

**ADDIS ABABA UNIVERSITY  
SCHOOL OF GRADUATE STUDIES  
COLLEGE OF SOCIAL SCIENCES**

**LOCAL PEOPLES' PERCEPTION ON CLIMATE CHANGE, ITS  
IMPACT AND ADAPTATION MEASURES IN SIMADA  
WEREDA OF SOUTH GONDAR**

**BY  
MARYE BELETE**

**JUNE 2011  
ADDIS ABABA**

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**A Thesis Submitted to the School of Graduate Studies of Addis Ababa  
University In partial Fulfillment of the Requirement for the Degree  
of Master of Art (MA) in Geography and Environmental Studies**

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## **ACKNOWLEDGEMENT**

This thesis work wouldn't have been realized without the help of the following persons. First and for most, I would like to thank my advisor Dr. Muluneh W/Tsadik for his consistent support in providing me with relevant literatures, critical comments, and advises right from title selection to completion of the paper; and always having opened hands and door for me despite the ample responsibility he shouldered as head of department. Special thanks also goes to Dr. Yirgalem Mahteme for indispensable comments he provided during title selection.

Thanks are also goes to Addis Ababa University, Simada Wereda Agriculture and rural development offices and Disaster Prevention and preparedness office, National Meteorology Service Agency (NMSA) for their welcoming approach, hospitality and support. I gratefully acknowledged my friends, especially Ato Mekonnen Zewdu, Ato Liyew Ferede, Ato Negash Atnafu, Ato Naod Mekonnen and Ato Kindye Essa. My special thank also goes to my wife Mommina Hussien, who is directly involved in data collection and my family who have directly or indirectly supported me over the time I was involved in this study.

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## **ABBREVIATIONS AND ACRONYMS**

ALP	Amhara region Livelihood Profile
AWD	Acute Water-borne Diarrhea
BFP	Backyard Fodder Production
CBA	Community-Based Approach
CDC	Center for Development Consultancy
CIER	Centre for Indignons Environnemental Ressources
CSA	Central Statistics Authority
DA	Development Agent
DPPC	Disaster Prevention and Preparedness Commission
DPPO	Disaster Prevention and Preparedness Office
FAO	Food and Agricultural Organization
FGD	Focus Group Discussion
FHI	Food for the Hungry International
FTC	Farmer Training Center
GBFP	Group Based Fodder Production
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GLCA	Global Leadership for Climate Action
HHs	Household Heads
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome
IPCC	Intergovernmental Panel for Climate Change
LDCs	Least Developed Countries
MDGs	Millennium Development Goals
NAPA	National Adaptation Program of Action
NCCF	National Climate Change Fourm
NGO	Non-Governmental Organization
NMSA	National Meteorological service Agency
NRC	National Research Council
NSF	National Science Foundation
OCC	Office of Climate Change

OFSP	Other Food Security Program
PANE	Poverty Action Network of civil society organizations in Ethiopia
PPM	Parts Per Million
PSNP	Productive Safety Net Program
SARDO	Simada Agriculture and Rural Development Office
SERA	Strengthening Emergency Response Abilities
SHG	Self Help Group
SPSS	Statistical Package for Social Science
TOT	Training of Trainer
UN	United Nations
UNCCD	United Nation convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WB	World Bank
WHO	World Health Organization
WMO	World Meteorological Organization
WWF	World Wide Fund for Nature
WWR	World Water Forum

## **ABSTRACT**

*Climate change is causing the greatest environmental, social and economic threats to all of mankind and across borders in many nations. Perception about the cause, impacts and necessary response mechanisms to cope with climate calamities is important for any population in a given community. In view of this fact therefore, this study assesses local peoples' perception of climate variability and change, focusing mainly on insight of the local people on climate variability and change, its impact, their responses and barriers of responses.*

*The study was conducted in three kebeles of Simada wereda found in South Gondar, Amara Region, as one of the drought-prone area in the country. It relied on both qualitative and quantitative methods of data collection and analysis. The primary data were collected by using data gathering tools such as FGDs, interviews, observation and household survey. The study also used historically recorded rainfall and temperature data from 1987 to 2009 to examine the trend of local climate variability and change. A time series analysis was used to show trend of temperature and rainfall. The researcher used Coefficient of variation and percent of deviation to discern rainfall variability.*

*The finding of the study showed that both maximum and minimum temperature had increased, belg rainfall had decreased whereas annual and meher rainfall had increased and showed inter annual and seasonal variation. Local people perceived climate variability and change-induced hazards such as drought, flood, pests and disease, land slide, erratic and heavy rainfall affects the environment and their livelihood. For the perceived changes, local people took remedial action to counteract the impacts of climate change. The most common adaptation options include: reforestation, terracing, rain water harvest, change in cropping pattern, growing short maturing crops, family planning and diversification of income. However, poverty, water scarcity, land scarcity, market problem, lack of information about the weather or long-term climate change, forage and feed scarcity, lack of agricultural technologies and appropriate seed and lack of health service were major constraints of adaptation for many people in the study area. Thus, the study recommends a relentless need to address these challenges by the concerned body.*

**Key words: Climate variability and change; Perception; Adaptation**

# CHAPTER ONE

## 1. INTRODUCTION

### 1.1. Background

In its fourth assessment report, the intergovernmental panel on climate change (IPCC) concluded that climate change is already happening with its multi-faceted effects on human society and the environment. An increased concentration of the so called greenhouse gases (i.e. CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O) in the atmosphere as a result of human activities and its possible consequence of climate change has been an international issue since the 1980's (NCCF, 2009). Climate and climate change will certainly have an effect on the future sustainable development of much of our planet's resources such as those relating to biodiversity, water, forests, land and oceans as well as in relation to various sectorial activities like agriculture, forestry and biodiversity (WMO, 1992).

A common theme in the climate change impact and vulnerability literature is the idea that countries, regions, economic sectors and social groups differ in their degree of vulnerability to climate change. This is partly due to the fact that changes in temperature and precipitation will occur unevenly and that climate change impacts will be unevenly distributed around the globe. It is also recognized that even within regions impacts, adaptive capacity and vulnerability will vary (IPCC, 2001). The least developed countries (LDCs) have contributed the least to the amount of global emission of greenhouse gases, but they are the most vulnerable to the adverse effects of climate change and have the least capacity to adapt to these changes. They will suffer from a possible increase in natural disasters such as floods and droughts due to climate change. The LDCs lack the necessary institutional, economic and financial capacity to cope with climate change impacts and to rebuild the infrastructure damaged by natural disasters (Sokona and Denton, 2001 cited in Huq, et al., 2003). When affected by natural disasters, the LDCs become dependent on external aid, as they do not have the necessary funds available to deal with the problems themselves. Therefore, poverty accentuates the degree of vulnerability to the impact of climate change.

It has become common knowledge that the poor are likely to be hit hardest by climate change, and their capacity to respond to climate change is lowest in the developing countries and among the poorest people in those countries (Olmos, 2001). People who live on arid or semi-arid lands,

low-laying coastal areas, in water-scarce or flood-prone areas, or on small islands are particularly more vulnerable to climate change (Watson, et al., 1996: 24 cited in Olmos, 2001). Climate change will affect socio-economic sectors including water resource, agriculture, forestry, fisheries and human settlements, ecological systems and human health in many parts of the world, with developing countries being the most vulnerable ones (IPCC, 2000a, cited in Olmos, 2001). The majority of developing countries are in tropical and sub-tropical zones, areas predicted to be seriously affected by the impacts of climate change. Africa, Asia, Latin America and the small Island states have all identified as regions of concern.

Africa is the most vulnerable region to climate change, because of the low adaptive capacity of the African population. This low capacity is due to the extreme poverty situation of many Africans, frequent natural disasters such as droughts, floods, and agriculture, which are heavily dependent on rainfall. The main impacts of climate change are on the water resource, food security and agriculture, natural resource management and biodiversity, and human health (Dievudonne, 2001 cited in Huq, et al., 2003). Occurrences of recurrent droughts have long been a permanent feature of life throughout the dry lands of Africa. Over the past 30 years, however, usually severe and/or prolonged droughts in these dry lands have seriously affected agriculture and wild life and caused many severe malnutrition and death. Currently, 36 countries in Africa are affected by recurrent drought and some degree of desertification (UNEP, 1992 cited in IPCC, 1998). Within the African region, the Horn Countries are among the most vulnerable and are the least prepared countries for adverse global environmental change in the world with a very weak economy, climate-sensitive livelihoods and fragile agro-ecological conditions. As a result, poverty, catastrophic droughts, vigorous hydrological cycles, and famines have been the hallmarks of these countries (UNEP, 2002 cited in Aklillu and Alebachew, 2009a). Despite this, high population growth coupled with low economic growth accentuated the impact of climate change. They are also most vulnerable to the impacts of projected changes because wide spread poverty limits adaptation capabilities. Increased droughts could seriously affect the availability of food in the horn of Africa during the 1980s and 1990s. Among the Horn countries, Ethiopia is one of the most poor and known by high population growth, which is adversely affected by the impact of climate change.

Ethiopia, with 1.12 million Km<sup>2</sup> area found in the Horn of Africa is the 27<sup>th</sup> largest country in the world and more than twice the size of Spain. It is one of the world's poorest and least developed

countries. About 45% of the country is defined as highland, areas that are at least 1500 meters above sea level (Haakansson, 2009). Mountains are delicate. Since Ethiopia is mountainous country, nearly half of the country and 90% of Ethiopian live on the highlands, which are the delicate components of the environment. The degradation of the environment and poverty made Ethiopia vulnerable to climate change impacts and has least adaptive capacity to climate change impact.

The national program on how Ethiopia can adapt to climate change, NAPA states that repeated droughts, hunger and the recent floods are among the most serious problems affecting millions of Ethiopians almost every year changes in climate will only make the situation worse. Drought and flood are most serious climate related natural hazard affecting the country from time to time. Drought occurs anywhere in the world but its damage is not as severe as in Africa in general and in Ethiopia in particular due to low adaptive capacity (NMSA, 2007). Rainfall variability and associated droughts have been major causes of the country's food shortage and famine because agriculture is the foundation of the national economy and constitutes the primary source of livelihood for the overwhelming majority of the population. Due to climate change impact, poverty, health, food security, ecosystems and social situation of the people are headache of the country (NCCF, 2009).

## **1.2. *Statement of the problem***

Although the economic reform made after the political change in 1991 brought significant improvement in the economy, Ethiopia is still one of the least developed countries (LDCs) in the world (NMSA, 2001). This development status makes the country more vulnerable to climate variability and change. The key socio-economic indicator of the country for the year 2004/2005 was very low compared to most countries of the world (NMSA, 2007). Because of low economic status, the country is prone to climate related hazards. Climate related hazards in Ethiopia include droughts, floods, heavy rain, diseases, high temperature, lightning etc. Because of these climate-related hazards, the country is expected to have adverse ecological, social and economic impacts.

Despite the development of environmental policy in Ethiopia, environmental degradation because of land degradation, soil erosion, deforestation, loss of biodiversity, desertification, recurrent drought, flood and water pollution are still the main environmental problems. According to National Meteorological service Agency (NMSA) (2007) recurrent drought, famine and flood are

the main problems that affect millions of people in the country almost every year. Although most disasters are caused by deterioration of natural environment, climate change contributes the lion's share of the disasters currently. The main climate change impacts are on agriculture and food security, health, water resource and natural resource degradation. The impact of climate change is further aggravated by poverty and population pressure.

Although the government recognizes vulnerability of the country to the impacts of global climate change, there is limited research-generated knowledge on impacts of the change, locally available adaptation and mitigation measures and community response (Aklilu and Alebachew, 2009a). Despite sustained economic growth and increased domestic cereal production, there has yet to be realized any substantial decrease in the size of the needy population. Rather climatic shocks render an already vulnerable population susceptible to livelihood crises that force millions of people to turn to the government for emergency assistance and safety net benefit each year to augment their own productive and coping strategies. In recent years, emergency food and non-food aid to Ethiopia has averaged \$320 million per year, with some years costing considerably more (NCCF, 2009). These realities show the country's development goals are unachievable unless the root cause of the complex development challenges of the country caused by the impacts of climate change is studied scientifically and solution is sought at local level.

Despite the increasing funds for disaster response, (\$320 million per year) damages from natural hazards continue to rise. Local adaptation plan cannot receive the necessary attention. The mitigation plans have been reactive rather than preventive (Aklilu and Alebachew, 2009a). The country is extremely vulnerable to the least change in climate. If the rain is late, does not arrive or irregular, it immediately results in an increase in the number of people who need help because they are already living on the margins of life.

Although many poverty and food insecurity focused research in the country have been mainly undertaken in the Northeastern highlands of the country, where historical famines of the 1970s, 1980s and 1990s predominate Melesse (2007), the issue of climate change did not get much concern. The research findings give different accounts to the causes of famine such as drought, political conflict & civil war, land degradation, population pressure and ill development policies. The food status of the Amhara region, as indicated by the regional Disaster Prevention and Preparedness Bureau (DPPO) (2006), becomes severe even before. About 42% of the total population and 52 *Weredas* are recognized as food insecure and drought-prone respectively. In

addition to the administrative zones of North and South Wollo- where food insecurity and poverty are deep rooted and complex, many *Weredas* that are located in North and South Gondar, East Gojam and North Shoa administrative zones, which were surplus-producing areas before the two decades, became food insecure and livelihood vulnerability trap (Melesse,2007). For example, out of the eleven *Weredas* of South Gondar administrative zone, five *Weredas* of Simada, Ibnat, Lay Gaint, TachGaint and Libokemkem are considered drought-affected (UN, 1994).

Perception about climate change, its cause, impacts and the necessary response mechanisms to cope with climate calamities are important for any population in a given community. Level of awareness determines the scope of implementation that needs to be taken to tackle the problem. Lower awareness will make intervention mechanisms to be very slow and untargeted. For instance, local peoples have a range of strategies to cope with drought. However, these traditional coping mechanisms are based on local knowledge and not supported by research. Therefore, they may not be able to counter all of the challenges imposed by climate change in the future. Studies have shown that climate change has potential to have several negative impacts on human welfare, natural resources and development activities in the country. However, most of these studies have been carried out at the macro-level. There are very few studies dealing with the empirical status at the micro-level. Unless, the impacts of climate change are known and expressed at the micro-level and understood by the local people and established the right perception, it would be difficult to convince and motivate local communities to undertake adaptation actions. To fill this gap, this research has been carried out with a focus on understanding the perceptions of people, assessing local impacts of climate change and the adaptation strategies of the people in Simada *Wereda* of South Gondar.

### **1.3. Objectives of the study**

The main objective of this study was to assess local peoples' perception of climate change, its impacts and adaptation practices that contribute to development activities. The specific objectives were:

1. To assess local peoples' perception towards changes in temperature and rainfall pattern over the last couple of decades;
2. To assess local impacts of climate change induced-hazards on peoples' livelihood and the environment in local peoples' view;

3. To identify ongoing adaptation strategies employed at local level in response to perceived changes in temperature and rainfall;
4. To identify barriers of adaptation strategies to the changing climatic conditions;

#### **1.4. Research questions**

In order to get hold the objectives, the following questions were posed and answered.

1. What is the level of perception of the local people about the existence of climate variability or change?
2. What were the local impacts of climate change induced-hazards on peoples' livelihood and the environment?
3. What adaptation strategies were adopted by different actors of the study area to cope with climate change?
4. What are the major constraints encountered by different actors of the study area to employ different adaptation strategies in response to changing temperature and rainfall?

#### **1.5. Scope and limitation of the study**

The study focused on Simada *wereda* as the area is drought prone. Within Simada, the study conducted in only three *kebeles* considering the prevalence of the problem and its scope is limited to the assessment of local peoples' perception on climate change, its impact and responses. The study could have been much more interesting had it been possible to include more *kebeles* in Simada and beyond. However, for practical reasons such as time and financial limitations, the study relied on three selected *kebeles* in Simada.

The other limitation of the study is that there is only one meteorological station, Mota metrological station, near by the study area and temperature and rainfall data recorded on the meteorological station represents merely the average climatic parameters of Simada wereda, not exactly any of the three study *kebeles*.

#### **1.6. Justification and significance of the study**

Ethiopia is one of the poorest nations of the world which has been vulnerable to the impacts of climate variability and change. The limited economic, institutional and logistic capacity to mitigate and adapt to climate change exacerbated the vulnerability of many peoples and communities to climate change induced-hazards that are occurring through global climatic

change and land use transformation. The problem is more serious on communities who heavily depend on climate sensitive livelihoods. This situation has retarded the country's development program and creating multi-faceted challenges. The challenge limits the country's primary agenda, poverty reduction, which is the main factor that made the country more vulnerable to climate change induced impacts and environmental degradation. Though climate change stands as a major obstacle to eradicate poverty and protect the environment; its direct and indirect impacts were not well studied in the country.

Facing climate change-induced hazards may not be new for the Ethiopian peoples. The challenges, however, are both diversified and frequent hazards in the current climate system. Now a day the magnitude and number of hazards are beyond the control of local people. In addition, the mitigation plans have been reactive rather than preventive. The practical measure expected from Ethiopia is, however, developing adaptation strategies and enhancing adaptive capacities of different stakeholders. This shows that the need to review disaster-response mechanism. This is however, impossible without research-generated knowledge at local level and community participation.

In addition to this understanding of peoples' perception about the issue of climate change is non-negotiable aspect of development program. Therefore, capturing the perception of people in general and local people in particular for development activity and planning appropriate adaptation strategy to cope with climate change is important. However, there is lack of adequate research generated data on perception of local people about climate change and their response.

This also holds true in the case of *Simada wereda* of South Gondar. Thus, the purpose of this research is to assess the local impacts of climate change, perception of local people and their adaptation strategies employed in the study area.

## **1.7. Organization of the thesis**

The study is organized in five chapters. Chapter one presents back ground, statement of the problem, objective of the study, the approaches and methods applied in the analysis. Chapter two reviews important literatures related with climate change, its impact and adaptation. Description of the study area is presented in chapter three. Chapter four presents findings of the survey. Conclusions and recommendations for policy formulation and adaptation strategies based on the discussion results are presented in chapter five.

## **CHAPTER TWO**

### **2. LITERATURE REVIEW**

Today, climate change is increasingly recognized as a critical challenge to ecological health, human well-being and future development (IPCC, 2007). It is one of the greatest challenges of humanity, affecting both current and future generations. The world community took initial steps in 1992 (United Nations Framework Convention on Climate Change-UNFCCC), in 1997 (Kyoto Protocol) and then again in 2009 (the Copenhagen Climate Change Conference) to curb global greenhouse gas emissions. However, these efforts have produced only modest gains in a handful of countries. The resulting emission reductions are nowhere near, what they should be in order to halt or slow the pace of climate change (GLCA, 2009). In addition, local community- based adaptation practice is an urgent issue particularly in developing countries. However, little is known about local community perception of climate change and adaptation worldwide.

In light of the above induction, the aim of this chapter is to review literatures on climate change its causes and impacts, adaptation and local people perception. Accordingly, the review of literature help to establishes conceptual framework of the study and highlight previous studies on climate change with their underling concepts so as to helps to identify gaps in the literature and forward research questions for the study.

#### **2.1. Global climate change: An overview**

In recent years, the term “climate change” has become a core issue in various developmental and political forums at the national, regional and international level. Many worldwide regional summits have dedicated discussion sessions on climate change based on the recognition, that global climate is subject to increasing change and this has become more evident in recent years (Aklilu and Alebachew, 2009a). According to the IPCC fourth assessment report, warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (IPCC, 2007). Eleven of the last twelve years (1995-2006) rank among the twelve warmest years in the instrumental record of global surface temperature (since 1850). According to IPCC (2007), the global average temperature has risen by 0.74<sup>o</sup>c and the global sea level has risen by 17cm during the 20<sup>th</sup> century, primarily due to melting snow and ice from the mountains and Polar Regions.

The World Meteorological Organization (WMO) (2003) and IPCC (2007) states that the concentration of carbon dioxide has increased from 280 parts per million (ppm) in the pre-industrial times (1750s) to 370 ppm at present and it is estimated that, with the present trend, the concentration will range between 540 and 970 ppm in the year 2100.

Based on climate change models, global average temperature is projected to increase by 1.4 to 5.8<sup>0</sup>c by the end of the present century (CIER, 2008). Sea level is expected to rise by 0.09 to 0.88 meter from the 1990 level by the end of this century and precipitation extremes are projected to increase more than the average in the future (WMO, 2003). What are possible causes and impacts of climate change?

## **2.2. Causes and impacts of climate change**

Climate change is a reality; it has changed in the past, it is changing at the present, and it will change in the future (Burroughs, 2007). The change of climate could be slow and gradual, rapid and catastrophic, short-term or long term could be at local, regional and global scales; and it could be due to natural factors or anthropogenic factors. The overwhelming majority of climate change researchers have reached the understanding-based on decades of evidence, modeling, and debate-that it is extremely likely that human activities are responsible for the rising temperatures on Earth. Human behavior will continue to be a major factor in climate change (UN, 1992; NSF, 2009).

The human factors that contribute to climate change are in the form of greenhouse gas (GHG) emissions and land-use/cover changes (Aklilu and Alebachew 2009a; World Bank, 2008; FAO, 2008). Most important greenhouse gases are emitted from electric power station, various industries, the transport sector and deforestation due to human activities. These activities increase the concentration of different greenhouse gases. The relative share of carbon dioxide, chlorofluorocarbons, methane and nitrous oxides to greenhouse gases emission were 51%, 20% 16% and 16% respectively up to 1990 (Singh and Sweta, 2008).

Global GHG emissions due to human activities have grown since pre-industrial times, with an increase of 70% between 1970 and 2004. Global atmospheric concentrations of carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), chlorofluorocarbons (CFC) and nitrous oxide (N<sub>2</sub>O) have increased markedly since 1750 because of human activities, and now far exceed the pre-industrial values determined from ice cores spanning many thousands of years. Global increases of CO<sub>2</sub>

concentrations are primarily due to increased fossil fuel use and land-use change. It is very likely that the observed increase in CH<sub>4</sub> concentration is predominantly due to agriculture and fossil fuel use. The increase in N<sub>2</sub>O concentration is primarily due to agriculture (IPCC, 2007). Thus, the greenhouse effect is intensified, resulting in rising temperature on earth.

Anthropogenic effects on the physical and chemical properties of the atmosphere have the potential to affect the quality of life and even the very existence of certain life forms. Weather and climate-related disasters result in high death, a decline in production of food, pollution of waters and land surfaces, and the destruction of production capacity and infrastructure. The data received from many observations indicate that regional climate changes have already affected many physical and biological processes and systems. Examples of observed changes include reduction in glacier cover, thawing permafrost, changes in altitudes of vegetation extent, reduction of populations of some species of plants and animals, expansion of desertification processes (Anon, 2002).

The international communities are scared of catastrophic adverse effects of future and present climatic changes on different spheres of man and nature (Ahmed, 2008; Mendelsohn, et al., 2000). While the regional patterns of future climate change are poorly known, it is clear that the altered patterns of radiative forcing associated with anthropogenic emissions will alter regional climates noticeably, and will have different effects on climate conditions in different regions. These local and regional changes will necessarily include changes in the lengths of growing seasons, the availability of water, and the incidence of disturbance regimes (extreme high temperature events, floods, droughts, fires, and pest outbreaks), which, in turn, will have important impacts on the structure and function of both natural and human-made environments. Systems and activities that are particularly sensitive to climate change and related changes in sea level include forests; mountain, aquatic and coastal ecosystems; hydrology and water resource management; food and fiber production; human infrastructure and human health (Houghton, et al., 1997).

The effect is more pronounced on those countries that are categorized under third world or developing countries. Because developing countries are most vulnerable, countries to the effects of climate change and they have the least capacity to adapt to these changes (IPCC, 2001 & UNFCCC, 2007).

According to IPCC (2007), terrestrial, low laying coastal and marine coral reefs are vulnerable ecosystems. In addition, water resource, agriculture and human health are vulnerable sectors. The same literature shows that Arctic, small islands, Asia, Latin America and Africa are the most vulnerable regions in the world. Within other areas, even those with high incomes, some people (such as the poor, young children and the elderly) can be particularly at risk, and also some areas and some activities.

The continent of Africa is primarily tropical or subtropical (National Research Council (NRC), 1995) which is one of the most vulnerable regions in the world to climate change (Desanker, n.d; Leary, et al., 2008). Africa's high vulnerability to the impacts of climate change is exacerbated by other factors such as wide spread poverty, recurrent droughts and floods, dependence on natural resources and biodiversity, over dependence on rain fed agriculture, a heavy disease burden and the numerous conflicts that have engulfed the continent. Changes in future climate may negatively affect the overall economy of Africa, thus hampering potential for economic growth (Davidson, et al., 2003 cited in Nyong, 2005). The main impacts of climate change will be on the water resource, food security and agriculture, natural resource management and human health (Dieudonne, 2001 cited in Huq, et al, 2003).

Agriculture is the basis for the livelihoods of millions of people in Africa. An average of 70% of the population lives by farming and 40% of all exports are earned from agricultural products (WRI, 1996 cited in IPCC, 2001). In addition, 10% to 70% of gross domestic product (GDP) in Africa is generated by agriculture (Mendelsohn, et al. 2000). However, agricultural production is affected by climate change. The estimate for Africa is that 25% to 42% of species habitats could be lost, affecting both food and non-food crops (FAO, 2007).

According to reports of the IPCC (2007), the projected yield reduction due to climate change in some poor countries could be as much as 50% by 2020. Under climate change, much agricultural land will be lost, with shorter growing seasons and lower yields. National communications report that climate change will cause a general decline in most of the subsistence crops, example sorghum in Sudan, Ethiopia, Eritrea and Zambia; maize in Ghana; Millet in Sudan; and groundnuts in Gambia (UNFCCC, 2007). Many countries in tropical and sub-tropical regions are expected to be more vulnerable to warming because additional warming will affect their marginal water balance and harm their agricultural sectors (Mendelsohn, et al., 2000).

African countries were identified as having the highest vulnerability to drought. The Sahel situated at the southern fringe of the Sahara desert and stretching from the West African coast to the East African highlands is particularly prone to drought. Droughts have particularly affected the Sahel, the Horn of Africa and Southern Africa since the end of the 1960s. For instance, estimates suggest that one third of African people live in drought-prone areas and that around 220 million people are annually exposed to drought (Elasha, et al., 2006; WWF, 2000).

Africa contains about one-fifth of all known species of plants, mammals, and birds, as well as one-sixth of amphibians and reptiles. These species compose some of the world's most diverse and biologically important ecosystems such as savannahs, tropical forests, coral reef marine and freshwater habitats, wetlands and montane ecosystems. These globally important ecosystems provide the economic foundation that many Africa countries rely on by providing water, food, and shelter. However, because of climate change, these ecosystems and the livelihoods that depend on them are threatened (WWF, 2006; McMullen & Jabbour, 2009). Climate change affects biodiversity by influencing species distribution, composition and function directly and indirectly (Aklilu and Alebachew, 2009a). Large changes in ecosystem composition and function because of regional climate change would have cascading effects on species diversity (Sykes and Prentice, 1996; Solomon and Kirilenko, 1997; Kirilenko and Solomon, 1998). Up to 50% of Africa's total biodiversity is at risk due to reduced habitat and other human-induced pressures (Boko, et al., 2007). Climate change, in particular rising temperatures, can have both direct and indirect effects on animal production. Heat stress (caused by the inability of animals to dissipate environmental heat) can have a direct and detrimental effect on health, growth and reproduction. Changes in the nutritional environment (e.g. the availability of livestock feeds, and the quantity and quality of livestock pastures and forage crops) can have an indirect effect (FAO, n.d.)

Climate change will affect human health and well-being through a variety of mechanisms. Climate change can adversely affect the availability of fresh water supplies, and the efficiency of local sewerage systems (WHO, 2000). Africa is vulnerable to a number of climate sensitive diseases including malaria, tuberculosis and diarrhea (Guernier, et al., 2004). Under climate change, rising temperatures are changing the geographical distribution of disease vectors, which are migrating to new areas, and higher altitudes, for example, migration of the malaria mosquito to higher altitudes will expose large numbers of previously unexposed people to infection in the densely populated east African highlands (Boko, et al., 2007). Future climate variability will also

interact with other stresses and vulnerabilities such as HIV/AIDS (which is already reducing life expectancy in many African countries) and conflict and war (Harrus and Baneth, 2005), resulting in increased susceptibility and risk to infectious diseases (e.g. cholera and diarrhea) and malnutrition for adults and children (WHO, 2004).

Climate change causes degradation and loss of important natural resources. The increasing occurrence of climate extremes (for example heat waves, droughts, heavy precipitation) is having an impact on land degradation processes, including floods, mass movements, soil erosion by water and wind and salinization in all parts of the globe. Climate variability, climate change and land degradation are intimately linked and are generating unexpected effects on soils, water, forest and wetlands (Sivakumar and Ndiang'ui, 2007). According to the report of IPCC (2007), climate change caused decreasing water availability and increasing drought in mid-latitudes and semi-arid low latitudes. As a result, hundreds of millions of people exposed to increased water stress. Higher water temperatures and changes in extremes, including floods and droughts, are projected to affect water quality and exacerbate many forms of water pollution-from sediments, nutrients, dissolved organic carbon, pathogens, pesticides and salt, as well as thermal pollution, with possible negative impacts on ecosystems, human health, and water system reliability and operating costs (Bates, et al., 2008).

Climate change also affects forest resources. Extensive changes in the area of forests due to deforestation can seriously affect the climate in the region of change. Changes in carbon dioxide, temperature or rainfall associated with climate change can have a major impact on the health or structure of forests that can in turn affect the climate (Houghton, 2009).

### **2.3. Global responses to climate change**

Climate change is a global issue that requires an urgent international response. Governments, industries, communities and organizations across the globe are working together to develop and implement measures to reduce greenhouse gas (GHG) emissions and avoid dangerous climate change (office of climate change (OCC), 2010). Several international conferences, seminars, symposia and workshops were held. Some of them were the first World Climate Summit (1979) in Geneva, Conference on Industries and Climate (1980 in Vienna), Vienna convention (1985, in Austria), Montreal Protocol (Canda 1987), constitution of IPCC by UNEP and WMO in 1988,

First Earth Summit (1992 Brazil), Kyoto Protocol (1997, Japan) and so on (Singh and Sweta, 2008).

The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty produced at United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992. The objective of the treaty is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. As a framework treaty, the convention set no mandatory limits on GHG emissions for individual nations and contained no enforcement provisions; it is therefore considered non-binding. Rather, the treaty includes provisions for updates (called “protocols”) that would set mandatory emission limits. The principal update is the Kyoto Protocol (Aklilu and Alebachew, 2009a).

The Kyoto Protocol, adopted in December 1997, is an international agreement, which builds on the UNFCCC and sets legally binding targets for cutting GHG emissions of industrialized countries. Like the UNFCCC, the Kyoto Protocol aims to stabilize GHG emissions in the atmosphere. The major distinction between the two documents is that while the convention encouraged developed countries to stabilize GHG emissions, the protocol commits them to do so. The protocol sets out emission reduction targets for developed countries because they have been responsible for the vast majority of the world’s human-induced GHG emissions (OCC, 2010). The protocol was entered into force on 16 February 2005. As of November 2009, 187 states have signed the protocol. Copenhagen Accord was forged at the 15<sup>th</sup> Conference of the Parties, held in Copenhagen in December 2009, towards a new agreement beyond the Kyoto Protocol (UNFCCC, 2009). The accord is significant because it is the first global agreement on climate change, involving the major developed and developing countries. The United States and major developing economies, such as China, Brazil and India, played a key role for the first time (OCC, 2010).

The UNFCCC and the Kyoto Protocol have faced several challenges to achieve their prime objectives of reducing emissions. For instance, despite the Kyoto Protocol's ambitious goals, even countries that have shown to be its leading advocates, such as Japan, Canada, and the members of the European Union had not been able to meet their targeted reductions of emissions. In addition, the Australian government still refuses to ratify this agreement and along with the United States of

America remain the only Annex I countries of the United Nations Convention on Climate Change to not ratify the Protocol (CamWalker, 2006).

Climate change is one of the all-encompassing global environmental changes that have deleterious effects on natural and human systems, economies and infrastructure. The risks associated with it call for a broad spectrum of policy responses and strategies at the local, regional, national and global level. The United Nations Framework Convention on Climate Change (UNFCCC) highlights two fundamental response strategies: mitigation and adaptation. While mitigation seeks to limit climate change by reducing the amount of emissions of GHG and by enhancing 'sink' opportunities, adaptation aims to alleviate the adverse impacts through a wide-range of system-specific actions (Fussel and Klein, 2002).

Although mitigation and adaptation measures must be pursued to tackle the climate change problem and to create an effective and inclusive international climate change regime, mitigation has received greater attention than adaptation, both from a scientific and policy perspective. One plausible reason for this could be that climate change emerged as a problem related to the long-term disturbance of the global geo-biochemical cycles and associated effects on the climate system (Cohen, et al., 1998). Given the far-ranging adverse impacts of climate change, adaptation must be an integral component of an effective strategy to address climate change, along with mitigation. The two are intricately linked-the more we mitigate, the less we have to adapt. However, even if substantial efforts are undertaken to reduce further greenhouse gas emissions, some degree of climate change is unavoidable and will lead to adverse impacts, some of which are already being felt (GLCA, 2009).

Adaptation is a focus in developing countries because these countries are resource dependent and so are sensitive to climate change. For vulnerable groups such as developing countries, adaptation strategies are vital, as failure to adapt could lead to "significant deprivation, social disruption and population displacement, and even morbidity and mortality (Downing, et al., 1997). Now adaptation to climate change is recognized as urgent, inevitable, and expensive (Olsson and Jerneck, 2010). This is because of first, no matter how robust mitigation measures are, a certain degree of climate change is inevitable due to historical emissions and the inertia of the climate system (IPCC, 2001). Second, while the effects of mitigation may take several decades to manifest, most adaptation activities take effect almost immediately. Third, such measures can be applied on a regional or local scale, and their effectiveness is less dependent on actions of others.

Fourth, adaptation besides addressing the risks associated with changes in the climate in the future typically reduces risks associated with current climate variability.

Depending on its timing, goal and motive of its implementation, adaptation can be reactive or anticipatory, private or public, planned or autonomous. Adaptations can also be short/long term, localized or widespread (IPCC, 2001). In unmanaged natural systems, adaptation is autonomous and reactive. It is the means by which species respond to changed conditions. In these situations, assessment of adaptation is essentially equivalent to natural system impact assessment. Adaptations undertaken by individuals/communities are the focus here and can be classified as:

**Reactive or Anticipatory:** - Reactive adaptation takes place after the initial impacts of climate change have occurred. Anticipatory adaptation takes place before impacts become apparent. In natural systems, there is no anticipatory adaptation.

**Private or public:** - The distinction is based on whether private (individual households and companies) motivates adaptation or public interest (government).

**Planned and Autonomous:** - Planned adaptation is consequence of deliberate policy decision, based on the awareness that conditions have changed or are expected to change and that some form of action is required to maintain a desired state. Autonomous adaptation involves changes that systems will undergo in response to changing climate irrespective of any policy, plan or decision (Huq, 2005).

Each of the levels of potential adaptation options comes with a relevant set of very real constraints (Ziervogel and Ericksen, 2010). In addition, identifying those adaptations that favor most vulnerable groups is difficult (Bewket, 2010). Patino (2010) identified four major barriers to adaptation: the perceived lack of leadership and action by governments, existing governance and institutional arrangements, policy and regulatory issues and uncertainty and lack of understanding.

## **2.4. Local community perception of climate change**

Local community's perception about their environment is critical because their perception fundamentally determine the socioeconomic activities in their locality. Successfully mitigating and adapting to climate change require changes in the behavior of billions of human being, who each day make individual choices that collectively have enormous impact on the earth's climate

(Brechin, 2003: 106 cited in Adane, 2009). However, very little is known about international local community opinion regarding climate change. For example, in Ethiopia empirical studies made so far about local community awareness of climate change are very limited (Adane, 2009).

Many people promote the use of a community-based approach (CBA) to climate change adaptation, yet the literatures on the topic are largely unpublished, limited, and poorly informed by theory or evidence. The CBA is described as adaptation with a community focus that seeks stakeholder engagement and which recognizes that adaptation to climate change occurs within the context of other risks and is implemented through existing institutions and decision-making processes (Dumaru, 2010). The same literature adds that response to disasters recently moved from a post impact relief and reconstruction approach toward a risk management process that includes pre-disaster planning and preparatory work. It has been argued that the involvement of communities is essential for this shift to occur. Therefore, focus on community adaptation is necessary because this is the scale where climate change will be experienced most by people, and to which they will have to adapt.

However, many programs are inconsiderate of communities. Assessing the awareness and knowledge of the beneficiaries of a given program is necessary, if such programs are to find support amongst targeted areas and be integrated into the day-to-day management of operations. An examination of the awareness and knowledge of resources, whether protected or not, provides a means of assessing the influence of such climate change programs (Infield and Namara, 2001). Despite being the primary custodians of natural resources, local communities are poorly involved in decision-making and policy formulation (David, 2009). Their exclusion from this process demotivates them and this makes it difficult for local projects to achieve their goals. The lack of appropriate incentives for community involvement in conservation is an important issue that needs to be considered (Mogoka, et al., 2001 cited in David, 2009). In addition to this, there is little awareness of the contribution of everyday individual actions to the problem of climate change (Defra, 2002; Mori, 2005; Thompson & Rayner, 1998 cited in Whitmarsh, 2009).

## **2.5. Climate change impacts and responses in Ethiopia**

Ethiopia is highly vulnerable to climate variability and change. This is because of very high dependence on rain fed agriculture, which is very sensitive to climate variability and change, under-development of water resources, low health service coverage, high population growth rate,

low economic development level, low adaptive capacity, inadequate road infrastructure in drought prone areas, weak institutions and lack of awareness (NMSA, 2007). Vulnerability assessment based on existing information and rapid assessments carried out under National Adaptation program of Action of Ethiopia (NAPA) has indicated that the most vulnerable sectors to climate variability and change are agriculture, water resources and human health. Agriculture is the most important sector in the Ethiopian economy (Temesgen, 2007). However, productivity and competitiveness of this sector is increasingly constrained by temporal and spatial variability of climate (NCCF, 2009). In addition, both droughts and floods are already common in Ethiopia.

Most of the country is prone to drought (NMSA, 1996, Degefu, 1987). Droughts destroy farmlands and pastures, contribute to land degradation, causes crops to fail and livestock to perish. During the 1984–5 drought, the GDP declined by about 10 percent and the 2002-3 drought cause over 3 percent decline. Drought severely affects the hydropower generation capacity, Ethiopia’s main source of electricity. Flooding in turn causes significant damage to settlements and infrastructure, livestock and animal health, and the water-logging of productive land undermines agriculture by delaying planting, reducing yields, and compromising the quality of crops, especially if the rains occur around harvest time (WB, 2006). Changes in temperature and rainfall have had many negative impacts on human and livestock health. For example, serious disease outbreaks including cholera, acute water-borne diarrhea (AWD), meningitis and malaria have been reported due to altered temperature and rainfall patterns (NMSA 2006, Assefa 1996, McMichael, et al., 2006 cited in Aklilu and Alebachew 2009a). The same literature adds that livestock also affected by diseases like schistosomiosis, trypanosomiasis, yellow fever and tick-borne hemorrhagic fevers.

Climate change is expected to have adverse ecological, social and economic impacts. The NMSA (2007) summarizes the impact of Climate change for selected sectors in Ethiopia as follows:

Table 1: impacts of climate change for selected sectors in Ethiopia

<b>Sector</b>	<b>Potential impact</b>
Agriculture	<ul style="list-style-type: none"> <li>• Shortening of maturity period and decrease in crop yield</li> </ul>
Grassland and Livestock	<ul style="list-style-type: none"> <li>• Change in livestock feed availability</li> <li>• Effects of climate change on animal health, growth and reproduction</li> <li>• Impacts on forage crops quality and quantity</li> <li>• Change in distribution of diseases</li> <li>• Changes in decomposition rate</li> <li>• Change in income and prices</li> <li>• Contracting pastoral zones in many parts of the country</li> </ul>
Forests	<ul style="list-style-type: none"> <li>• Expansion of tropical dry forests and the disappearance of lower montane wet forests;</li> <li>• Expansion of desertification</li> </ul>
Water Resources	<ul style="list-style-type: none"> <li>• Decrease in river run-off</li> <li>• Decrease in energy production</li> <li>• Flood and drought impacts</li> </ul>
Human Health	<ul style="list-style-type: none"> <li>• Expansion of malaria to highland areas</li> </ul>
Wild life	<ul style="list-style-type: none"> <li>• Shift in physiological responses of individual organisms</li> <li>• Shift in species distribution from one to the next</li> <li>• Shift in biomes over decades/centuries</li> <li>• Shifts in genetic makeup of population</li> <li>• Loss of key wetland stopover and breeding sites for threatened bird species; and in general endemic and threatened species of flora and fauna are front line victims</li> </ul>

Impacts of climate change in Ethiopia are severe and climate change adversely affects the efforts to achieve Millennium Development Goals (MDGs). Falling of agricultural outputs and deteriorating conditions of rural areas caused by climate change will directly increase poverty of households in poor countries like Ethiopia (Diao, et al., 2005). Current experience of extreme weather events underlines how devastating droughts and floods can be for household incomes. For example, in North Eastern Ethiopia drought induced losses in crop and livestock between 1998 and 2000 were estimated at \$266 per household (PANE, 2009).

The Ethiopian government has recognized climate change has adverse effect on the country's development agenda. As a result, the country ratified the UNFCCC (in May 1994), UNCCD (in June 1997) and Kyoto protocol (February 2005). Within these frameworks, Ethiopia prepared national adaptation programs of Action (NAPA) against the impacts of climate change and desertification (Aklilu and Alebachew, 2009a). However, by 2008, Ethiopia had no explicit policy for dealing with climate change (Aklilu and Dereje, 2010). Unlike the case of developed nations, the practical measures expected from Ethiopia is to reduce the impact of climate change through the development of local adaptation measures while lobbying for mitigation options, international solidarity and climate justice (Aklilu & Alebachew, 2009b).

The people of Ethiopia are struggling against the impact of climate variations. They have been facing the impacts in various forms over millennia and have developed a range of coping mechanisms to deal with the impacts (McKee, 2008 cited in Aklilu & Dereje, 2010). The most important coping mechanisms widely used include: changes in cropping and planting practices, reduction of consumption level, use of inter-household transfers and loans, collection of wild foods, increased petty commodity production, temporary and permanent migration of people and animals, hidden secure grain storage, sale of assets such as livestock and agricultural tools, mortgaging of land/ taking credit from merchants and money lenders, use of early warning systems and appeals for food and other forms of aid (NMSA, 2006 cited in Aklilu & Dereje, 2010).

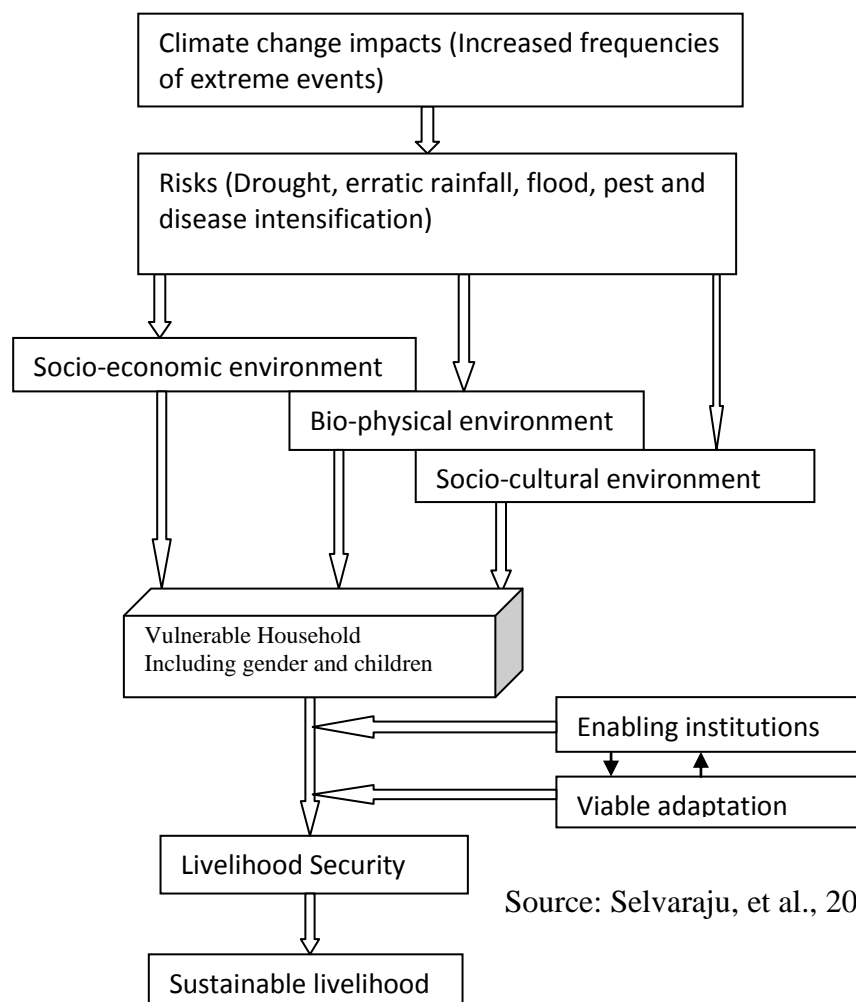
Most of the coping mechanisms are based on local knowledge and cannot be able to cope with all of climate change impacts. However, local perception of people should be the base for the choice of adaptation strategies. Unfortunately no or little is known about local perception of people. Hence, there are no appropriate adaptation strategies to cope with the impact of climate change in the country particularly in vulnerable regions.

## **2.6. Conceptual framework**

Figure 1 shows how different climate change impacts together with risk factors influence household livelihood strategies and decision-making processes over time, taking the role of gender and other vulnerable populations into account. At the center of the model are the households, where strategies are developed and decisions taken to develop and maintain livelihoods. Looking at the model from a systems perspective, climate change could influence the

bio-physical, agriculture, socio-cultural and socio-economic environments of households, impacting resources and assets, including social capital. The resource management strategies and decision-making potential of the local population is also affected.

Figure 1: Conceptual framework for improving livelihood security and sustainable livelihoods through adaptation to climate change.



In this case, an impact is a function of hazard exposure and both the biophysical and social vulnerability, where biophysical vulnerability is the sensitivity of the natural environment to the exposure and social vulnerability is the sensitivity of the human environment to the exposure. Therefore, exposure to a hazard is a prerequisite for an impact. Whether that exposure translates into a hazard depends on the nature of the vulnerability. If the natural environment is particularly sensitive and the human population is of low economic status with poor preparedness and few social institutions to facilitate coping, then the impact will be high. If the social vulnerability is lower due to a more appropriate coping capacity, then exposure of the same nature may result in

a lesser or even no impact. This approach relies on the notion of each exposure unit having a coping capacity, or range of exposure which can be coped with. The nature of this range is dependent on the determinants of vulnerability that render the unit vulnerable or resilient in the face of such exposure.

Many African societies including Ethiopians are already adapted to the climate variability to which they are exposed (Mortimore, 1998), and this variability is a good proxy for risks associated with future climate change, provided the rate of change is not too fast (Adger and Brooks, 2003). Ethiopian people in general and local people in Simada in particular have been exposed to climate shocks for years and they have developed their own traditional and innovative adaptation knowledge and practices out of necessity. Building adaptive capacity to climate change relies on assessing current adaptation strategies to expand coping ranges and thus improving livelihood security.

To sum up, in recent years, the term “climate change” has become a core issue in various developmental and political forums at the national, regional and international level. According to the IPCC fourth assessment report, warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level. Climate change is contemporary global issue that requires an urgent international response. Governments, industries, communities and organizations across the globe are working together to develop and implement measures to reduce greenhouse gases (GHG) emissions and avoid dangerous climate change. However, even if substantial efforts are undertaken to reduce further greenhouse gas emissions, some degree of climate change is unavoidable and will lead to adverse impacts, some of which are already being felt. Therefore, assessment of local situation, and perception of local people and work out locally appropriate adaptation strategies is an urgent issue particularly for developing countries.

Successfully mitigating and adapting to climate change require changes in the behavior of billions of human being, who each day make individual choices that collectively have enormous impact on the Earth’s climate. However, very little is known about international local community perception regarding climate change. As per the researcher knowledge, there is no comprehensive study made on local peoples’ perception on climate change, its impact and adaptation practices in Ethiopia. Thus, this gap leads to originate the research questions to this study on local peoples’ perception on climate change, its impact and adaptation practices.

# CHAPTER THREE

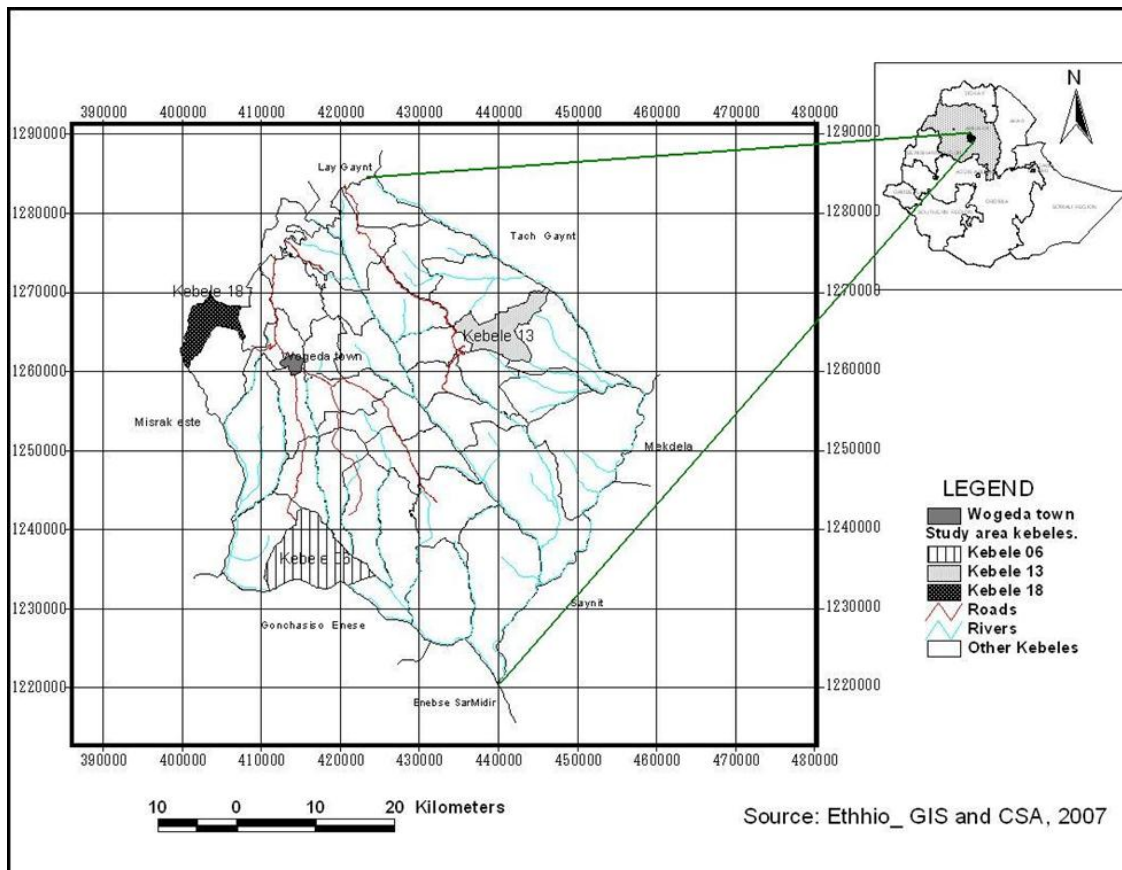
## 3. STUDY AREA DESCRIPTION AND METHODOLOGY

### 3.1. Study Area Description

#### 3.1.1. Location of the study area

Simada is located in South Gondar Administrative Zone, Amhara Regional State. It is one of the 11 administrative *weredas* of South Gondar Zone. It is divided into 40 *kebeles*, 1 town and 39 rural *kebele* administrations. The seat (capital) of wereda administration is Wogeda which is located at 105 km. distance southeast of the zonal capital Debretabor and found at about 205 km. distance away from the regional capital Bahir Dar and at 770 km distance from Addis Ababa. Simada *wereda* boards in the north with Tach Gaint and Lay Gaint *weredas*, in the south with East Gojam's Enebse SarMidir *wereda*, in the east with South Wollo's Amhara Saint and Mekdela *weredas* and in the west with Este *wereda* of South Gondar Zone.

Figure 2: location map of the study area



### **3.1.2. Biophysical condition**

The physiographic setting of the study area is characterized by valleys (10%), mountainous (20%), plateau/plain/ (20%), hills (40%) and others (10%). Its elevation ranges from 1500 to 4000 meters above sea level. About 11%, 42 % and 47% of the study area is occur in dega (highland), woinadega (midland) and kola (lowland) respectively (Center for Development Consultancy (CDC), 2008). Average annual rainfall amount varies between 1000 to 1500 mm and average annual temperature is 23<sup>0</sup> c (SARDO, 2009).

According to SARDO, the major soil types in Simada *wereda* are red, brown and black; constitutes about 30%, 30% and 25% of the total area respectively. The remaining 15% of the area is covered with gray soil. Red and brown soils are the dominant soil type in the area.

According to the information obtained from the CDC (2008), land use system of the area shows the following pattern. Out of the estimated total land area of 228,172 hectare; 46,664 hectare (44%) is arable land, 21,445 hectare (10%) is used for grazing, 554 hectare (1%) is covered with natural forest and shrubs, 4,806 hectare (2%) covered with water, 9,765 hectare (4%) is allocated for residential and infrastructure development, and 42,813 hectare (39%) is not suitable for any economical purpose.

Both perennial and seasonal streams drain the study area. There are more than 80 rivers. There are also some 1055 springs which are suitable sources of drinking water and small irrigation schemes. The main perennial rivers include Fesas, Mugie, Joga, Bijena and Yiba. The rest are seasonal and intermittent in nature. Rivers bordering the study area are Abay, Bashilo and Wanka. Patterns of vegetation of the area vary with agro ecology zone. The types of vegetation in the area include scattered trees and bush/shrubs like *Acacia* species, *Dodonia*, *Dedeho* (local name), *Oliaafricana*, *Croton macrostacheous*, *Embach* (local name) and *Eucalyptus* plantations (Amhara region Livelihood Profile (ALP), 2007). However, their area coverage is very small due to deforestation except eucalyptus trees, and remnants of natural forests found around the churches.

### **3.1.3. Socio-economic characteristics**

Simada has a total population of 228,207 of which 113,274 (49.6%) are males and 114,933 (50.4%) are females. About 217,929 (95.5%) are rural settler and 10,278 (4.5%) are urban

dweller (CSA, 2008). Population density of the wereda was 120.5 persons per square kilometer. Simada is entirely inhabited by the Amhara people.

Regarding distribution of towns, schools, and health services; Simada has 1 wereda town and 5 *ketena* towns. According to wereda education office Simada has 101 schools, of which 96, 4 and 1 are primary, secondary and preparatory respectively. Health office also indicates that Simada has 6 clinics and 33 health posts distributed in each *kebele*. In addition the area has 8 veterinary posts with very limited function.

The development of infrastructure in the area is low. The area has 93 km all-weather and 260 km seasonal, only used in winter, roads. After 2010 wegeda has started using electric power and wireless phone.

Most of the people in the area are engaged in mixed agriculture. Crop cultivation and livestock production is practiced. Crop production is entirely rain fed, except in very specific and small areas where vegetables are cultivated based on traditional and small-scale irrigation. There are two rainy seasons, *kremt and belg*, and they are used for the cultivation of both long and short cycle crops. The dominant crops of the study area are Teff, Wheat, Barley, Maize, Sorghum, Green paper, Bean, Gomenzer, Pea, Neug, Nech boloke, Lentils, Shimbra, *Guaya*, Telba, Suff, and Abish (CDC, 2008). Land preparation is carried on using mainly ox-plowing but tilling by hand occurs in the hilly areas on steeply sloping lands. Recently crop productivity is very low. As a result, many people involve in seasonal migration to East Shewa (Nazaret), Metemma, Humera, Pawi and North Gondar to subsidize their livelihoods. Petty-trading is another way of subsidizing the lively hood of the local people. Simada has 12 *kebele*, 5 *ketena* and 1 wereda market places. All of them are weekly, and are open on same day-Saturday.

Despite the provision of credit, SARDO run extension services in order to increase agricultural productivity through introduction of improved technologies, increasing agricultural inputs and provision of technical advices to the farmers. To meet this objective, different extension system and packages has been practiced for a decade through DAs who are working with farmers in the rural areas.

The number of domestic animals found in the wereda include: Cattle (93049), Pack animals (37214), sheep (184426), Goats (18548) and Poultry (88664) (CDC, 2008). Domestic animals are

usually freely grazed, but the middle and better off also purchase animal feed like hay and crop residues from October to January from the very poor and poor. This makes the poor poorer. This days, honey production, petty-trade, seasonal migration and daily labor sale supplement household income obtained from crop cultivation and livestock production.

Land degradation, deforestation, moisture shortage, depletion of both ground and surface water, increasing infertility of soil (SERA, 2000) and natural hazards like drought, landslide, pest infestation, and livestock diseases are among the major problems in the study area (SARDO). According to ALP (2007), the main diseases and parasites affecting livestock are anthrax, blackleg (cattle and equines), sheep pox, pasteurellosis (all livestock), African horse fever, lumpy skin and parasites (tick, mange, helminthiasis, fasciola). In addition, poor physical infrastructure, the remote location of the area and limited social services together with inaccessibility accentuated the problem. In the study area resources are diminishing over time. All these have aggravated food insecurity problem.

### **3.2. Methodology**

The study is attempting to assess local peoples' perception of climate change and their responses. The study was carried out with in three selected *kebeles* of Simada wereda: Ligaba (*kebele* 18), Gedamicael (*kebele* 13) and Sholacherer (*kebele* 06).

#### **Study population and study unit**

The people living in Simada *Wereda*<sup>1</sup> were the study population. The study depended on data collected from sample household units, observations, focus group discussion (FGD) and key informant interviews. The people selected for FGD and interview were those individuals living in the sample kebeles, who are knowledgeable and elderly people who likely represent the opinion of the community. For expert interviews, government officials and NGO representatives were selected.

#### **Sampling design and sample size**

The combination of multi-stage proportionate stratified sampling, simple random sampling and purposive sampling techniques were used in the selection of study site and sample households. At

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<sup>1</sup> *Wereda refers to the forth tier of government administration unit, which is closely equal to district.*

the first stage, three *ketenas*<sup>2</sup> (Muja and Soscham from *kolla* (lowland) and *Mikrie* from *woinadega* (midland) agro-ecologies were selected purposefully. The criteria considered for the selection of *ketenas* were: representativeness, prevalence of the problem, availability of relevant data and proximity to meteorology station. At the second stage, three *kebeles*<sup>3</sup> from these *ketenas* were selected: one from each *Ketena* randomly. Based on this, the sample *kebeles* are Gedamicael, Sollacheler and Ligaba. At stage three, households were selected from those *kebeles* based on proportionate stratified random sampling technique for structured household survey. In the study communities, households were stratified into two: male headed and female headed. The purpose of this stratification is to include the view of both sexes and to know the most affected segment of the community and to find out the reason(s) for this variation. Concerning the sample size determination, Bartlett, et al., (2001) sample size formulae and procedures were used. As the total populations of the household heads in the selected areas were 3,315 and the sample size for continuous data (the case for this study) is nearly 83 for low, 119 for medium and 198 for high, a medium sample size is applied for this study. Accordingly for household survey, 120 households (90 male headed and 30 female headed) were selected randomly using *kebele* registration lists obtained from the respective development agents.

Table 2: Distribution of Sample Households

No	<i>Ketenas</i>	<i>Kebele</i>	Agro-ecology Zone	Size of HHs			Sample size		
				Male headed	Female headed	Total	Male headed	Female headed	Total
1	Muja	Gedamicael	<i>kolla</i>	594	236	830	21	9	30
2	Soscham	Sholacherer	<i>kolla</i>	725	304	1,029	26	11	37
3	Mikrie	Ligaba	<i>W/ dega</i>	1,190	266	1,456	43	10	53
Total	3	3		2,509	806	<b>3,315</b>	90	30	<b>120</b>

Source: Field survey, 2010

For key informant interviews, nine household heads (HHs) were selected (3 HHs from each *kebele*). The purpose of the interview was to explore the perception of the community about climate change its causes and their responses. Interview was also made with experts: two

<sup>2</sup>Ketena is a local term referring to place which consists of 5-7 *kebeles* in Simada wereda.

<sup>3</sup>Kebele refers to the fifth tier of government administration unit.

government officials and one NGO representative in order to get relevant and reliable information.

In addition to these, two group discussions consisting of 30 persons at *kebele* level (one from each agro-ecology) were conducted. The individuals who participated in the FGD were knowledgeable, and fairly represent and reflect the opinion of the community at large.

### **Data collection**

“Using both qualitative and quantitative approaches together yields more than the sum of two approaches used independently” (Devereux, et al, 2003). Degefa (2005) also confirms that a mix of the two research approaches have paramount importance because either of them are not sufficient. Hence, both quantitative and qualitative research methods were integrated for this study for both data collection and analysis. The main purpose of using quantitative technique were to get households’ demographic information, to know the proportion of the most vulnerable segment of the community and to establish the pattern of local climate based on past temperature and rainfall records. The qualitative technique was used mainly to assess coping and adaptation strategies, cause and impacts of climate variability and change; as well as peoples’ perception on local climate variability and change.

### **Data sources**

The required input data of this study was generated from both primary and secondary sources. Primary data were generated from three groups of respondents and direct personal observation. The first group was selected households from the study area; the second group of data sources were key informants comprised of people who represent and reflect the opinion of the community member and expert interviewees. The third group was participants of FGDs. On the other hand, secondary data were generated by reviewing different relevant literature from books, research works, journals, published and unpublished documents, different activity reports of government and non-government institutions, and available rainfall and temperature records of Mota station. Secondary data are means to augment the data to be collected from primary sources (Adane, 2009).

### **Data collection instruments**

**Structured household survey:** household survey is the commonly used approach in various data collection activities. The structured household survey was mainly used to collect quantitative

data. The survey consisted of four parts: collection of demographic data, local peoples' perception of climate change and its cause, communities' understanding of the impacts of climate change induced hazards and the responses of local people, NGO and government to the impacts.

The survey was conducted on the selected 120 households. It was handled by three development agents of the respective kebeles after taking appropriate training. One day training was organized and orientation was given for the three enumerators. The preference to use DAs to collect data was based on the fact that:

- they do have a list of households of each category that could be included in the survey;
- they are more familiar with the community hence communication and getting reliable data was easier;
- they have had rich experience of similar data collection and surveying;
- they do have knowledge and experience on the subject matter and can easily understand the questionnaires and;
- they have training background in area of agriculture;

While the enumerators handled the survey, the researcher was supervising the enumerators, and side-by-side conducted in-depth interviews with the selected households.

**Interviews:** Individual in-depth interview was used to collect qualitative data and it was conducted on a one-to-one basis between a respondent and the interviewer. It is a straightforward and less problematic way of finding things out (Robson, 1995). Interviews were made on nine households (6 men and 3 women), two government officials and one NGO representative. The main purposes of conducting interviews were to clearly understand the perception of peoples on climate change, its cause and the responses of the community, government and NGOs. In addition, it is important to triangulate the household survey.

The interview made with government officials focused on the impacts of climate variability and change on the study area, responses of the government and level of participation and role of the community to tackle the impact. Similar interview was conducted with the representative of Food for the Hungry International (FHI).

**Focus group discussion:** It helps to generate data on group dynamics, and allows a small group of respondents guided by a skilled moderator, to focus on key issue of the research topic

(Mwanje, 2001). The focus group discussions were held with a few knowledgeable elderly individuals of the communities and development agents. At each agro-ecology, one focus group discussion was held with the community. The main purpose of the focus group discussions was to get insights on and understand the perception of the people about climate change, its impacts, causes and their responses. The major discussion topics were local communities' understanding of climate change and its cause, major hazards and their impact and adaptation strategies and barriers to employ them effectively. About 15 persons were participated at each FGD.

**Observation:** Observation was made as supportive or supplementary technique to collect data that can complement or set in perspective the data obtained by other means (Robson, 1995). During the researcher's stay in the study area, he was able to observe various environmental changes. The researcher observed changes in agro-ecology, vegetation covers, other topographic features, development interventions and peoples' perception.

**Document review:** various documents available at *regional, zonal, wereda* and *kebele* level were reviewed and used to generate secondary data. Census reports, activity progress reports, relief distribution that contain demographic characteristics, climate distribution, and economic information were reviewed and used to supplement the primary data.

### **Data analysis and presentation**

Data obtained from various sources were analyzed using qualitative and quantitative data analysis techniques. The qualitative information gathered using direct observation, focus group discussion and interview were analyzed and transcribed using qualitative techniques, whereas the quantitative data generated by questionnaire and meteorological data were analyzed using descriptive statistics. Descriptive statistics such as mean, frequency, crosstabs, percentage and count were used to characterize farmers' perceptions on long-term temperature and precipitation changes as well as various adaptation measures used by farmers, and barriers they face to adapt. Descriptive statistics based on summary counts of the questionnaire structure were used to assess farmers' perception, adaptation options, and barriers they faced to adapt. For perception, further comparison was made by undertaking linear trend analysis of annual mean of temperature, and total annual rainfall of 22 years (1987-2009) record obtained from *Mota* meteorological station. Coefficient of variation and percent of deviation used to discern rainfall variability. Statistical Package for Social Science (SPSS) version number 19, Instat+ V3.36 for Windows and EXCEL 2010 software were used as the tools of analysis.

### **Working definition of terms**

**Climate change-** Refers to a statistically significant variation either in the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural processes or external forces, or persistent changes in the composition of the atmosphere or in land-use due to anthropogenic factors (IPCC, 2001).

**Climate Variability: -** Refers to variations in the mean state and other statistics (such as standard of deviations, the occurrence of extremes, etc.) of the climate on temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability) (Levina & Tirpak, 2006).

**Vulnerability: -** Vulnerability to climate change means different things to different people. The Intergovernmental Panel on Climate Change describes vulnerability as the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change including increased variability and downside risk (IPCC, 2001).

**Adaptation: -** The IPCC (2007) defines adaptation as “an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities”.

**Adaptive capacity: -** The potential or capability of a system to adjust to climate change, including climate variability and extremes, to moderate potential damages, to take advantage of opportunities, or to cope with consequences (Smit and Pilifosova, 2001).

**Mitigation: -** The IPCC (2001) defines Mitigation as” an anthropogenic intervention to reduce the sources or enhance the sinks of Green House Gases (GHG).

**Perception: -** As Ban and Hawkins (2000) cited in Bhusa, 2009 define perception is the process by which we receive information or stimuli from our environment and transform it into psychological awareness.

**Resilience –** Refers to three conditions that enable social or ecological systems to bounce back after a shock. The conditions are: ability to self-organize, ability to buffer disturbance and capacity for learning and adapting (Tompkins E. et al. 2005).

## **CHAPTER FOUR**

### **4. RESULTS AND DISCUSSIONS**

This chapter discusses and presents observation results of climate variability and change, local peoples' perception of climate change, impacts of climate change, coping mechanisms and adaptation practices and barriers to adaptation in the study area based on results obtained from household survey, historical rainfall and temperature records, and qualitative information generated from various groups of the community and concerned officials through FGDs and interviews.

#### **4.1 Profile of the respondent households**

The survey results reveals that of the total household heads included in the survey, 25% and 75% were female-headed and male-headed households respectively. The age distribution of the respondents ranges from 22-92 years with an average age of 50 years. However, more than half of the respondents (52%) are below the average. Regarding marital status, 84% of the respondents are married, while 16% of them are single. Although the average household size of the respondents is 6, the absolute size of the respondents ranges from 1 to 12 members.

The survey results also shows that of the total household heads included in the survey 99% and 1% ethnically were Amhara and Tigre respectively. In terms of religious composition, 89% of the survey households are adherent of orthodox Christianity, and the proportion of Muslims is 11%.

As shown in table 3, more than half of (63%) of the household heads were illiterate with no formal education of any kind and thus are unable to read and write. Only 31% of the respondents stated that they could only read and write, while only 6% have very limited formal schooling, 5% completed first cycle education. As a result, 89% of the households were farmers and 11% were both farmer and petty-traders.

Regarding household income, it was difficult to establish because the respondents could hardly tell sincerely their household earnings. However, an attempt had been made to know their income by asking the amount of croup production per year and converting it to Ethiopian birr based on the current market price. Accordingly, the income distribution of the respondents ranges from

750-22000 Ethiopian birr with an average income of 7546 birr per year. However, 58% of the respondents earn below the average. On average a household holds about 1.78 hectare of land.

Table 3: Characteristics of the respondents

Characteristics of the respondents		Frequency	% respondents
Sex of HHs	Female	30	25.0
	Male	90	75.0
Religion of HHs	Muslim	13	10.8
	Orthodox	107	89.2
Ethnicity of HHs	Amhara	119	99.2
	Tigre	1	0.8
Marital status of HHs	Single	19	15.8
	Married	101	84.2
Place of HHs	Simada	120	100
HHs by agro- ecological zone	Midland (woina dega)	53	44.2
	Lowland ( <i>kola</i> )	67	55.8
Educational levels attained by HHs	Illiterate	75	62.5
	Read & Write	37	30.8
	1st cycle completed	6	5.0
	2nd cycle completed	1	.8
	High school completed	1	.8
Current occupation of HHs	Farmer	107	89.2
	Farmer & Petty-trader	13	10.8

Source: Field survey, 2010

#### 4.2. Patterns of the local climate

In general, meteorological stations in Ethiopia are few in number and data for most of the stations is very scant and incomplete. There is one recently, in 2005, established meteorological station in Simada *wereda*. Hence, there is no reliable detailed information on aspects of climate of the area from this station. Although incomplete, information from the nearest meteorological station of Mota town, which is located southwest of the study area at 48 km distance, was used by proxy and has topography similarity to analyze the situation. Monthly rainfall and temperature data of

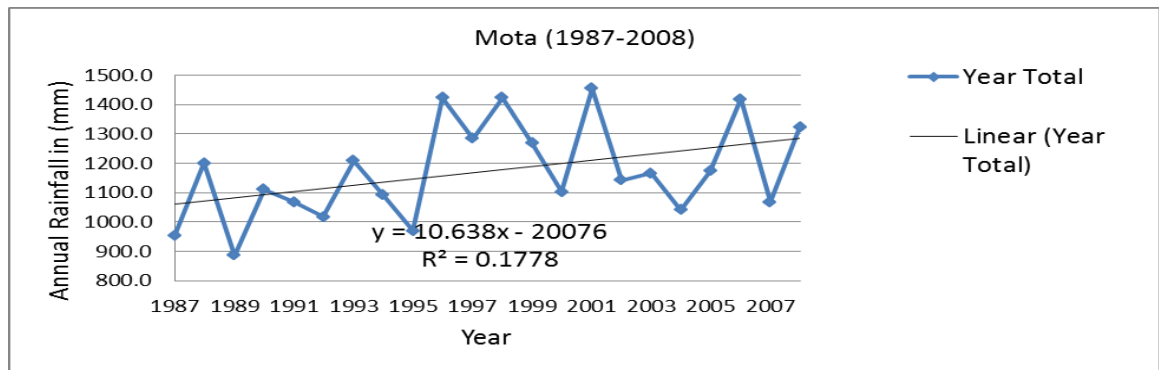
1987 to 2008 for Mota station was obtained from National Meteorological Service Agency (NMSA). However, temperature data for some months of the year 1991, 1994, 1995, 1996, and all months of 2007 rainfall data for some months of the year 1991 and 2006 were missing. Hence, the missing data were replaced by computed average temperature and rainfall values of the station. Different estimation methods for replacing the missing values are available in SPSS software. The researcher used mean of the nearby points for replacing the missing values.

#### 4.2.1. Annual and seasonal rainfall variability and trends

##### Annual rainfall variability and trends

The average annual rainfall of Simada ranges between 1000 mm in the driest year to 1500 mm in the wettest year. As it is shown in figure 3, annual rainfall has experienced inter-annual variability over the past 22 years. Analysis of linear trend of annual rainfall indicates an increasing trend in the station. The amount of rainfall was increased by about 10.6 mm every year between 1987 and 2008 (Figure 3). The inter-annual patterns of rainfall distribution showed that annual amounts were below the average for periods before 1996.

Figure 3: Inter-annual Rainfall Patterns and Trends of Change



Data source: NMSA, 2010

Based on inter-annual rainfall amount records, analysis for Choke Mountain covering the period 1970-2009 reported similar trends, an increasing trend of rainfall amount in the areas (Bewket 2010). Similarly, after analyzing the inter-annual rainfall amount trend of the central highlands of Ethiopia, Mahadie (2001) reported similar finding of an increasing trend.

Table 4: change and variability of mean annual, *meher* and *belg* rainfall (1987-2008).

	Mean Rainfall in (mm)	CV (%)	Trend
Belg	163.64	45	-0.23
Meher	847.87	16	8.82
Annual	1172.8	14	10.63

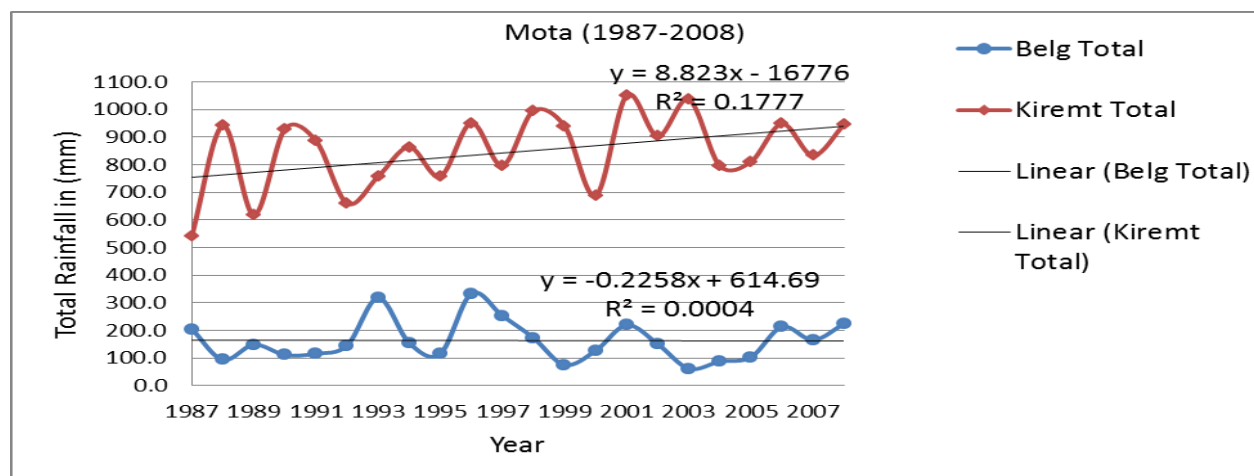
Source: NMSA, 2010

The coefficients of variation were about 45%, 16%, and 14% for *belg*<sup>4</sup>, *meher*<sup>5</sup> and annual total rainfall respectively, which indicated there was high inter annual variability of rainfall in the period between 1987 and 2008. The scales of variation in amount appear more for the *belg* than the rest. Generally the pattern appears erratic.

### Seasonal rainfall variability and trends

Analysis of *belg* rain has shown decline trend from 1987 to 2008. It has decreased by about 0.23 mm every year during the past couple of decades. On the other hand, *meher* rain has showed an increasing trend. The amount of rainfall increased by about 8.8 mm every year in the above noted period (Figure 4). In addition, year to year variability of rainfall of *belg* season was much higher than *meher* season.

Figure 4: *Meher* and *belg* Rainfall Patterns and Trends of Change



Data source: NMSA, 2010

<sup>4</sup> Small rainy season in Ethiopia from February to May

<sup>5</sup> Main rainy season in Ethiopia extends from June to September (NMSA, 2006 cited in Demeke, 2010)

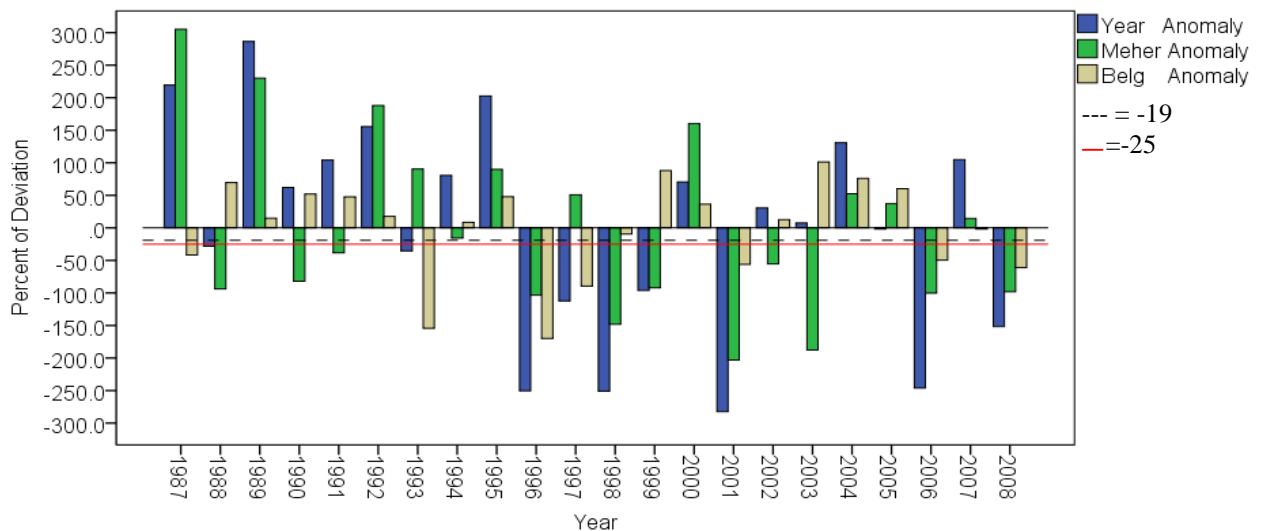
### Metrological drought in the study area

The National Meteorological Service Agency of Ethiopia (NMSA, 1996a cited in Demeke, 2010), defined meteorological drought years based on seasonal rainfall anomaly. According to NMSA drought occur over a region if the negative anomaly from the mean seasonal rainfall 19% or more, but less than 21%. Further droughts are classified as moderate and sever if the seasonal rainfall deficiency is between 21% to 25% and more than 25% respectively.

Based on this criterion, it was found that the area has experienced significant number of drought years. In the period between 1987 and 2008, 11 and 7 severe droughts occurred in *meher* and *belg* seasons. In the same period, 11 annual severe droughts occurred. This indicates the frequency of drought has been once in two years. Among the 11 severe droughts which occurred in *meher* season 7 of them happened from 1998 to 2008. This clearly indicates that the frequency and severity of drought increased over time.

Generally, as can be seen from figure 5, the frequency and severity of drought has increased in *meher* season but it were relatively constant in *belg* season over the period.

Figure 5: percentage deviation of annual total, *meher* and *belg* rainfall



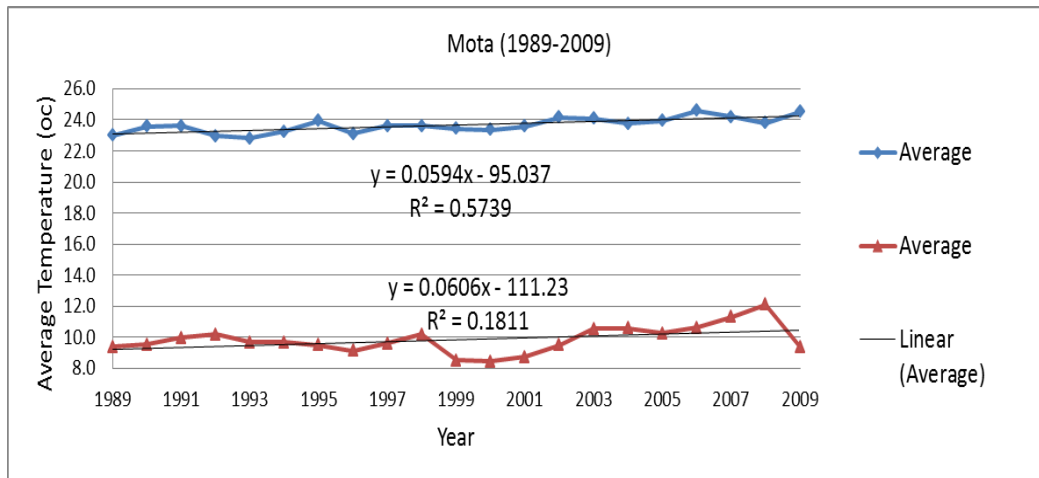
Data source: NMSA, 2010

#### 4.2.2. Temperature variability and trends

According to NMSA (2007), the average annual minimum temperature over the country has increased by about 0.37°C, whereas, average annual maximum temperature has increased by about 0.1°C every decade (NMSA, 2001). Temperature distribution in the study area was

characterized by a general trend of increase and vivid inter-annual variability. As depicted in figure 6, the average of maximum and minimum temperature has increased by about 0.6°C every decade which is much higher than the national average since 1989 in the study area.

Figure 6: Patterns of annual average maximum and minimum temperature in the study area.



Source: Data source: NMSA, 2010

This finding is consistent with studies of Muna (2006), in which she showed that an increasing trend of temperature by about 0.3°C per decade in the Ethiopian highlands.

### 4.3. Local peoples' perception of climate change

Understanding of local peoples' perception to climatic variation is crucial to designing appropriate adaptation and coping strategies to climate change and variability for many poor countries that are highly vulnerable to the impact of climate change and variability (Maddison, 2006 cited in Demeke, 2010). It is important to have an insight of local peoples' view on temperature and rainfall trends of change to dig out locally available climate change and variability adaptation options. In line with this, FGD participants, key informants and respondents were asked their understanding of climate change and source of information. Their response shows that most of the people and more than 93% and 91% of the respondents were informed and understand climate change respectively. The respondents reported that the major sources of climate change information were radio (74%) and government agents (26%) (See Table 5).

Table 5: Local communities understanding of climate change and source of information

Questions		Frequency	% of respondents
Have you heard of the word “climate change” before?	Yes	112	93.3
	No	8	6.7
Do you understand what “climate change” mean?	Yes	109	90.8
	No	11	9.2
From which source you heard about climate change?	Radio	83	74.1
	Governments	29	25.9

Source: Field survey, 2010

#### 4.3.1. Local community understanding and perception of changes in rainfall

All participants of FGDs, key informant and expert interviewees recognized there were changes in rainfall amount, its timing and distribution in the study area over the past 20 years. This was substantiated by household respondents. The survey result reveals that all the respondent household heads included in the survey perceived long-term change in pattern of rainfall amount and distribution. Most of the household heads (97%) showed that rainfall amount in Simada *wereda* in the last 20 years showed a decreasing trend whereas only 3% of the respondents reported it has increased.

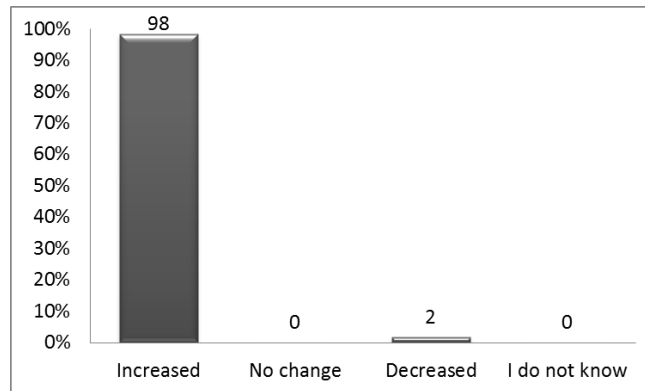
In the survey, local people were asked to tell what indicators they have been using to perceive changes in rainfall over the last couple of decades. Their responses revealed that loss of livestock and plant species (69%), increased frequency of occurrence of drought and flood (98%), shortening of growing period (99%), rainfall comes early or lately (97%), decline of agricultural yields (99%) and decreased available water (93%) were reported as indicators of changes in rainfall in the area over the past 20 years.

Although the trend analysis is in harmony with only 3% of the respondents who felt an increased rainfall amount, it does not in any way contradict perceptions of respondents who observed decreased *belg* rainfall amount, increase in flood and drought frequency, growing period shortened, decreased available water, decline of agricultural yields, loss of some animal and plant species and change in the timing of rains.

### 4.3.2. Perception of temperature changes

In the FGDs and interviews, the local people and experts indicated that since the downfall of the Derg regime the temperature pattern has changed and shown an increasing trend in amount and intensity. The survey result reveals that out of the total household heads included in the survey, all of them perceived there is long-term change in temperature in Simada over the past 22 years. Out of which, 98% recognized increased in temperature and the remaining 2% felt there is a decreasing trend (figure 7).

Figure 7: local peoples' perception of changes in temperature in Simada, 2010.



Source: Field survey, 2010

In the survey, the respondents were asked to identify some of changes they have observed in the environment resulting from changes in temperature over the past couple of decades. Prevalence of newly introduced human and animal disease (61%), introduction of new plant and animal species that were not common in the area (61%), change in clothing style (61%), dry up of rivers and streams (96%), habitat shift towards higher grounds (60%) and damage of crops caused by pests (96%) were some of indicators in the environment reported by the respondents as a result of changed temperature over time. FGD participants also show increasing water consumption, loss of indigenous seeds and melting of butter are indicators of increasing temperature in the area.

As can be seen from figure 7 above, about 98% of the respondents perceived increased temperature. This is in accordance with the trend analysis of both inter-annual mean minimum and maximum temperatures.

The key informants also pointed out that the patterns of temperature in Simada *wereda* changed. For instance, one farmer key informant explained:

I lived here in Simada wereda for about 67 years. I can tell you that temperature of Simada wereda during the Derg regime was different from that of today. For example, during the Derg regime the month of October was very cold but now it is as hot as in the month of February. In addition, clothes that people were using changed from thicker to lighter ones. Not only these, due to increased temperature barley, wheat and boleke affected by pests after harvest which is new for us.

The assessment of climate change by people of different sex showed that the proportion of female respondents who have heard about climate change in the study area was 87%. The remaining 13% did not have any idea about climate change. About 96% of male respondents reported that they have heard about climate change (see Table 6).

Table 6: Respondents' awareness of climate change by sex differential (N=120)

		Sex of household head			
		Female		Male	
		Count	Percent	Count	Percent
Have you heard of the word "climate change" before?	Yes	26	86.7	86	95.6
	No	4	13.3	4	4.4

Source: Field survey, 2010

When the respondents' awareness of climate change is assessed in relation to their educational status, observations showed that as the level of literacy increases, their awareness of climate change also increases (see Table 7).

Table 7: Respondents' awareness of climate change by educational status (N=120)

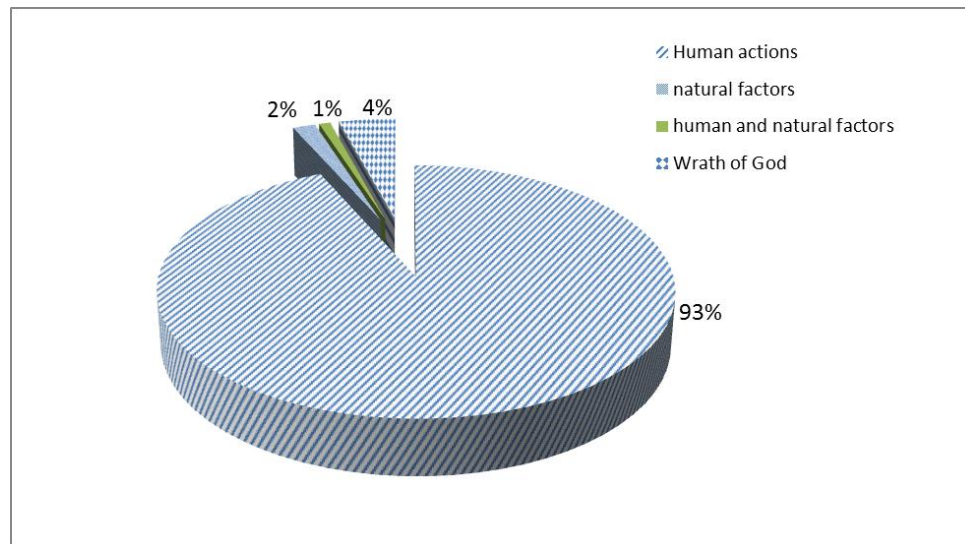
		Have you heard of the word "climate change" before?			
		Yes		No	
		Count	Percent	Count	Percent
Educational status attended by HHs	Illiterate	68	90.7	7	9.3
	Read & Write	36	97.3	1	2.7
	First cycle complete	6	100.0	0	0
	Secondary education complete	2	100.0	0	0

Source: Field survey, 2010

#### 4.4. local peoples' perception of cause of climate change and its impacts

Most peoples in Ethiopia consider climate change as an act of God, which is regarded as punishment for peoples' wrong doings. However, a few people associated climate change with anthropogenic factors. In the contrary most of the respondents in the study area associated climate change with human action. The responses disclosed that more than 93% of them associated climate change with human action. Of the total respondents, only 4% consider climate change as an act of God, which is a punishment for peoples' wrong doings (see Figure 8).

Figure 8: local peoples' perception of cause of climate change in Simada *wereda*, 2010.



Source: Field survey, 2010

The respondents also listed down some of human activities, which affected the local climate. More than 90% of the respondents showed that over cultivation, loss of forest and population pressure are the main cause of climate change in the study area. They gave little credit for the contribution of fossil fuels and air pollution to climate change.

Table 8: local peoples' perception on cause of climate change from human activities

Cause of climate change		Frequency	% of respondents
Use of fossil fuels	Yes	13	10.8
	No	107	89.2
Loss of forest	Yes	113	94.2
	No	7	5.8
Air pollution	Yes	8	6.7
	No	112	93.3
Population pressure	Yes	107	89.2
	No	13	10.8
over cultivation	Yes	112	93.3
	No	8	6.7

Source: Field survey, 2010

Many of FGD participants, community representatives and experts also identified deforestation, population pressure, wrath of God, shortage of land, poverty, and over cultivation as causes of climate change at local level.

Hazards are events or occurrences that have the potential for causing injury to life, or damage to property or the environment on which the community depends for its social and economic existence. In addition to distinct events that occur at specific points in time and space, the definition of hazards has been extended to include embedded features of the physical, social, political and economic environment with effects that gradually (cumulatively) cause disastrous outcomes. Hazards can be sudden events (such as epidemic dysentery and flood) or things that accumulate gradually (for example soil erosion and population growth) (SERA, 2000).

In the study area, drought, pests and disease, and flood are recurring problems affecting agricultural activities and human wellbeing. Landslide is also another hazard recently occurring in Simada *wereda* due to increasing intensity of rainfall. Nearly all (99%) of the respondents assured that the existence of climate change induced-hazards.

**Drought:** - Drought is not a new phenomenon in Simada *wereda*. The area experienced several droughts over the past years. In its 2000 vulnerability profile assessment report, the SERA project

disclosed the prevalence of droughts on the average every 2 to 3 years particularly after 1966 in Tach Gaint wereda which borders Simada. More than 90% of the respondents reported that, the recurrence interval of drought has changed in recent periods. The re-occurrence interval became more frequent and takes only, 1-2 years, giving no sufficient time to recover from its past impacts. Drought, which can include both insufficient amount of rainfall and uneven distribution over the rainy season, is the single most important cause of acute food insecurity in the zone.

Rainfall is bimodal in Simada *wereda*. While the 2010 *belg* rain started on time, it was characterized by poor distribution and insufficient amount. This has adversely affected land preparation for *meher* crop productions and sowing of long cycle crops. In the highlands of Simada *wereda* failure of the *belg* rain led to failure of root crops and other green vegetables production in 2009. The *meher* rain, on the other hand, was late by one month in all areas of Simada. Nevertheless, the distribution of *meher* rain has remained favorable for the remaining period. An exception to this is the lowland parts of the *wereda*, where rainfall has been poor in quantity and distribution.

The survey result reveals that 97.5% of the respondents confirmed the severity of very recent drought. For instance, FHI has assisted 22,000 people with regular food distributions for the months of July through September in 2002. The number of beneficiaries increased to 78,767 in 2009. In addition, 1,337 beneficiaries moved to a resettlement area. Community representatives and experts confirmed also the existence and severity of drought recently.

**Pests and diseases:** - climate change has direct and indirect impacts on prevalence and spread of pests and diseases (Aklilu & Alebachew, 2009a). Community representatives and experts indicated that the study area is exposed to human diseases, livestock diseases and crop pests. Livestock diseases are mainly anthrax (cattle and goats), sheep and goat pox, lack leg, internal and external parasites (cattle and goats), pasteurellosis, African horse fever and lamp skin. Crop pests are a chronic problem in the administrative zone of South Gonder, of which the most hazardous are stalk borer (sorghum and maize), Aphids (all crops), cut worm, root rot, shoots fly (teff), African boll worm and late blight, Striga (sorghum and maize). Human diseases are malaria, diarrhea and typhoid.

Experts told that human and livestock diseases and crop pests are not new for the study area. However, climate change resulted in an increase in the frequency of occurrence of pests and

diseases in recent years. For instance, malaria was not common in the highland and midland part of the study area but now a day it is becoming a common problem in these areas. Small increase in temperature and change in precipitation can result in measurable impacts on pests and diseases (Haines, et al., 2006 cited in Aklilu & Alebachew, 2009a).

**Flood:** - flood is one of climate change induced-hazards in Simada. Floods are common among those who live near riverbanks, inside valleys, at foot (bottoms) of mountains and on hillside of rugged terrain in the study area.

**Landslide:** - Landslide is very recently occurring hazard in Simada *wereda*. As indicated by Ato Liyew Ferede, head of Disaster Prevention and Preparedness Office (DPPO) of Simada *wereda*, *the area* has encountered landslides in 2010 summer season when the ground become too wet because of excessive rain. In August 2010, DPPO reported the death of 142 livestock and displacement of 438 peoples in the study area. In addition, Landslide destroyed houses, agricultural lands and infrastructure such as roads.



Figure 9: Area affected by landslide in 2010

#### 4.4.1. Impacts on livelihood

Climate change and variability have had serious impacts on livestock and crop production in Simada *wereda* recently. Both crop production and animal husbandry are practiced in the area. As a result, livelihood of the people is dependent on crop production and animal husbandry. Hence, the livelihood of the people is sensitive to climate change. The main natural constraints to accessing food and generating cash income include drought, pest infestation and livestock disease. According to SARDO, climate change and variability particularly reoccurrence of drought, early cessation and late onset of rain, heavy and unseasoned rain and pests has caused massive crop failure. Respondents were asked about the impacts of climate change induced-

hazards in Simada. As shown in table 9, the most commonly mentioned impacts of climate change were famine (98%), shortage of feed of animals (98%), loss of livestock (97%), shortage of water (95%), forced to out-migrate (91%), expose to disease (80%) and more deaths observed amongst household member (21%).

Table 9: Respondents understanding of the impact of climate change (N=120)

<b>Impacts of climate change</b>	<b>Frequency</b>	<b>% of respondents</b>
Famine	118	98
Shortage of feed of animal	118	98
Loss of livestock	117	97
Shortage of water	114	95
Forced to migrate	110	91
Expose to disease	96	80
Death of household member	25	21

Source: Field survey, 2010

Some of impacts of climate change on livelihood of the people reported by FGD participants, community representatives and experts include: reduction of crop and animal production, intensification of pests and diseases, shortage of water, food and feed of animals.



Figure 10: Livestock affected by drought in 2009

The household survey data shows that there is declining trend in the production and availability of food crops in Simada *wereda* (Table 10). Generally, about 86% of the respondents reported that crop productivity was better in the past (20 years ago) than recent years (2010). As I noted earlier, climate variability and change particularly drought, early cessation, late onset, heavy and unseasoned rain and pests were the major reasons for the reduction of crop production. For

instance, hundreds of thousands people in Simada and neighboring *weredas* have suffered from insufficient *belg* rainfall for much of 2009. As a result, crop yields were low, many livestock are died and market prices soared.

Table 10: performance of crop production over the past 20 years

		Frequency	% of respondents
Performance of crop production 20 years ago	Good	100	86.2
	Normal	13	11.2
	Poor	3	2.6
Performance of crop production in 2010	Good	11	9.2
	Normal	37	30.8
	Poor	72	60.0

Source: Field survey, 2010

An assessment of tame animal possession of sample households was conducted in the area in the last 20 years. Average ownership of tame animal per household in the sample shows that the number of domestic animal assets decreased over time (Table 11). For instance, the average number of livestock per household in the study area has declined from 3 oxen, 2 cows, 10 goats, 8 sheep and 2 pack animals before 20 years to 1 ox, 1 cow, 6 goats, 3 sheep and 1 pack animal at present. This shows a declining trend of animal assets.

Table 11: Tame animal possession of sample households during the past 20 years

Livestock	Average number	Total
<b>Before 20 years</b>		
Oxen	3	301
Cows	2	258
Goats	10	1118
Sheep	8	925
pack animal	2	286
<b>2010</b>		
Oxen	1	170
Cows	1	120
Goats	6	670
Sheep	3	408
pack animal	1	86

Source: Field survey, 2010

Generally, the households in Simada are facing declining trend of crop and animal production because of erratic rainfall, intensified occurrence of pest and diseases, and increased temperature. As a result, considerable portions of the households were exposed to food shortage. In line with this, household respondents were asked about food shortage and around 82% of the total household heads reported that they faced food shortage for 5 months on average every year. They also add that the situation is aggravated over time. As shown in Table 12, the problem was more pronounced and critical in lowland areas.

Table 12: Food scarcity by agro ecology of residence of household heads

		Have you ever faced food scarcity in your household?			
		Yes		No	
		Count	Percent	Count	Percent
Household heads in	Midland	33	62.3	20	37.7
	Lowland	65	97.0	2	3.0

Source: Field survey, 2010

#### 4.4.2. Impacts on natural resources and the environment

Table 13 shows households assessment of the state of environmental resources in the area. About 82% and 77% of the respondent households in the study area indicated that the forest cover and water availability have decreased over time respectively. About 86% of the respondents were also assured increment of problems of soil erosion in Simada wereda. Generally, 96% of the respondents show that land degradation is serious problem of the society now a day.

Table 13: Households' assessment of the state of environmental resources

State of environmental resources		Frequency	% of respondents
Change in forest cover	Increased	22	18.3
	Decreased	98	81.7
Problem of soil erosion over time	Increased	103	85.8
	No change	3	2.5
	Decreased	14	11.7
Change in water availability	Increased	28	23.3
	Decreased	92	76.7
Land degradation	Yes	115	95.8
	No	5	4.2

Source: Field survey, 2010

Focus group discussion participants, community representatives and experts also established existence of environmental degradation due to climate change related hazards. They also outlined attributable factors of the above noted problems, which include population pressure, settlement expansion and collection of firewood and expansion of agricultural land.

#### **4.4.3. Which group of the community is more affected?**

In the study area, women and children have several household responsibilities. They are taking care of children, fetching water, collecting firewood and cooking food. Impacts of climate change create additional burden on women and children. Table 14 shows participants of household members in basic household activities of fetching water and collecting firewood. Mainly female children and women carry out the routine household activities. Key informants and experts assured that children and women are more affected by climate change impacts.

Table 14: Participants of household members to fetch water and collect firewood

Activities		Frequency	% of respondents
Fetch water and collect firewood	Male adult	10	8.3
	Male children	3	2.5
	Female adult	23	19.2
	Female children	84	70.0

Source: Field survey, 2010

## **4.5. Responses to climate change**

### **4.5.1. Local responses**

For many years, the local people of the study area have struggled against the impact of different types of natural hazards. In order to adapt the impact of climate change hazards, which are noted in the preceding sections, the local communities have been applying different strategies. However, increased frequency and intensity of climate change impacts have reduced the capacity of local people to adaptation and cope with the problems.

The household survey indicates that it is possible to adapt with some of the impacts of climate change induced-hazards. About 90% of the respondents confirmed same. In line with this, household respondents were asked responsibility for the adaptation practice. About 94% of the responses established that adaptation to changing climate was the responsibility of individual

respondent where as 67.5% of them considered it was the responsibility of international organization, 84% and 86% regarded as responsibility of the regional and local governments and local communities respectively (Table 15). Key informants and FGD participants confirm same.

Table 15: Respondents perception of responsibility for adaptation practices (N=120)

Who is responsible for the adaptation practice?		Frequency	% of respondents
International organization	Yes	81	67.5
	No	39	32.5
Local community	Yes	103	85.8
	No	17	14.2
National and local government	Yes	101	84.2
	No	19	15.8
Own initiative	Yes	113	94.2
	No	7	5.8

Source: Field survey, 2010

Respondents were also asked whether they were engaged or not in activities with the purpose of coping with local impacts of climate change. About 86% of them were engaged in activities related to coping with local impacts of climate change. Local peoples adopted a wide range of response measures to counteract the impacts of climate change induced-hazards. The household head were asked to identify their major adaptation strategies. Their responses are depicted in Table 16. In concrete terms, more than 90% engaged with reforestation, terracing, growing short maturing crops and change in cropping pattern, while 17 % abandoned cultivation of steep slope areas, 88%, adopted practicing family planning, 9% harvest rainwater and 48% of them diversified their household income.

Table 16: Household's responses to climate change (N=120) (Multiple response)

Responses to climate change		Frequency	% of respondents
Reforestation	Yes	119	99.2
	No	1	.8
Terracing	Yes	118	98.3
	No	2	1.7
Rain water harvest	Yes	11	9.2
	No	109	90.8
Change in cropping pattern	Yes	114	95.0
	No	6	5.0
Growing short maturing crops	Yes	110	91.7
	No	10	8.3
Stops cultivation of steep slope areas	Yes	100	16.7
	No	20	83.3
Family planning	Yes	105	87.5
	No	15	12.5
Diversified income	Yes	57	47.5
	No	63	52.5

Source: Field survey, 2010

**Change in cropping pattern:** The household survey indicated that change in cropping pattern, which is dominantly practiced by farmers, was reported by about 95% of the respondents. Rainfall in the study area is very erratic and unpredictable recently. As a result, farmers could not be certain about rainfall condition even after the onset of rain. According to them, even after the onset, rainfall could be heavy or light or it may stop earlier than the expected time. The farmers are aware about the type of crops planted in accordance with the characteristic (pattern) of the rain. As a result, the cropping pattern of the study area changed from *Teff*, Wheat, Barley, Maize, Sorghum, Bean, *Gomenzer*, Pea, Lentils, Chickpeas, *Guaya*, Sesame, Sunflower, Potato, Garlic, and “*Abish*” dominant, according to their decreasing importance, to *Nech boloke*, Wheat, Barley, *Teff*, highland pulses (Faba Beans, Lentils, Field peas, Chickpeas and Vetch), highland oil crops (*Noug* and Flax), and lowland oil crops like Safflower, Green paper, etc.

Although soil erosion, government policies, land scarcity, market situation and population pressure are the cause of cropping pattern change, all of the respondents have had the opinion that the contribution of climate change is considerable (table 17).

Table 17: Respondents perception of cause of cropping pattern change (Multiple responses)

Cause		Frequency	% of respondents
Climate change	Yes	120	100.0
	No		
Soil erosion	Yes	59	49.2
	No	61	50.8
Land scarcity	Yes	2	1.7
	No	118	98.3
Market situation	Yes	110	91.7
	No	10	8.3
Government policies	Yes	26	21.7
	No	94	78.3
Population pressure	Yes	17	14.2
	No	103	85.8

Source: Field survey, 2010

**Growing short maturing crops:** More than 91% of the households plant early maturing crop types. According to FGD participants, early maturing crop are planted due to shortening of growing season in the study area. For instance, *meher* season is shortened from four to two months. As a result, *Feshoteff* and *Nech boloke* in lowland and *HR* Wheat and Barley in highland became more common crops recently. *Nech boloke* was not common crop in the area in the past years but recently it has become dominant crop in lowland area of Simada *wereda* because of climate change.

**Reforestation:** The largest proportions (99%) of the respondents reforested hill sides and deforested areas in their locality. They explained that soil erosion by flood and increased temperature are serious problem. Therefore, the only solution for this problem is reforesting the deforested area. Participants of FGDs also confirmed that soil erosion by running water and increased temperature forced them to reforest hilly area in order to protect their farmland from soil erosion by flash flood. Such method is viable in increasing agricultural productivity and

assists to control increasing temperature. Moreover, more than 98% of the respondents also practiced terracing along the hilly areas and on the farmland to control soil erosion and increase agricultural productivity. About 83% of the respondents reported that reforestation and terracing were practiced by stopping free grazing of sloppy areas.



Figure 11: Local peoples involved on terracing activity in 2010.

**Rainwater harvesting:** Rainwater harvesting for growing crops is another viable option to compromise scarcity of water. However, only 9% of respondents practiced rainwater harvesting to curb the problem of food scarcity that resulted from erratic rainfall by growing vegetables in homesteads because of water scarcity, increased evaporation and low level of awareness.



Figure 12: Rainwater harvesting in 2010

**Family planning:** Reducing the number of family size is another adaptation option that has been undertaken in Simada *wereda*. According to the survey data in table 12, 88% of household head respondents in the study area claimed to employ this option to apprehended drought or food scarcity.

**Diversification of household income sources:** Diversification of household income sources is a method used by local people to increase their income to compensate the amount of earnings lost due to decreased agricultural productivity. The respondents asked whether they were engaged in

diversifying sources of household income or not to cope with climate change impacts. Some households reported that they have diversified their income sources. The household survey showed that about 80% of the total households reported that they were engaged in non-farm activities because of climate change (Table 18). Of the total respondents 56% and 9% engaged in wage labor and petty trading, respectively, whereas, 11% of them preferred to out-migrate to other towns and other rural areas and more than 22% showed no interest to involve in non-farm activities.

Table 18: Activities that are diversifying households' income sources

Questions		Frequency	% of respondents
Did you (or your household members) engage in non-farm activities because of climate change?	Yes	96	80.0
	No	24	20.0
If yes, what were these non-farm activities?	Petty-trading	11	9.2
	wage labor	67	55.8
	Migration	13	10.8
	Other	2	1.7
	No response	27	22.5

Source: Field survey, 2010

Result of FGD, community representatives and experts also showed that local peoples were more engaged in non-farm activities to subsidize their agricultural income. Wage labor, petty-trading, charcoal making, firewood selling, handcraft and others are among the activities local people engaged.

In addition to the aforementioned coping mechanisms and adaptation strategies, the local communities also used coping mechanisms at time of food shortage. Among these were reducing numbers of meal, selling assets, loan, earning money or else from daily labor and requesting aid from NGOs. The government was the main source of food at times of food shortage.

#### **4.5.2. NGOs responses**

FHI, NGO, operating in the study area, play a significant role in assisting local development and emergency activities. By considering the area as drought prone, FHI has been implementing several projects aimed at disaster impact mitigation and poverty reduction in the study area.

Despite inability of the projects in achieving the objective of attaining food security and mitigating disaster impacts, it saves the lives of many peoples. Some of the activities of the FHI are discussed in the following sections.

### **Assist and improve the assets and livelihoods of food insecure households**

The recurring droughts and associated food shortages in the project areas forced the community to use destructive coping strategies like selling basic assets. This has consequently eroded the household's resilience, which increased vulnerability to further shocks. In order to tackle this destructive cycle FHI has implemented various activities to protect and improve household's assets and livelihood.

**Emergency food aid:** - Food availability is below the annual requirements in Simada *wereda*. Local production in normal years supports the family only for six months. This has put the community under a six-month food gap every year. The number of food deficient months increased due to occur of external shocks. With the view to bridge food gaps and thereby contribute to asset and livelihood protection of the chronically food insecure beneficiaries, the FHI has implemented various activities. For instance, Warehouses were constructed and maintained, and about 8065.25 metric tons of food was distributed in 2009.

*Figure 13:* Snapshot of warehouse and commodity distribution in Simada



Soure: FHI

**Early Warning and Response:** - Improving the early warning system is the basis for proactively responding to the needs of vulnerable communities either through the existing resources or by seeking additional resources. After 2008, FHI has focused on strengthening early warning system of the existing government rather than introducing its own system. In order to attain this outcome, the FHI has provided TOT training to *wereda* level government and FHI project staff.

The same training was also cascaded to community members drawn from *kebeles*. The training encompassed both theoretical and practical aspects including familiarization of trainees to proper use of data collection formats.

**Household income source diversification:** - Currently economic risks related to income fluctuations and savings depletion among vulnerable households are envisaged to be addressed via market-led income generation and diversification activities. For this to be materialized in the study area, high-potential farm and off-farm value chains were researched with the objective of increasing and diversifying rural income by the FHI. For instance, livelihood beneficiaries across the FHI projects have used a minimum of one defined sustainable agricultural technology. The technologies promoted and being used by the livelihood beneficiaries are proper cultural practices, improved high yielding and early maturing crop varieties and improved bee-hives with accessories. The FHI has also encouraged the Productive Safety Net Program (PSNP) beneficiaries to be organized into Self-Help-Groups (SHGs), based on a model adopted from CARE/Ethiopia. In 2009, 5 SHGs with 50 members were organized and became operational across the study area. The project supported these groups by providing village level safe box and technical training on the importance of group formation, saving and credit ventures. Other than these, the project does not inject any external inputs or capital to this type of groups.

Table 19: Households assessment of the responses of NGO (% of households)

Responses to:	Very effective	Moderately effective	Not effective	No idea
Drought	32	46	21	1
Disease	0	14	86	0
Forest management	43	41	16	0
Water management	3	61	34	2

Source: Field survey, 2010

### **Enhancing community resilience to withstand shocks**

Crop productivity has been declining in the study area due to the factors associated with drought, soil erosion and infertility. In order to mitigate significant risk of food insecurity, the FHI has undertaken various activities.

**Conserving and improving community watershed assets:** - intensive training has been given to *wereda* sector office experts and development agents on the concepts & importance of watershed approach and community participation in watershed planning. After the training, the annual target watershed plans were developed across the target *kebeles* in 2009. Gullies were treated with bio-physical conservation measures. Loose stone, gabion and wooden check dams were constructed to halt the growth and expansion of gullies in selected catchments. Following this, the gullies were planted with multi-purpose fodder seedlings. Different community level physical assets created by watershed management approach can directly contribute to improving the food security status of the community through enhancing the community capacity to mitigate the impact of various shocks.

**Improving Availability of Fodder:** - In order to improve livestock feed availability in the target areas, the FHI has given top priority to improving availability and quality of fodder in the target areas. It has employed two main strategies namely Group Based Fodder Production (GBFP) and Backyard Fodder Production (BFP) /homestead fodder plots.

Through GBFP, which is a communal watershed based fodder development approach exotic fodder trees, shrubs, herbs and grasses were raised in central nurseries and planted inside the selected watersheds in 2009. The seedlings are planted on degraded communal lands along hillside terraces, farmland bunds and inside and along gully banks. As the name implies this strategy encouraged the establishment of group managed (communal) fodder plots which will be used as a source of livestock feed and bee-forage.

BFP was promoted in addition to GBFP. BFP was launched to complement government livestock related OFSP beneficiaries and as a pilot in hopes of scaling it up to a wider number of PSNP beneficiaries in the long run.

**Improving Rural Infrastructure:** - FHI has also given special focus to improve rural infrastructure in the program operation areas. To this end, construction and maintenance of rural access road, health facilities, school classrooms and farmer training centers (FTCs) were done in 2009. The construction and maintenance roads activities have significantly contributed to the improvement of agricultural input and output. It has improved also physical accessibility to market places. It is believed that the improvement in community health will in turn significantly improve labor contribution to the agricultural activities and eventually to the food security status

of the target community. Upgrading activities in schools would also contribute towards increasing school enrollment while FTC construction enable development agents (DAs) to render better extension services to farmers.

#### 4.5.3. Government responses

The government of Ethiopia has adopted national policies, sector strategies and programs. The priorities of the national policies, sector strategies and programs of the government are primarily targeted at promoting rural and agricultural development and poverty reduction. Ethiopia has no an explicit policy on climate change. As a result, climate change and adaptation issues are often treated indirectly in sector specific policies and programs since climate impacts are considered as a sub-component of the overall development goal particularly in relation to natural resources and environmental protection (NMSA, 2007). Government responses related to climate change and variability impacts in the study area are discussed in relation to emergency aid, asset protection and livelihood enhancement and disaster risk reduction.

**Emergency aid:** - The government of Ethiopia has long history in supplying emergency aid to victims of various types of disasters like droughts. In Simada *wereda*, the government has been supplying food and non-food items since the 1985s and particularly during recent drought. For example, the government launched a productive safety net program (PSNP) in 2005. Accordingly, the local government allocated more than 2.5 million birr on average per year starting from 2006 for PSNP. The majority of FGDs participants and key informants reported that the government supports those critically food insecure households through its productive safety net program starting from 2006.

Table 20: Households' assessment of the responses of government (% of households)

Responses to:	Very effective	Moderately effective	Not effective	No idea
Drought	18	42	31	9
Disease	24	37	23	16
Forest management	0	12	81	7
Water management	4	36	49	11

Source: Field survey, 2010

**Asset protection and livelihood enhancement:** - Protection of household and community assets reduces vulnerability to the impacts of climate variability and change. Households that have lost all or most of their agricultural products and livestock due to drought, flood and outbreak of disease may face serious challenges that could eventually expose them to destitution (Aklilu and Alebachew, 2009). Since 2004, the national government introduced a productive safety net program aimed to prevention and creation of household and community assets in food insecure and vulnerable *weredas* of the country. During the FGDs and interview with informants from all the study sites reported that the program is supporting vulnerable and destitute households through direct transfer of cash and food in collaboration with FHI. The program also mobilizes the community through food for work arrangements to engage in soil and water conservation, construction and maintenance of rural roads, and planting seedlings. However, a government activity in the management of natural resources has not been effective. For instance, 60282 km terracing and 1228 hectare were covered with plants in 2009 but 29248 km and 367 hectare were damaged in the same year (SARDO). Therefore, increased local people participation and awareness creation is required to reduce vulnerability of households through improved management of basic natural assets. However, 92% of respondents reported that awareness creation is low in the study area. In addition, the government has been supporting households by providing different packages that facilitate diversification of income through the provision of training, loan and tools like beehives etc.

**Disaster prevention and management:** - In drought-prone areas like Simada, the role of government in disaster prevention and risk management is very crucial. In Simada *wereda*, there is Disaster Prevention and Preparedness Office (DPPO) that organized to provide early warning information, assess needs and monitor risks. However, the DPPO in Simada *wereda* is poorly organized, has limited capacity and human and material resources and finance constraints. Most respondent households of the study area (78%) reported that government responses to impacts of climate change were not effective.

FGD participants and key informants indicated that they are not satisfied with responses of the government particularly against droughts, disease and pests which affected the livelihood of the people in the area. In fact, SARDO carried out environmental protection and rehabilitation programs to improve natural resources. However, most of these activities were not effective due to material and capacity limitation and lack of continuity.



Figure 14: Natural resource management by SARDO

#### 4.6. Barriers to adaptations in Simada

As shown in the above sections, a large number of local people consider that climate has become hotter and drier. All the respondents and most of the FGDs participants, experts and interviewed informants perceived changes in temperature and precipitation. Despite the higher level of perception, only 80% of the respondents for changes in rainfall patterns and temperature changes took remedial actions. Even, 62% of those who practiced adaptation confirmed that the adaptation options they employed were not successful. In other words, local people adaptation options were not successful due to various perceived limitations.

This survey assessed local peoples' perceived barriers to using various adaptation options. Survey results obtained from household respondents, FGDs, experts and key informants on barriers to taking up adaptation options indicate that poverty, water scarcity, land scarcity, market problem, lack of information about the weather or long-term climate change, forage and feed scarcity, lack of agricultural technologies and appropriate seed and lack of health service were major constraints of adaptation for many peoples in the study area.

A study conducted by Bewket (2010) in Choke Mountain, East Gojjam, identified lack of access to water, market, information, and knowledge about the appropriate adaptations as barriers to adaptation. In a study made by Bryan, et al. (2010), it was reported that lack of access to land and information represented barriers to adaptation climate change in Ethiopia. These studies support the findings of such study.

**Poverty:** - Adaptation comes at a cost. Hence, poor households have low adaptive capacity. The local people in the area indicated poverty as a major constraint for not taking up the following

adaptation options: changing crop pattern, diversify crop cultivated, digging water wells and rainwater harvesting, implement different soil conservation measures, transforming from dominant crop cultivation to livestock rearing, and adopting non-farm activities. For instance, to engage with petty- trading availability of money, to start with, is a primary precondition. Many people do not have it.

**Land scarcity:** - Another important major constraint of adaptation to impacts of climate change noted by the respondents was land scarcity. Many household heads indicated that diminutive (very small) land holding size was reported as the main cause. Farmers explained that a decrease in their respective land holdings size and farm fragmentation made traditional soil conservation techniques such as fallowing became economically not viable.

**Water Scarcity:** - Water scarcity was mentioned as one of the most critical constraints to climatic change adaptation. Irrigation, digging water wells, rainwater harvesting and putting trees for shade were potential adaptation measures to reduce climate related impacts especially rainfall variability. Although the peasants are well aware of the importance of application of small-scale irrigation, digging wells, etc., most farmers could not employ them because of scarcity of water in the area.

**Lack of Access to market:** - A substantial proportion of respondents indicated that market as a problem, poor access to market facilities, to undertake adaptation options including to change cropping pattern crop diversity and reducing the number of livestock. According to local peoples, access to and information about different crop varieties that can better tolerate rainfall scarcity and variability, drought and use of fertilizer are coming to them only through one channel - SARDO. Best sowing seeds (crop) and fertilizer is distributed (delivered) to them by quota system. Usually such materials are scarce and not available in local markets. Respondents also reported that lack of buyers (local market demand) for crops that are new to the local communities in the area but found to be more productive and can better adapt to changing climate is a problem. Farmers face similar problem poor demand- to reduce number of livestock during period of forage or feed scarcity, water scarcity, famine, or drought due to market inaccessibility.

**Lack of meteorological information:** - Lack of information is one of the most important barriers to adapt in the study area. The respondents and agricultural experts found in the area declared that lack of access to timely meteorological reports (information) is one most pressing constraint for

making adjustment to erratic or reduced rainfall to adjust planting dates. Weather forecasts related with onset and/or offset of rains have never been communicated. They also said that the weather information that rarely delivered to them for pre-harvest is very general and lack specificity. This adversely affects the accuracy, trustworthiness and acceptability of meteorological reports.

**Feed and Forage scarcity:** - Even though both crops and animals are susceptible to climate change and variability, animals seemed to be less affected because of their ability to move. They can escape spatially and temporally stresses full conditions of climate change. For instance, in time of forage and water scarcity, livestock can be sheltered in manmade structures and feed through cut and carry system or taken to a place where there is sufficient water and feed. Farmers were aware of this but could not transform from farming to livestock as scarcity of feed and water is a very severe problem in the area.

**Lack of agricultural technologies and inputs:** - Substantial number of respondents considered lack of appropriate agricultural technologies and inputs as a barrier that constraint to change cropping pattern by introducing new and high value crops, diversify crops in their farms, improve farm productivity, putting trees for shade, and changing use of chemicals and fertilizers.

**Lack of health services:** - A considerable proportion of the respondents and FGDs participants indicated lack of animal health care centers and poor service in the area as one major constraint to adjust and improve livestock management. Due to frequent droughts, livestock exposed to different animal disease. For example, a considerable number of livestock died in 2009.

**Other barriers:** - The survey results showed that lack of appropriate institutions that can assist and facilitate desired changes, lack of employment opportunity, high dependency on rain feed agriculture and food scarcity were some of the problems reported by the respondents and local community members. Participants of FGDs exceptionally raised exaggerated reports about their local situation and unseasoned extension program by government and NGO workers that hinder them to get assistance from the concerned body.

## CHAPTER FIVE

### 5. SUMMARY, CONCLUSION AND RECOMMENDATION

#### 5.1. Summary

Local people in Simada *wereda* perceived changes in temperature and rainfall. They are able to recognize that temperatures, frequencies of drought and flood have increased, and rainfall pattern has become unpredictable and more erratic. They feel there has been a major shift in agro-ecological conditions i.e., the area is becoming warmer and drier by local indicators (standards).

Analysis of historical climate data in the study area reveals that there has been increased rainfall amount and variability. The average annual and *meher* rainfall amount shows trend of increasing, whereas the average *belg* rain showed a trend of slight decrease with high variation (45%) over the past 22 years. Meteorological drought in *meher*, the main rainy season, has become more frequent and intense during the past 11 years. Similarly, temperature pattern clearly showed an increasing trend of warming. The average minimum and maximum temperature has increased by 0.6°C every decade since 1987. Such changes in the pattern of rainfall and temperature created moisture stress, more pressure on the available water supply, forest and range resources. Thus it has exacerbated food and feed shortages and making the environment more vulnerable to future changes in the climate system. As the result of unfavorable changes in the pattern of climate a number of hazards occurred in the study area that exposed the people to the risks of several types of disasters such as drought, flood, land slide and pests and diseases.

For many years, the local people of the study area have struggled against the impact of different types of natural hazards. In order to adapt the impact of climate change disasters the local peoples have been applying different strategies. The major local adaptation strategies include reforestation, terracing, rain water harvest, change in cropping pattern, growing short maturing crops, family planning and diversified income. The local government and NGOs helped the people by emergency aid, asset protection and livelihood enhancement and disaster risk reduction. The adaptation options employed are reactive ones, born out of necessity by the peoples themselves. The adaptation options they employed are not enough to reduce the impact of current climate change and variability due to various barriers. The study identified poverty, water scarcity, land scarcity, market problem, lack of information about the weather or long-term

climate change, forage and feed scarcity, lack of agricultural technologies and appropriate seed and lack of health service were major constraints of adaptation for many peoples in the study area.

## **5.2. Conclusion**

The survey result reveals that most of the local people perceived long-term change in pattern of rainfall amount and distribution and an increasing trend of temperature. Local peoples' perceptions of climate change and variability is in line with the climatic records except annual and *meher* rainfall amount.

Communities of Simada have been facing climate variability and change impacts but today the impacts have become more serious as there has been more climate variability and change-induced disasters as compared to the situation in the past. Generally, the people in Simada are facing declining trend of crop and animal productivity because of erratic rainfall, drought, and increased temperature, intensified occurrence of pest and diseases, and environmental degradation.

Although drought is a common phenomenon in the study area, it has become more frequent and intense in recent years. The drought cycle, reoccurrence interval, has become shorter and prevails almost every other year. The impacts of flood and landslide have also been considerable in recent years when rainfall amount is more than the average. Study results indicated that human and livestock diseases and crop pests are not new for the area. However, climate change resulted in an increase in the frequency of occurrence of pests and diseases in recent years. For instance, malaria was not common in the highland and midland part of the study area but now a day it has become a common problem in the lower *midland* zone. The disasters have caused increased vulnerability to poverty, food insecurity and loss of productive assets. For instance, production of crops and the number of livestock owned by households decreased considerably over the past two decades.

Women and children are most affected by the impacts of climate variability and change-induced hazards in the study area. Mainly female children and women carry out the routine household activities. The hazards created additional burden and make them more vulnerable to the impacts.

For many years, the local people of the study area have struggled against the impacts of different types of natural hazards. In order to adapt the impact of climate change hazards the households

and local communities have applied different adaptation strategies. However, increased frequency and intensity of climate change impacts have reduced the capacity of local people to adapt and cope with the problems. The ever-increasing climate variability and change have challenged the coping and adaptation strategies and the people in the area confronted with a situation they are not equipped to handle the new situation. Some of the coping and adaptation strategies such as selling assets, charcoal making and fuel-wood selling are not only unsuitable but would also cause depletion of assets, resource degradation and even desertification. Hence, institutional support is vital to reduce impacts of the hazards. The NGO operating in the study area has provided some assistance to communities in terms of water shade management, asset protection, livelihood diversification and natural resource management. Though the contribution is encouraging, most of the efforts suffer from lack of continuity and community participation.

The government has also played significant role in introducing adaptation strategies to climate variability and change impacts. However, government responses have been sectorial, short lived and biased towards emergency aid than preventive adaptive measures. The government encouraged communities to mitigate climate variability and change by way of introducing and or enhancing soil conservation measures (terrace, ditch, check dam, agro-forestry), new land use technologies (farming machineries, use of compost, etc.), building health centers, developing small-scale irrigation and rain water harvesting schemes, expanding fertilizer use, expanding markets, education and training (farmers training centers, formal education), strengthening off-farm activities and enforcing the implementation of land use policies, establishing local meteorology stations, monitoring and publishing climate data, developing climate forecasts, and formulating planned and anticipatory adaptation strategies.

Without strong coordination and cooperation of all actors and stakeholders, neither the local people responses nor NGOs and government intervention will sufficiently address the complex impacts of climate variability and change. In this regard, all governmental and nongovernmental institutions have fundamental role to play in developing appropriate adaptation strategies to climate variability and change impacts. In the light of the main findings and conclusions noted above, the writer forwarded the following recommendations.

### 5.3. Recommendations

- **Empowering local people with information and education:** Creating and expanding awareness among the population and policy makers about climate change , its causes and consequences by providing reliable and up to-to-date information to take appropriate adaptive measures.
- **Build on existing local (indigenous) knowledge and practices:** Reviving traditional practices and improving indigenous knowledge on how to harvest rainwater, forest management, crop and livelihood diversification, provide one way of coping with different climatic variability. Interventions need to build on existing knowledge and coping strategies in order to insure sustainability of their activities. Therefore, before planning interventions, a proper assessment of locally available adaptations options and coping strategies should be considered and build upon indigenous knowledge.
- **Improve Agricultural Production:** The people in Simada are facing declining trend of crop productivity because of erratic rainfall, drought, intensified occurrence of pest and diseases, environmental degradation and increased temperature. With the ever-increasing climate variability, the problem shall continue in the future unless appropriate measures are taken. Hence, crop diversification, selecting appropriate variety of crops [i.e., drought and diseases resistant, early maturing and high yielding], improving the method of cultivation and agricultural technologies and promote traditional pest management are areas of critical concern.
- **Protect assets and diversify income sources:** The recurring droughts and associated food shortages in the project areas forced the community to use destructive coping strategies like selling basic assets. This has consequently eroded the household's resilience, which increased vulnerability to further shocks. Protect vital livestock, environmental resources and community water-shade in order to enhance local adaptive capacity and resilience through credit facility, emergency aid, awareness creation etc. Diversification of household income sources is also necessary to minimize exposure to climate variability and change shocks. For this to be materialized in the study area, farmers should be encouraged to take part in off-farm activities such as petty-trading, engaged with handcraft are important. Improving road transport, market and storage &

distribution infrastructure, extension services, training and credit facilities are also some areas of major concern that largely require the attention of government.

- **Environmental rehabilitation:** An area of immediate intervention is the rehabilitation of degraded wasteland that could be rehabilitated if enclosed for some time without human and animal intervention. Resettlement programs would pave the way for such interventions on the one hand and ease population pressure on the other. However, this requires clearly working out the property rights over the final products of such enclosed land. Any conservation program needs to be designed in such a way that the maximum benefit goes to the community, and meet the urgent needs required for the very survival of the community.
- **Foster institutional linkages for livelihood sustainability:** Concerted actions by the national and regional governments and NGOs are needed to tackle the impacts of climate change. The ever-increasing climate variability and change impacts would require institutional involvement and integrated effort to enable rural livelihoods survive in the changing climate and its adverse impacts. In addition, mainstream adaptation and resilience to climate change in the development process.
- **Improve the coverage and quality of climate data:** Meteorological stations in Ethiopia are few in number; hence density of networks of stations is very sparse. Data for most of the stations is very scant and incomplete. There is one recently established (2005) meteorological station in Simada *wereda*. Hence, there is no reliable detailed information on aspects of climate of the area. Climate data is necessary to enhance the understanding, analysis and prediction of climate change and its impacts and for improved preparedness and adaptation. It is therefore necessary to improve the coverage and quality of climate data in the study area in particular and in the country at large.
- In the future, similar studies should be conducted which adequately address the issue of vulnerability to climate change, adaptation and the relative merit of each adaptation option to better guide policy options for adaptation to climate change and to develop a locality specific adaptation menu, which is able to account for impacts of climate change and variability.

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## Annexes

**Annex 1:** Structured questionnaires to be completed by household head

**Title :** Local Peoples' Perception on Climate Change, Its Impact and Adaptation Measures in Simada Wereda of South Gondar.

My name is Marye Belete, a graduate student of addis Ababa University. I am conducting a research for the partial fulfillment of master of art (MA) degree in geography and environmental studies. Therefore, I kindly request the respondent to fill this questionnaire.

Note that:

- All your responses will be held confidential;
- Your name will not be written on this form ;
- Feel free to ask any question you may have about the questionnaire;
- You have the right to obtain information about the findings of the research.

Your genuine participation by responding patiently to the questionnaire is highly appreciated and thanks you for giving your time and willingness to participate in filling this questionnaire.

Household head identification number \_\_\_\_\_

Enumerator name \_\_\_\_\_

Date \_\_\_\_\_

## Part I: Background information of household head

1. Sex of house hold head:

Male  Female

2. Age of household head:.....

3. Religion of household head:

Muslim  Orthodox  
 Protestant  Other (specify) .....

4. Ethnicity of household head:

Amhara  Tigre  Other (specify).....

5. Marital status of household head:

Single  Married  
 Widowed  Divorced

6. Place of birth of household head:

Simada, Ketena....., Kebele.....  
 Other place (specify).....

7. Continuous duration of stay at current place of residence (year) .....

8. Educational status attended by household

Illiterate  Secondary education complete  
 Read & Write  High school complete  
 First cycle complete  Higher education complete

9. Number of permanent household members at time of survey including household head

Male  Female  
Total.....

10. Current occupation of the household

Farmer  Daily laborer  
 Trader  Other (specify).....  
 Farmer and Trader

11. Crop production/year in quintal before 20 years ago is.....

12. Crop production/year in quintal currently .....

**Part II: Local community understanding of climate change and its causes**

13. What do you say about the trend of temperature after the downfall of Derg regime?

- Increased  No change  
 Decreased  I do not know

14. What local indicators do you use to evaluate the temperature trend in the area? (Multiple answers are possible).

- Prevalence of newly introduced human and animal disease (Malaria)  
 Prevalence of newly introduced plant and animal species (goat in highland)  
 Change in clothing style (dressing light cloths)  
 Dry up of rivers and streams  
 Habitat shift towards higher location  
 Damage of crops by pests (haricot bean)

15. How about precipitation?

- Increased  No change  
 Decreased  I do not know

16. What local indicators do you use to evaluate the precipitation trend in the area? (Multiple answers are possible).

- Loss of some animal and plant species  
 Increased drought and flood frequency  
 Growing period shortened  
 Rainfall comes early or lately  
 Decline of agricultural yields  
 Decreased available water

17. Have you heard of the word “climate change” before?

- Yes  No

18. Do you understand what “climate change” mean?

- Yes  No

19. From which source you heard about climate change?

- Television  Newspaper  
 School (college)  Government agencies  
 Radio  NGO

20. What do you think is the cause of climate change?

- |  |  |
|--|--|
| <input type="checkbox"/> Human actions             | <input type="checkbox"/> Wrath of God          |
| <input type="checkbox"/> Natural factors           | <input type="checkbox"/> Other (specify) ..... |
| <input type="checkbox"/> Human and natural factors |  |

21. If your answer is “Human actions” Which of the following do you think is the main cause of climate change? (Multiple answers are possible).

- |  |  |
|--|--|
| <input type="checkbox"/> Use of fossil fuels | <input type="checkbox"/> Loss of forest      |
| <input type="checkbox"/> Air pollution       | <input type="checkbox"/> Population pressure |
| <input type="checkbox"/> Over cultivation    |  |

**Part III: Assessment of the impact of climate change induced-hazards**

22. Have you encountered any climate change induced-hazards in the past 15-20 years?

- Yes                       No                       Do not remember

23. If yes, what are climate change induced-hazards in the past 15-20 years? (Multiple answers are possible).

- |   |                                    |
|---|------------------------------------|
| <input type="checkbox"/> Drought          | <input type="checkbox"/> Flood     |
| <input type="checkbox"/> Pest and disease | <input type="checkbox"/> Landslide |

24. How frequently have these hazards occurred in your locality?

- |  |  |
|--|--|
| <input type="checkbox"/> Every year      | <input type="checkbox"/> Every three years     |
| <input type="checkbox"/> Every two years | <input type="checkbox"/> Other (specify) ..... |

25. Which one is most frequent and severest? (Multiple answers are possible).

- |   |                                    |
|---|------------------------------------|
| <input type="checkbox"/> Drought          | <input type="checkbox"/> Flood     |
| <input type="checkbox"/> Pest and disease | <input type="checkbox"/> Landslide |

26. What are the impacts of climate change induced-hazards? (Multiple answers are possible).

- |  |   |
|--|---|
| <input type="checkbox"/> Death of household member | <input type="checkbox"/> Famine                     |
| <input type="checkbox"/> Damage to house           | <input type="checkbox"/> Loss of livestock          |
| <input type="checkbox"/> Expose to disease         | <input type="checkbox"/> Land degradation           |
| <input type="checkbox"/> Forced to migrate         | <input type="checkbox"/> Shortage of feed of animal |
| <input type="checkbox"/> Damage of infrastructure  | <input type="checkbox"/> Shortage of water          |

27. Assessing crop production trend in the area over the past 20 years

NQ	Cropping season (E.c)	Amount of land holding/ (timad)	Performance (good, normal & poor)	Inputs used			Date of sowing	Date of harvest	Total production (Qt)
				Fertilizer (kg/timad)	Pesticide (ml/timad)	Improved seed			
1	1983								
2	1993								
3	2002								

28. Assessing tame animals' possession and composition over the past 20 years

NQ	Year (E.C)	Total no of lives tocks			Total no of goats	Total no of sheep	Total no of poultry	Total no of donkey	Total no of mule	Total no of horse
		Cow	Ox	Calf						
1	1983									
2	1993									
3	2003									

29. Change in forest cover

Increased                       Decreased                       No change

30. Problem of soil erosion over time

Increased                       Decrease                       No change

31. Change in water availability

Increase                       Decrease                       No change

32. Who participate to fetch water and collect firewood? (Multiple answers are possible).

Male adult                       Male children  
 Female adult                       Female children

33. Have you ever faced food scarcity to your family?

Yes                       No                       I do not remember

34. If yes to question no 35, in which year was the problem more sever.

1983                       1993                       Currently

35. For how many months you are food insecure.....

**Part IV: Assessment of adaptation options and barriers**

36. Do you think that it is possible to adapt the impacts of climate change induced-hazards?

Yes                       No

37. Who is responsible for the adaptation practice? (Multiple answers are possible).
- |  |  |
|--|--|
| <input type="checkbox"/> International organization    | <input type="checkbox"/> Local community |
| <input type="checkbox"/> National and local government | <input type="checkbox"/> Own initiative  |
38. What local actions do you think are possible within your capacity? (Multiple answers are possible).
- |   |  |
|---|--|
| <input type="checkbox"/> Reforestation                    | <input type="checkbox"/> Growing high value tree crops |
| <input type="checkbox"/> Stops cultivation of sloppy area | <input type="checkbox"/> Change in cropping pattern    |
| <input type="checkbox"/> Terracing                        | <input type="checkbox"/> Diversified income            |
| <input type="checkbox"/> Family planning                  | <input type="checkbox"/> Growing short maturing crops  |
| <input type="checkbox"/> Rainwater harvesting             | <input type="checkbox"/> Other (specify) .....         |
39. Are you engaged in activities with the purpose of coping with local impacts of climate change?
- |                              |                             |
|------------------------------|-----------------------------|
| <input type="checkbox"/> Yes | <input type="checkbox"/> No |
|------------------------------|-----------------------------|
40. What new crops introduced to the area since 1983? List:.....
41. What new technology introduced to the area? List:.....
42. Do you (your family member) engage in non-farm activities because of climate change?
- |                              |                             |
|------------------------------|-----------------------------|
| <input type="checkbox"/> Yes | <input type="checkbox"/> No |
|------------------------------|-----------------------------|
43. If your answer is yes to question No 42, what are the activities?
- |                                     |  |
|-------------------------------------|--|
| <input type="checkbox"/> Trading    | <input type="checkbox"/> Migration             |
| <input type="checkbox"/> Wage labor | <input type="checkbox"/> Other (specify) ..... |
44. What activities were done by government institutions to cope with local impacts of climate change at your locality? .....
- .....
- .....
45. What activities were done by none government organizations to cope with local impacts of climate change at your locality? .....
- .....
- .....
46. Is there any program ever been held to boost awareness on climate change, its cause, impacts and adaptation strategies?
- |                              |                             |
|------------------------------|-----------------------------|
| <input type="checkbox"/> Yes | <input type="checkbox"/> No |
|------------------------------|-----------------------------|

47. Do you think the adaptation mechanisms you employed for climate change are successful?

Yes  No

48. If 'no' to question no 47, what are the barriers of adaptation to climate change? List down

.....  
 .....

49. Household head 'assessment of responses of government institutions

Responses to:	Very effective	Moderately effective	Not effective	No idea
Drought				
Disease				
Forest management				
Water management				

50. Households 'assessment of the responses of none government organizations (FHI)

Responses to:	Very effective	Moderately effective	Not effective	No idea
Drought				
Disease				
Forest management				
Water management				

51. Do you think the activities done by government and NGOs effective?

Yes  No

52. What type of crops you cultivate before 20 years? List down according to their decreasing importance: .....

.....  
 .....

53. What type of crops you cultivate in 2003? List down according to their decreasing importance: .....

.....  
 .....

54. If there is change in crop pattern, what were the possible reasons? (Multiple answers are possible).

Climate change     Soil erosion     Land scarcity  
 Market situation     Government policies     Population pressure

## **Annex 2: Questions used for interview**

### **Questions for key informant interview**

1. Do you feel that the temperature and rainfall of Simada has changed in the past 20 years? Why do you think this might be?
2. Have you heard of the word “climate change” before? What do you know about it?
3. What do you think is the cause of climate change?
4. What local indicator can identify to evaluate the changing climate?
5. Do you think climate change affected the lives of the community? If yes, how?
6. What are the major impacts of climate change up on the community, the livestock and the environment? List them.
7. Who is more affected by climate change? Why?
8. Who is responsible to give response to the changing climate?
9. What has been the responsibility of the community?
10. What were the response of government and nongovernment organization?
11. What were the limitations to give response to the changing climate on the part of the community and organization?

### **Interview question for disaster prevention and preparedness office (DPPO)**

Name\_\_\_\_\_ position\_\_\_\_\_

1. What are the causes of climate change and variability?
2. What are climate change induced-hazards in Simada wereda? List down.
3. What new crops introduced to the area recently?
4. What new crop’s and human’s disease introduced to the area recently?
5. What are the major impacts of climate change induced-hazards up on the people, the livestock and the environment?
6. What was your office role in response to these impacts?
7. What are the major challenges in alleviation of the problem and what should be done?

**Interview question for agriculture and rural development office at wereda level**

Name\_\_\_\_\_ position\_\_\_\_\_

1. Is there any form of climate change in Simada wereda over the past 20 years? If yes, list.
2. What are the major causes of climate change and variability? List down.
3. What are the major impacts of climate change? List down.
4. Would you explain the measures taken in response to climate change by your office?
5. What are the major challenges to cope with the impact of climate change?
6. Which group of people do you think more affected? Why?
7. How many people are in need of emergency aid and what is the trend over time at wereda level? Increase, decrease or no change
8. What are the livestock, crop and human diseases prevail in Simada wereda?
9. What are newly introduced crops and disease?
10. How do you see the migration and resettlement trend of the people?
11. For how long there is food insecurity and in which months?

**Interview question for nongovernment organization in Simada**

Name\_\_\_\_\_ position\_\_\_\_\_

1. Is there any form of climate change in Simada wereda over the past 20 years?
2. What are the major causes of climate change and variability? List down.
3. What are the major impacts of climate change induced-hazards upon the people, the livestock and the environment?
4. What was your office role in response to these impacts?
5. What are the barriers to cope with the impact of climate change?
6. How many people are in need of emergency aid and what is the trend over time at wereda level? Increase, decrease or no change
7. Is there early warning system in relation with climate change induced-hazards?
8. Generally how do you see the environmental situation of the area?

### Annex 3: Topics and guiding question for focus group discussion (FGD)

Discussion topics	Guiding questions
Local community understanding of climate change and its causes	<ul style="list-style-type: none"> <li>• Do you feel that the temperature and rainfall of Simada has changed during the past 15-20 years?</li> <li>• Have you heard of the word “climate change” before? What do you know about it?</li> <li>• What local indicators do you use to evaluate the changing climate?</li> <li>• What do you think is the cause of climate change? Do you think our activities may contribute for the changing climate?</li> </ul>
Major hazards and their impact	<ul style="list-style-type: none"> <li>• What are climate change induced-hazards in Simada wereda?</li> <li>• What are the major impacts of climate change induced-hazards up on the people, the livestock and the environment?</li> <li>• Do you think climate change affect your life?</li> </ul>
Adaptation strategies and barriers to give response	<ul style="list-style-type: none"> <li>• Who is responsible to give response to the changing climate?</li> <li>• What are the response of the community, government and nongovernment organization?</li> <li>• Are you engaged in activities with the purpose of coping with local impacts of climate change? If yes, what are those activities?</li> <li>• What activities were done by government, and none government organizations to cope with local impacts of climate change at your locality?</li> <li>• What are the barriers to cope with the impact of climate change?</li> <li>• What do you think of other adaptation options?</li> </ul>

**Annex 4:** A table that shows sample size value determination

Population size	Sample size					
	Continuous Data			Categorical data		
100	46	55	68	74	80	87
200	59	75	102	116	132	154
300	65	85	123	143	169	207
400	69	92	137	162	196	250
500	72	96	147	176	218	286
600	73	100	155	187	231	316
700	75	102	161	196	249	341
800	76	104	166	203	260	363
900	76	105	170	209	270	382
1,000	77	106	173	213	278	399
1,500	79	110	183	230	306	461
2,000	83	112	189	239	323	499
4,000	83	119	198	254	351	570
6,000	83	119	209	259	362	598
8,000	83	119	209	262	367	613
10,000	83	119	209	264	370	623

Source Bartlett, et al., (2001: 48)

Annex 5: Monthly rainfall, maximum and minimum temperature of Mota station

Monthly Maximum Temperature in °C

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1989	23.6	24.4	24.5	24.8	25.4	24.3	20.8	20.2	21.2	21.7	23.0	22.1
1990	23.7	24.1	25.6	26.2	26.4	25.2	20.2	20.7	21.0	22.4	23.6	23.7
1991	24.6	25.8	26.1	26.0	26.3	25.3	19.8	19.8	21.4	22.2	23.4	22.5
1992	23.2	24.9	26.6	25.9	26.1	25.5	20.8	18.6	20.9	20.4	20.4	22.2
1993	22.0	23.4	25.5	23.6	24.0	23.0	20.6	21.5	21.4	22.1	23.1	23.7
1994	23.3	24.7	26.1	25.1	25.0	24.7	19.6	19.5	21.1	22.9	23.3	23.7
1995	24.7	25.9	26.6	26.6	25.9	26.4	20.8	20.0	21.5	23.0	22.7	23.4
1996	24.5	25.8	25.6	25.4	23.6	22.1	20.5	20.4	21.8	22.8	22.1	22.9
1997	24.2	25.6	26.0	25.3	25.0	23.4	21.1	21.1	23.0	22.1	22.6	24.2
1998	25.1	26.1	27.4	26.0	26.1	24.8	19.7	20.0	21.6	21.8	22.0	22.6
1999	23.1	26.1	26.4	26.8	26.7	25.2	19.9	20.0	21.4	21.1	22.0	22.5
2000	23.7	25.2	26.8	23.9	26.9	25.2	20.9	20.0	21.2	21.4	22.2	23.0
2001	23.5	25.4	24.7	26.5	25.8	25.0	20.7	20.2	21.7	23.0	22.9	23.6
2002	23.7	25.8	26.2	27.0	27.6	24.7	22.3	20.6	21.4	23.1	23.5	24.0
2003	24.8	26.0	26.3	27.3	28.3	25.3	20.6	20.5	21.2	22.1	23.3	23.3
2004	24.8	25.1	25.7	26.0	27.2	23.5	21.7	20.9	21.6	21.9	23.1	23.6
2005	24.1	27.0	26.4	26.9	26.4	25.7	20.6	21.0	21.5	21.8	22.8	23.0
2006	24.5	28.0	27.0	27.5	25.6	24.3	21.3	20.7	26.4	22.3	23.5	24.0
2007												
2008	24.6	25.6	27.8	26.0	24.8	23.7	21.4	21.2	21.7	22.5	22.7	23.5
2009	24.5	25.8	26.8	27.2	27.6	27.2	21.5	21.4	22.8	22.3	23.5	23.5

Monthly Minimum Temperature in °C

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1989	6.5	8.3	9.3	10.5	11.3	10.4	11.0	11.0	10.3	9.3	7.1	7.9
1990	7.0	8.3	8.7	10.9	11.5	10.6	10.9	11.2	10.8	8.9	8.5	7.1
1991	9.1	9.3	10.6	11.3	12.0	10.9	11.4	11.3	10.0	8.6	8.0	7.3
1992	7.7	8.5	11.5	11.7	12.4	11.2	11.4	11.6	9.8	10.2	8.3	7.8
1993	6.6	7.6	10.2	11.6	11.6	11.7	11.4	11.0	9.9	9.3	8.4	7.0
1994	6.7	8.2	9.8	12.0	11.8	11.3	11.3	10.8	10.0	8.5	8.7	7.1
1995	6.7	8.7	9.3	12.3	12.1	10.9	11.7	10.3	9.8	7.9	8.0	6.3
1996	6.9	8.5	10.9	12.1	11.2	11.1	10.2	9.8	8.7	7.3	7.3	5.6
1997	7.0	8.0	11.1	10.5	11.1	10.7	10.8	10.5	9.1	9.7	9.7	7.3
1998	7.0	7.5	11.2	12.9	12.6	11.2	11.6	11.8	11.2	11.1	7.9	6.2
1999	7.2	9.4	7.8	11.7	10.1	8.8	9.5	9.5	8.5	8.7	5.3	5.9
2000	5.5	6.9	8.7	9.6	10.0	9.2	10.0	9.7	8.9	8.8	7.5	6.5
2001	4.2	6.6	8.5	10.6	10.9	9.7	10.5	11.0	9.5	9.3	6.9	7.1
2002	7.0	8.5	10.0	11.8	11.9	10.3	10.7	10.9	10.0	8.5	7.8	6.5
2003	6.4	10.5	12.1	12.6	13.4	12.2	11.6	11.6	11.1	8.8	8.7	7.5
2004	8.6	9.8	12.5	12.8	11.8	11.0	11.2	11.3	11.2	9.6	9.5	7.7
2005	7.2	10.4	11.6	13.0	8.9	11.1	11.8	12.0	11.2	10.5	8.6	6.7
2006	8.6	10.6	11.3	11.7	11.8	11.3	12.0	11.7	11.5	11.0	9.2	7.0
2007												
2008	7.4	7.8	10.4	11.9	10.7	13.0	13.9	14.1	14.1	14.6	14.3	13.3
2009	7.2	11.1	11.0	12.2	10.9	10.4	10.5	10.4	8.5	8.2	6.0	6.4

Monthly Rainfall in mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1987	2.9	10.8	31.3	14.6	148.6	98.7	170.6	194.8	78.6	149.1	52.5	0.8
1988	1.4	75.3	2.0	5.8	11.0	81.3	389.2	323.4	147.7	158.9	5.0	0.0
1989	2.1	3.5	55.6	43.2	46.5	62.4	245.6	230.3	79.7	78.8	10.6	28.1
1990	1.3	32.2	14.4	45.1	20.0	112.6	380.5	178.1	258.8	38.1	5.9	23.8
1991	0.9	5.1	14.0	55.6	41.2	61.7	318.7	276.7	229.2	44.8	1.2	19.6
1992	0.0	2.3	13.6	67.7	62.3	73.3	184.1	324.4	78.2	122.5	56.4	32.5
1993	3.0	13.1	36.7	124.7	143.4	77.5	333.4	146.0	200.5	118.0	12.0	0.0
1994	0.0	8.9	10.0	32.8	103.3	99.9	312.3	301.1	150.3	36.1	29.7	7.8
1995	0.0	7.0	9.0	22.0	77.8	60.2	355.2	238.0	104.5	70.3	4.1	22.2
1996	0.2	2.1	66.4	61.4	203.7	110.6	310.9	365.7	164.0	58.4	70.5	9.2
1997	0.4	0.0	54.4	58.7	139.9	176.5	272.0	184.4	164.3	188.2	43.0	3.3
1998	5.7	1.0	18.2	34.4	119.6	93.4	363.4	368.5	170.7	198.8	49.2	0.9
1999	18.8	0.0	0.0	22.6	52.9	109.9	300.4	372.6	157.2	202.7	5.5	26.5
2000	0.0	0.0	7.6	111.5	8.0	38.4	243.1	257.8	148.2	209.8	63.0	15.0
2001	0.0	15.3	106.2	28.5	69.6	137.5	443.1	326.1	144.3	143.7	37.2	3.6
2002	10.8	0.3	30.8	93.0	26.8	127.9	300.7	288.6	186.1	60.9	7.0	9.3
2003	0.0	11.4	33.6	8.5	8.8	76.5	339.8	354.1	265.3	52.3	14.7	0.3
2004	0.0	7.4	7.0	59.0	14.2	142.0	203.0	269.2	181.3	134.9	23.9	0.0
2005	3.8	4.5	50.7	27.9	20.3	138.5	241.3	226.2	204.5	195.6	61.4	0.0
2006	0	2.2	27.9	76.9	106.3	164.1	241	339	204	196	61.5	0
2007	26.2	0	32.4	16.5	116.6	175.5	225.8	295.7	136.4	42.5	0.2	0.2
2008	41.7	0.7	0	78.9	145.1	94.2	362.4	279.8	209.7	96.5	15.4	0

Source: NMSA, 2010

## **Declaration**

I, the undersigned, declare that the thesis is my original work, has not been presented for a degree in any other university and that all sources of material used for the thesis have been duly acknowledged.

### **Declared by**

Name

Marye Belete

---

Candidate

### **Confirmed by**

Name

Dr. Muluneh W/Tsadik

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Advisor