslide, Flood, Drought and Hailstone to be in 1st, 2nd, 3rd and 4th priority respectively as harmful hazards of this area. Like this, children are more vulnerable than elder and young.

Regarding the adaptation measures, more than 90% local people were practicing adaptation measures against the hazards such as plantation and bioengineering against flood and landslide; water pond (Kuwa) conservation, rain water & kitchen water harvesting, change the crop variety, change the technology, change the sowing time and soil fertility improvement (using bedding, SALT, agroforestry, chemical fertilizer) against drought and save seed & occupation change against the hailstone.

People are facing problems like changes in sprouting and ripening time of crops; number of hot days have been increased ever than before; new types of vector's like Mosquito and epidemic; habitat shifting of plants and animals; increased diseases in plants and animals; soil erosion and dried up and decreased of water sprouts and sources. So, local people are practicing different adaptation measures to minimize the effect on their livelihood from CC induced problem. Specially technical problems was the main problem among technical, financial, lack of martials, lack of fund and lack of skilled manpower problems during practicing different adaptation measures.

5.3 Recommendations

Well-coordinated, quick and serious implementation of CAPA will be extremely important to adapt to the growing impacts of CC in this area. More improved technology, training and awareness to the farmers, promotion of green house for growing vegetables and short rotational crops are recommended to combat with the risk associated to CC. Crop and livestock insurance mechanism should be established and functioned to secure the investment of farmers to secure the livelihoods. Mitigation measures such as plantation, new technologies like biogas, improved cooking stoves, solar energy generation for heating and cooking, etc. which ultimately reduce the CC impacts should be prioritized in the local level.

More focused should be given to make adaptation strategy of CC in local area which should be mainstreaming with regular development process. And CC issues should be addressed as a key political and development concern. Local level institutions, networking, capacity building should be developed for information collection, documentation, sharing for future adaptation. All prepared plan of CC adaptation should be implemented with strong ownership of local community and technical and financial support should be provided from supporting organizations.

There is need for focused efforts to promote conservation and sustainable use of scarce resources such as water, biodiversity, forests, and grasslands. This can be attained through sustained efforts to increase awareness, prudence and efficiency in the use and management of natural resources in this area, and by implementing specific measures for adaptation and mitigation.

For the academic recommendation, (i) research is required on changing life style of the people in relation to CC, production and productivity of crops and income generating activities and direct impact in health and (ii) research is also required what type of problems (with depth study) faced by local people during practicing adaptation measures in terms of technical, financial, materials and skilled manpower problems.

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Annex 1

A Checklist for House Hold Survey

Form No. .....

Date .....

Q.No.	Questions	Answer options
Section 1: Household Characteristics		
1.1	Full Name of the Respondent:	
1.2	Sex:	Male ( ) Female ( )
1.3	Age of the respondent:	…….. years
1.4	Address of respondent:	**District**: Kaski **VDC**: Sarangkot **Ward**:… Tole: ……
1.5	Education of the respondent	illiterate ( ) Primary school ( ) higher secondary ( ) > higher secondary ( )
1.6	Occupation of the respondent:	
1.7	Well-being ranked as CFUG:	Ka ( ) Kha ( ) Ga ( )
1.8	Total Land Holding Size	Bari..... ropani and Khet..... ropani
1.9	Who is the head of the family?	Name:- Male ( ) / Female ( ) Occupation: ……..
1.10	Contact No of the respondent	
Section 2: Situation of Climate Change (Rainfalls and Temperature)		
Rainfalls		
2.1	Have you ever felt some uncertainties and **changes in rainfall pattern** between since last 30 years and before 30 years?	Yes ( ) No ( )
2.1.1	What is change in **amount/volume of rainfall** since last 30 years?	Increasing ( ) Decreasing( ) No change( ) No idea( )
2.1.2	What is change in **intensity of rainfall** between since last 30 years and before 30 years?	Higher( ) Lower( ) No change( ) No idea( )
Temperature		
2.2	Have you ever felt any **changes in temperature** since last 30 years?	Yes ( ) No ( )
2.2.1	If yes, how you know about these changes? (Multiple answers).	a. Changes in **sprouting and ripening time** of crops ( ) b. No of **hot days** have been increased ever than before ( ) c. New types of vector's like **Mosquito and epidemic** has been observed ( ) d. **Habitat shifting** of plants and animals has been observed ( ) e. **Increased diseases** in plants and animals ( ) f. **Dried up** and decreased water sprouts and sources ( ) g. If any other……..
2.3	What type of changes do you feel in **climate** since 30 years?	Hotter than before ( ) Cooler than before ( ) No change ( ) No idea ( )
2.4	**Intensity of radiation/sun** light since last 30 years?	Higher ( ) Lower ( ) No change ( ) No idea ( )
2.5	Any extreme events of rainfall and temperature in your experiences?	•

<table>
<tr><td></td><td></td><td>•
•
•</td></tr>
<tr><td colspan="3">Section 3: Climate Change Vulnerability</td></tr>
<tr><td>3.1</td><td>Are there any hazards (flood, drought and landslides, etc.) occurred in the past 30 years?</td><td>Yes ( ) No ( ) No Idea ( )</td></tr>
<tr><td>3.1.1</td><td>If yes, can you remember it?
<table>
<tr><th>S. N.</th><th>Events</th><th>Year/Month (B.S)</th><th>Loss</th></tr>
<tr><td>1</td><td>Landslide</td><td></td><td></td></tr>
<tr><td>2</td><td>Flood</td><td></td><td></td></tr>
<tr><td>3</td><td>Drought</td><td></td><td></td></tr>
<tr><td>4</td><td>Hailstone</td><td></td><td></td></tr>
</table></td><td></td></tr>
<tr><td>3.2</td><td>Do you know any injury or death because of natural disasters since 30 years?</td><td>Yes ( ) No ( )</td></tr>
<tr><td>3.2.1</td><td>If yes, how much they were? (in number)</td><td>Human …….. Livestock …….. Wildlife …..</td></tr>
<tr><td>3.3</td><td>How long does it take you to get to a health facility?</td><td>.....hours</td></tr>
<tr><td>3.4</td><td>Who are more vulnerable due to climate change in your community?</td><td>Children ( ) youths ( ) Elders ( ) (Why? …… ….)</td></tr>
<tr><td>3.5</td><td>Which hazard is most harmful for you? Rank it.</td><td>Landslide ( ) Flood ( ) Drought ( ) Hailstone ( )</td></tr>
<tr><td>3.6</td><td>Did you receive any kind of help through relatives or friends or organizations?</td><td>Yes ( ) No ( )</td></tr>
<tr><td>3.7</td><td>Did you borrow any money through relatives or friends?</td><td>Yes ( ) No ( )</td></tr>
<tr><td>3.8</td><td>Are there any institutions (GOs& NGOs) that help to CC adaptations in your locality?</td><td>Yes ( ) No ( )</td></tr>
<tr><td>3.9</td><td>If yes, Name of organizations' Activities on CC adaptation.</td><td>(a) ..
(b) ..
(c)</td></tr>
<tr><td>3.10</td><td>Any additional idea regarding climate change vulnerability?</td><td></td></tr>
<tr><td colspan="3">Section 4: Adaptation measures</td></tr>
<tr><td>4.1</td><td>Are you carrying out the adaptation activities?</td><td>Yes ( ) No ( )</td></tr>
<tr><td>4.1.1</td><td>If yes, what adaptation practices are currently used to deal with hazards identified? Are they working?
<table>
<tr><th>Climate hazards</th><th>Adaptation activities</th><th>Effectiveness with detail descri</th></tr>
<tr><td rowspan="2">Landslide</td><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td rowspan="2">Flood</td><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td rowspan="2">Drought</td><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td rowspan="2">Hailstone</td><td></td><td></td></tr>
<tr><td></td><td></td></tr>
</table></td><td></td></tr>
<tr><td>4.2</td><td>Does your family save seeds to grow the next year? Yes ( ) No ( )</td><td>Why do you save or do not? …..</td></tr>
<tr><td>4.3</td><td>Is there a practice of aforestation/reforestation</td><td>If yes, plantation area…….ha.</td></tr>
</table>

	in your areas? Yes ( ) No ( )	forest area ( )/private land ( )/……
4.4	Do you think the knowledge of elders would be useful in decreasing the peoples' vulnerability?	Yes ( ) No ( ) If yes, what knowledge good for what purpose? • •
4.5	Change in cropping pattern?	Yes ( ) No ( )
4.5.1	Since when you have changed?	Since last.....years
4.5.2	Change in sowing time? Yes ( ) No ( ) If yes,	
4.5.3	Change in variety? Yes ( ) No ( ) If yes,	
4.6	Change in technology? Yes ( ) No ( ) If yes,	
4.7	Water source protection and improvement?	Yes ( ) No ( )
4.7.1	Do you harvest the waste water of Kitchen?	Yes ( ) No ( )
4.7.1.1	If yes, What practices do you apply to Kitchen's waste water harvesting?	Mud pond ( ) Plastic pond ( ) Poly tank ( ) Concrete tank ( )
4.7.2	Do you harvest the Rainwater?	Yes ( ) No ( )
4.7.2.1	If yes, What practices do you apply to Rainwater harvesting?	Mud pond ( ) Plastic pond ( ) Poly tank ( ) Concrete tank ( )
4.7.3	Do you use harvested water for irrigation purpose?	Yes ( ) No ( )
4.7.3.1	How do you practicing to use the harvesting water for irrigation?	Drip-irrigation ( ) Laying polythene pipe ( ) Electric pump-set ( ) Cannel ( )
4.8	Do you apply bioengineering technics for soil conservation?	Yes ( ) No ( ) If yes,
4.9	Do you practice organic mulch?	Yes ( ) No ( )
4.10	Do you practice plastic sheet?	Yes ( ) No ( )

Crop	**Name of month**		**Why change? (Reason)**
	Before	**Now**	
Rice			
Maize			
Millet			
Wheat			
Barley			

Crop	**Name of the varieties**		**Why change? (Reason)**
	Before	**Now**	
Rice			
Maize			
Millet			
Wheat			
Barley			

Sector	**Name of technology**		**Benefit (comparison with old**
	Old	New	
Agriculture			
Forestry			
Water			
Infrastructure			

Technics	**effectiveness**

4.11	Do you apply any practices to improve soil fertility?	Yes ( ) No ( )
4.11.1	If yes, what practice do you apply?	Bedding ( ) SALT ( ) Agroforestry ( ) …….. ( )
4.11.2	Is this practice working well?	Yes ( ) No ( )
4.12	Change the occupation? Yes ( ) No ( )	If yes, what occupation adoption? ……new occupation …… previous occupation
4.13	Do you want to adapt improved technology in your farm to minimize Climate change impact?	Yes ( ) No ( )
4.13.1	If yes, what support do you need from support agency to adapt climate change?	Technical ( ) Financial ( ) Skilled manpower ( ) No idea ( )
Section 5: Problems of adaptation practices (for objective third)		
5.1	**What problems do you faced during the applying the adaptation activities?** Technical ( ) Financial ( ) Skilled manpower ( ) Intervention/idea ( )	*Short description(SD) of problems regarding* Landslide: …….. Flood: …… Drought: ……... Hailstone: …….
5.2	What is the main problem to save seed to grow for further years?	Technical ( ) Financial ( ) Skilled manpower ( ) Intervention/idea ( )
5.3	What problems did you face in plantation? ……	Technical ( ) Financial ( ) Skilled manpower ( ) Materials ( )
5.4	What are the problems to adapt the indigenous knowledge? ……	Technical ( ) Financial ( ) Skilled manpower ( ) Materials ( )
5.5	**What problems did you face to adopt flowing practices? :**	
	Change the sowing time: ……(SD)	Technical ( ) Financial ( ) Skilled manpower ( ) Materials ( )
	Change the crop verity: ……(SD)	Technical ( ) Financial ( ) Skilled manpower ( ) Materials ( )
	Change the technology: ……(SD)	Technical ( ) Financial ( ) Skilled manpower ( ) Materials ( )
5.6	**What problems did you face to water harvest?**	
	Kitchen's waste water harvesting: ……(SD)	Technical ( ) Financial ( ) Skilled manpower ( ) Materials ( )
	Rainwater harvesting: ……(SD)	Technical ( ) Financial ( ) Skilled manpower ( ) Materials ( )
5.7	**If yes, What problems did you face during irrigation from it?**	Technical ( ) Financial ( ) Skilled manpower ( ) Materials ( )
5.8	**What problems did you face to apply the following practices?**	Yes ( ) No ( )
	Bioengineering: ……(SD)	Technical ( ) Financial ( ) Skilled manpower ( ) Materials ( )
	Organic mulch: ……(SD)	Technical ( ) Financial ( ) Skilled manpower ( ) Materials ( )

	Plastic sheet: ……(SD)	Technical ( ) Financial ( ) Skilled manpower ( ) Materials ( )
	Bedding: ……(SD)	Technical ( ) Financial ( ) Skilled manpower ( ) Materials ( )
	SALT ……(SD)	Technical ( ) Financial ( ) Skilled manpower ( ) Materials ( )
	Agroforestry ……(SD)	Technical ( ) Financial ( ) Skilled manpower ( ) Materials ( )
5.9	What problems did you face to adapt new occupation? ……	Social ( ) Skill( ) Risk ( ) Migration ( )
5.10	What problem did you face to get support from support agencies for climate change adaptation?	Information ( ) Access ( ) Good governance ( ) No idea ( )
5.11	Do you believe on adaptation plan (CAPA) or practices that had support to adaptation from climate change induce problems?	Yes ( ) No ( )
5.11.1	Have these provisions implemented effectively?	Yes ( ) No ( )
5.11.2	If no, what is the reason for not effectiveness?	Nonrealistic plan ( ) Lack of money ( ) Lack of skilled manpower( ) Political instability( )
5.12	Who must be responsible for addressing the climate change induced problems?	National government ( ) Local government ( ) Myself ( ) No idea ( )
5.13	Any suggestions regarding climate change adaptation?	

Thank you very much for your kind cooperation

Annex 2

A Checklist for the Focus Group Discussion

A. Historical timeline

Please list out the all events what hazards had occurred since 30 years?

S.N	Events	frequency
	Flood	
	Land slide	
	Forest fire	
	Drought	
	Hailstorm	

B. Hazard prioritization

Hazards	Flood	Land slide	Forest fire	Drought	Hailstorm	**Rank**
Flood	×					
Land slide	×	×				
Forest fire	×	×	×			
Drought	×	×	×	×		
Hailstorm	×	×	×	×	×	
Total No.						

C. Seasonal calendar

What type of differences between past 3o years' season and today's season?

(before: before 30 years and now: now to before 30 years)

Description		Baisakh		Jeth		Asad		Sawon		Bhadau		Asoj		Kartik		Mansir		Push		Magh		Fagun		Chaitra	
Rain	before																								
	now																								
Warm	before																								
	now																								
Cold	before																								
	now																								
Snow	before																								
	now																								
Cloud	before																								

	now																							

D. Crop calendar

What you have felt the changed on cropping pattern between past 30 years before and now because of CC?

Description		Baisakh		Jeth		Asad		Sawon		Bhadau		Asoj		Kartik		Mansir		Push		Magh		Fagun		Chaitra	
Rice	before																								
	now																								
Maize	before																								
	now																								
Millet	before																								
	now																								
Wheat	before																								
	now																								
Barley	before																								
	now																								

E. Adaptation measures and problems of its implementation

What you have practiced as adaptation options for CC induced problem in agriculture and forestry sector and what you have faced problem during these adaptation practices applying since 30 years?

Hazard	**Problems from hazard**	**Applied adaptation options**	**Faced problems during applying the adaptation options**
Drought			
Flood			
Landslide			
Hailstone			

Annex 3

A Checklist for the Key Informant Interview

I. What you understand about climate change?

II. What do you feel the changes on temperature and rain fall in your locality?

III. What is the vulnerability condition of your locality in sense of climate change?

IV. How can you face with that climate change induced problems?

V. What are the problems of adaptation measures faced by you?

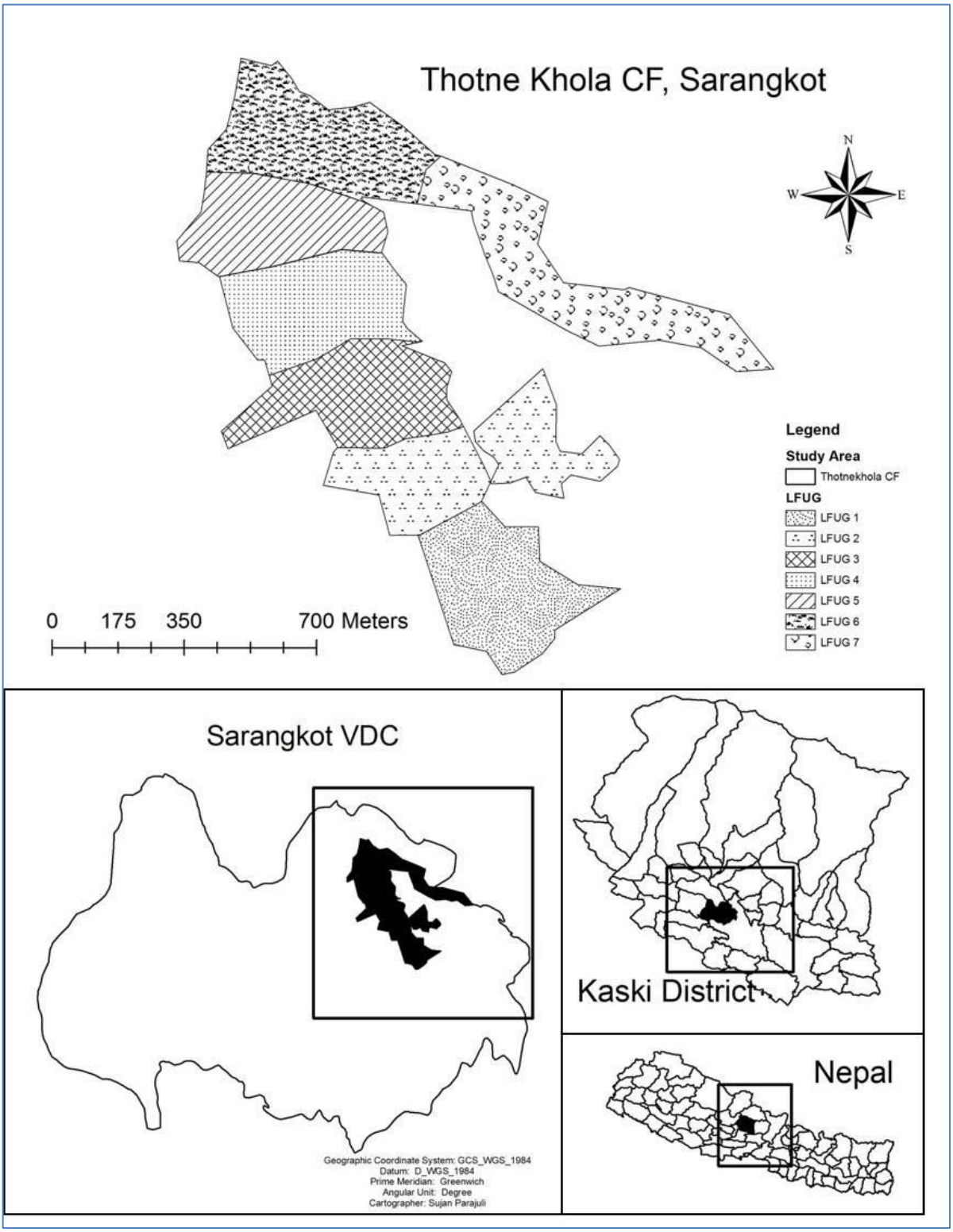
Annex 4

A Checklist for direct observation

I. Biophysical activities (Deforestation, biodiversity conservation, efforts made by local people like local rules and traditional norms, conservation, etc.)?
II. Physical activities, Size if stream, forest condition, agriculture pattern, etc.?
III. The cropping pattern of local people/the condition of crop?
IV. Soil conservation practices?
V. Adaptation practices?

Annex 5

Map of Thotnekhola forest area



Annex 6

Photographs

Researcher with a respondent during Questionnaire Survey

Focus Group Discussion with Thothnekhola CFUG members