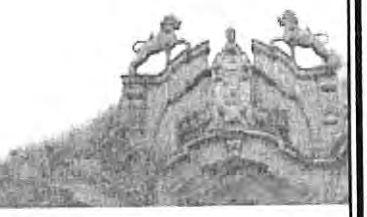

SCHOOL OF GRADUATE STUDIES
COLLAGE OF DEVELOPMENT STUDIES

ASSESSMENT OF LOCAL COMMUNITY UNDERSTANDING OF AND RESPONSE TO CLIMATE CHANGE
THE CASE OF FOUR KEBELES OF DIRE DAWA CITY

A thesis submitted to the School of Graduate Studies of Addis Ababa University in partial fulfillment of the requirements for the degree of Master of Arts in Development Studies (Environment and Development)

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ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

COLLEGE OF DEVELOPMENT STUDIES (CDS)

Title

Assessment of Local Community Understanding of and Response to Climate Change the case of Four Kebeles of Dire Dawa City

By

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DEVELOPMENT STUDIES

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Table of Contents

List of Tables

Page

List of Figures

Page

Acronyms

AIDS:	Acquired Immune Deficiency Syndrome
AWD:	Acute Water Borne Diarrhea
CEEPA:	Centre for Environmental Economics and Policy in Africa.
CSA:	Central Statistics Authority.
DDAC:	Dire Dawa Administrative Council.
DEFRA:	Department for Environment Food and Rural Affairs
DFID:	Department for International Development
EPA:	Environment Protection Authority.
FAR:	First Assessment Report
FGD:	Focus Group Discussion.
GDP:	Gross Domestic Product.
GHGs:	Green House Gases
HH:	House Hold
HIV:	Human Immune deficiency Virus
IDP:	Integrated Development Plan
IFRCS:	International Federation of Red Cross and Red Crescent Societies
IPCC:	Intergovernmental Panel on Climate Change
MoFED:	Ministry of Finance and Economic Development.
NAPA:	National Adaptation Program of Action of Ethiopia
NBDSAP:	National Biodiversity Strategy and Action Plan
NMA:	National Meteorological Agency
NMSA:	National Meteorological Service Agency
PASDEP:	Plan for Accelerated and Sustained Development to End Poverty
RiPPLE:	Research inspired Policy and Practice Learning in Ethiopia and the Nile Region
SAR:	Second Assessment Report.
SPSS:	Statistical Package for Social Science.
TAR:	Third Assessment Report
TNA:	Technology Needs Assessment.
UN:	United Nation.
UNFCCC:	United Nations Framework Convention on Climate Change
UNDP:	United Nations Development Program.
WG:	Working Group.
WHO:	World Health Organization

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 causes, impacts and the 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 considers local community understanding of and response to climate change, focusing mainly on insight of the local community on weather change, climate change, causes and the impacts of climate change, understanding of local community towards flood risk, local community concern and personal importance of the climate change issue and perception of the local community on controlling or adapting to Climate Change.

The study was conducted in four kebeles' of Dire Dawa Administrative Council as one of the flood prone area in the country. Although this study explores a variety of potentially salient influences on perceptions and responses to climate change, one factor that is given particular attention is experience and understanding of flooding.

The study relied on both qualitative and quantitative methods of data collection and analysis. The primary data were collected by using qualitative data gathering tools such as FGDs and key informant interviews. Accordingly, two FGDs, were held with local people purposively selected from two kebeles. Interviews were done with eight purposively selected individuals. With the view of supplementing the qualitative data, the study employed a questionnaire survey with 107 sampled heads of households selected from four kebeles of Dire Dawa.

The findings of the study showed that temperatures had increased, rainfall levels had decreased and the timing of rainfall had undergone changes and the region is getting drier and drier in Dire Dawa. The findings also confirmed that weather is changing solely due to anthropogenic (human activity) causes. The finding also showed that, the local community awareness (and understanding) of climate change does not seem to have advanced in recent years and hence, there is little awareness of the issue of climate change. The finding sought that with regard to the connection between flooding and climate change, the respondents do not at all see the connection between climate change and flooding. Most people think that climate change has begun and a great many acknowledge that it is a serious problem. However, compared to other problems, the community has not ranked climate change among its top concerns.. Most respondents blame government and businesses most for not doing more to combat climate change. They think these institutions – especially government – should do more. Most people recognize that they, as individuals, and their local community also make some contribution to climate change and many feel uneasy about their own role.

Finally, the study suggests, creating awareness among the population and policymakers about climate change, its causes and its consequences is needed. Information needs to be provided to the community in order for them to take appropriate adaptive measures and convince people of the great seriousness of the problem of climate change by making clear the magnitude of the possible losses involved.

Chapter One

Introduction

1.1 Background of the Study

Climate change in IPCC usage refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods (IPCC, 2007:30).

The earth's climate is changing and is projected to continue to change under a variety of emissions scenarios. It is projected that average temperature will continue to increase, rainfall patterns will change, and as a result sea levels will rise. Extreme weather events (hurricanes, storms, flooding, drought, heat waves) are likely to become more common (i.e., increased frequency), more widespread spatially, and of increased severity. Melting glaciers will increase flood risk during the wet season and reduce dry season water supply. Ocean acidification will have major effects on marine ecosystems and fish stocks could decrease. Crop and livestock production patterns and productivity will be impacted by changing climate and expected changes in pests and diseases. Human mortality and morbidity from malnutrition, heat stress, and vector borne diseases are expected to increase. As ecosystems change a growing number of plant and animal species will probably face extinction, and some eco-systems might disappear or radically transform (Rasmus Heltberg et al., 2008:6)

In the theoretical debates over the role of perception in human behavior and its effect on decision-making, it has been generally noted that if a community or government perceives a problem to be a very serious threat, as in the case of HIV and AIDS, then it is

likely to initiate appropriate intervention measures (Shisanya & M. Khayesi, 2007:272). Weber, Lorenzoni and Pidgeon (2006:56) have shown that the perception of the risk of climate change on the part of a society may influence its decision as to whether it should do something about it, and subsequently how to adapt to the perceived threat.

The vital question, which has yet to be adequately addressed in climate change research, is: Do communities in the developing world in general and in Ethiopia in particular perceive climate change as being a significant threat when compared to other developmental and environmental problems? IPCC has made an effort to address this lack by devoting its July 2006 issue (volume 77, numbers 1–2) to research on psychology of global warming (IPCC, 2006).

An article by Weber (2006) in this issue indicates that people must clearly perceive risks in order to take actions to manage them. This finding supports earlier studies by Halloway and Ilbery (1996:161) who found significant variations in perception of climate change between the professional community and the general local community.

The importance of perception assessment is also noted in suggestions made by Parry (2001:258) on research priorities for the fourth Intergovernmental Panel on Climate Change (IPCC) assessment report, which is due in 2007. Parry's suggestions, however, place emphasis on statistical modeling rather than on a more qualitative analysis of the social context, which would include study of the perception of the threat of climate change by the community. While different studies are not negating the need for good quantitative research, they are, nonetheless, arguing that qualitative research focused on the perception of the problem should be a necessary complement to the existing quantitative research on the issue. A meaningful assessment of the perception of the problem of climate change must be founded in an understanding of the likely level of priority and response that may be given to it by individuals, communities and governments (Bord et al., 1998:79).

An environmentally informed global population is essential to addressing and coping with climate change. Throughout the world in whatever the sphere of human activity, or exchange, there is now ignorance, apprehension, and confusion about climate change. For some individuals, groups and organizations, the problem is unknown, irrelevant or remote. For others, it is devastating the population. Few bring to the world forum a workable grasp of the issue and the potential adverse consequence of climate change (Brechin, 2003:112).

Ethiopia is highly vulnerable to climate change due to its low level of economic and social development, low levels of income per capita, limited disaster management skills, and weak institutional capacity. Climate change impact is of major concern for Ethiopia as related particularly to human health, water resources, wildlife, and most importantly, rain-fed agriculture. The Ethiopian agricultural system is very sensitive to climate changes due to the risky environment and also due to the intra-seasonal and inter-annual variability of rainfall. Drought is the dominant climate-related disaster in Ethiopia. Food insecurity arising from occurrences of drought may worsen with climate change. Unreliable and declining rainfall will lead to crop failure. Though not pronounced as drought in their impact and publicity, floods have also increasingly caused disasters in Ethiopia. In addition, soil erosion could become more frequent and severe under climate change (Asefa & Berhanu, 2007:2).

Thus climate change is an issue that demands a role for scientific expertise, along with diverse perspectives from other areas of society. Local community awareness (and understanding) of climate change does not seem to have advanced in recent years and hence, there is little awareness of the contribution of everyday individual actions to the problem, and a tendency to place responsibility for tackling climate change with international organizations rather than at the level of the individual. Therefore, this thesis investigates the local community understanding of and response to climate change.

1.2. Statement of the Problem

In recent years environment has become a key issue in Ethiopia. The main environmental problems in the country include land degradation, soil erosion, deforestation, loss of biodiversity, desertification, recurrent drought, flood and water and air pollution (NAPA, 2007:1). According to case studies made by Abebe, head of research at the National Meteorological Agency in Addis Ababa there have been signs of climate change in Ethiopia now and even before (Abebe, 2006:71).

There was also a general observation from the regional consultative meeting that temperature has increased over the country and recurrent drought and flood are the most severe problems that affected millions of the country's population almost every year. This perception of change in temperature and in the frequency of drought could be linked to a changing climate. Climate change may also impact the land resources of the country by exacerbating desertification and its consequences (NAPA, 2007:30).

Ethiopian farmers are already being affected from the erratic rainfall patterns, the distribution of which is becoming increasingly unpredictable. Some reports suggest that both intensity and distribution of rainfall has significantly changed in the last couple of years. This is attributable to the resultant effect of the change in the climate system. Among other factors, the country has been impacted with consistent crop failures and drought (Abebe, 2006:71).

Meanwhile 2006 saw some of the worst floods in Ethiopia's history, displacing people in the country. Areas in the Afar Region along the Awash River, in the Somali Region along the Wabi Shebele River and in the Gambela Region along the Baro-Akobo River, in the Southern Region along the Oomo-Gibe River, Bahirdar Zuria and Fogera areas along the Abbay River in the Amhara Region are prone to seasonal river floods (Endalkachew, et al., 2004:24). Flash floods in Dire Dawa, the second largest city after Addis Ababa, killed nearly 250 people and displaced thousands (NMA, 2006:26).

According to (NAPA, 2007:25) current and future impacts of climate change on Ethiopia include:

- Increasing temperatures will reduce agricultural production and lifestyles of many Ethiopians.
- Increasing climate variability and changing rainfall patterns will threaten the livelihood of local communities.
- Diseases such as malaria will spread further and threaten the lives of millions in the highlands.
- Biodiversity and associated cultures will be substantially reduced.
- Drying wetlands and lakes and declining water resources will threaten water availability for millions of people.

Despite the environmental problems in the country which include land degradation, soil erosion, and deforestation, loss of biodiversity, desertification, recurrent drought, flood and water and air pollution, local community awareness (and understanding) of climate change in Ethiopia does not seem to have advanced in recent years and hence, there is little awareness of the contribution of everyday individual actions to the problem (Asefa & Berhanu, 2007:3).

Worldwide, people may be concerned about the potential impacts of climate change on human health, followed by water shortages, species loss, or extreme weather events. Many individuals in Ethiopia, however, do not personally worry that much about the issue (NAPA, 2007:34). There are also a number of other significant discrepancies between official governmental information about climate change and local community understanding of the issue. The evidence suggests that there is much that needs to be done to ensure that everyone understands the evidence for [climate change], its causes, the distribution of its impacts and the action that can be taken to alleviate them (Houghton, 2004:14). Given this apparent lack of engagement in the issue of climate change, it is, therefore, unsurprising that there has been little change in behavior.

Perception about climate changes, its causes, 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 perception will make local intervention mechanisms to be very slow and untargeted.

This paper attempted to determine awareness level of the people, feeling of the people on who is responsible for tackling climate change, and how should it be tackled; and the extent climate change is perceived as a personal risk, whether it is a priority environmental concern, or an issue of personal importance in four selected kebeles of Dire Dawa Administrative Council.

1.3 Research Objectives

1.3.1 General Objective

To investigate the general perception and responses of local communities in four selected Kebeles of Dire Dawa on climate change.

1.3.2 Specific Objectives

1. To assess the awareness and knowledge of local community towards climate change, its causes and impacts;
2. To assess perception of people in Dire Dawa towards flooding;
3. To assess the relative importance of climate change issues as compared to other environmental problems;
4. To determine feeling of the people in the study area on who is responsible for tackling climate change, and how should it be tackled.

1.4 Research Questions

In order to meet the study objectives the following questions were addressed in this study:

1. Do local community in Dire Dawa perceive that the whether and hence the climate has changed?
2. What are the main environmental problems that have been observed in Dire Dawa?
3. Was flooding in Dire Dawa due to climate change?
4. To what extent is climate change perceived as a personal risk, a priority environmental concern, or an issue of personal importance?
5. Does local community perceive that it is possible to avert or adapt to the impacts of climate change by actions in their locality?

1.5 Research Design

The study was primarily a descriptive type which used quantitative approaches of data gathering and analysis. However, focusing on the study objectives and the major study questions, the study also devised qualitative research methods to examine local community understanding of and response to climate change. Although this study explores a variety of potentially salient influences on perceptions and behavioral responses to climate change, one factor that is given particular attention is *experience and understanding of flooding*. The relationship of their experience of flooding and knowledge of climate change is given due emphasis.

1.5.1 Study Population and Study Unit

The people living in Dire Dawa City are the study population. The study units for the household survey were sample households. For the focus group discussion (FGD) and key informant interview, the people selected were those individuals living in the sampled *kebeles* which are believed to represent the opinion of the community.

1.5.2 Site Selection

Dire Dawa is commonly known for its disastrous flooding with the root causes being land degradation, physiographic condition, and intensive nature of rainfall with short duration. In Dire Dawa the flood is mainly associated with the major wadis crossing the city such as Dechatu, Goro, Butiji, Lega Hare and Melka Jebdu. According to the new administrative arrangement, the former 25 urban kebeles of the City are regrouped into nine kebeles of which 6 are prone to flooding. Kebele 09, 07, 06, 05, 03 and 01 were hit by the flood in 2006. Kebele 09, 06, 05 and 03 were affected by the flood seriously (DDAC, 2007). The severity of flood disaster was used as a criterion to select the kebeles considered for the study. Beside these, the study area has a warm dry climate, which is a characteristic of semi-desert climate. Thus, four kebele's of Dire Dawa Administrative Council namely kebele 05 and 09 which were flood victims and kebele 02 and 04 the non flood victims were purposively selected to asses the local community understanding of and response to climate change.

1.5.3 Sampling Design and Sample Size Determination

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

By using stratified sampling technique the nine kebeles were stratified into two strata, namely Kebele 09, 07, 06, 05, 03 and 01 which were hit by the flood and Kebeles 02, 04 and 05 those kebels that are the non victims of flooding. Then among the six kebeles which are the victims of flooding, kebeles[1] 09 and 05 were purposely selected. This is due to the reason that they were severely affected by the of flooding. Using simple random sampling technique two kebeles namely kebele 02 and 04 were selected from the remaining three kebeles which are the non-victims of flooding. However, neighborhood of kebele 09 and 05 were not equally affected by the flooding. Then, again using stratified sampling technique, the neighborhoods were stratified based on the severity of flooding. Places like Bihere Tsige and Ganda[2] Garada of kebele 09 and Addis ketema,

[1] Kebele refers to the fifth tier of government administration unit, which is also referred to us sub–district administration.

[2] Ganda is a local language referring to places or neighborhood in kebeles of Dire Dawa City.

Dachatu, Ashawa, Coka Cola and Ganda Gara of kebele 05 were highly affected by the flood. Thus, neighborhood of Bihere Tsige and Ganda Garada from kebele 09 and neighborhood of Addis Ketema and Ganda Gara of kebele 05 were again purposively selected.

Also, there are some parts of kebele 02 and 04 which were affected by the flooding. Thus, using stratified sampling technique, the neighborhoods of kebele 02 and 04 were again stratified based on their experience of flooding. Thus, the researcher identified places which were not affected by the flooding. Places like Ganda Kore, Ganda Lonii, Greek Camp, Mebrat Hail, Ganda Boyye of kebele 04 and Goro, Sabiyan, Memriya Sefer of kebele 02 were the non-victims of flooding. Again using purposive sampling techinique Ganda Qore and Greek Camp of kebele 04 and Goro and Memriya sefer of kebele 02 were selected.

Finally, after selecting the four kebeles, a list of households for residents of Bihere Tsige, Ganda Garada, Addis Ketema, Ganda Gara, Ganda Qore, Greek Camp, Goro and Memriya Sefer was recompiled in collaboration with the kebele officials, particularly the *Dembi Askebaris* [3]and used as a sampling frame to select the households for the study.

Concerning the sample size determination among different methods developed by different researchers, the one which has been developed by Bartlett et al., (2001:45) sample size formulas and procedures were used. This method is selected because of the fact that it provides the sample size values that will be appropriate for many common sampling problems (Bartlett, 2001:47). The details of sample size value determined for different population size, is portrayed in (*annex 7*).

As the total population of the household heads in the selected areas is approximately 1,028 and the sample size for continuous data (the case for this study), as shown in (*annex 7*) is nearly 77 for low, 106 for medium and 173 for high, a medium sample size is applied for this study. With the list, a simple random sampling technique was used to

[3] Dembi Askebari refers to kebele officials responsible for code enforcement.

select 107 sample household. *Table 1* presents the sample size distribution among the neighborhood proportionately.

Table 1: Total number of sample households

Name of Sampled Kebeles	Flooding experience	Name of Selected Areas/Neighborhoods	Number of HHs in sample areas	Sample size
09	Flood victims	Bihere Tsige	136	14
		Ganda Garada	134	13
05	Flood victims	Addis Ketema	142	17
		Ganda Gara	118	12
02	Non flood victims	Goro	122	13
		Memriya	112	11
04	Non flood victims	Ganda Qore	138	14
		Greek Camp	126	13
Total			**1,028**	**107**

1.5.4 Selection of Focus Group Participants and Key Informants

Focus Group Discussion

Two focus Group Discussion each containing 9 and 12 participants was established for discussion. From the selected four kebeles, two kebeles were purposively selected among different groups. The first group of FGD participants was drawn from the victims of flooding and the other group was from the non-victims. The people participated in the FGD are believed to represent and reflect the opinion of the community members.

Key Informant Interview

A total of eight interviewees were purposively selected. Four interviewees were those who directly experienced flooding, and four had not. All these interviewees were selected through contact with the kebele officials. Also, interviewees from diverse backgrounds were selected.

1.6 Data Source

Both primary and secondary data were gathered and used in this thesis.

1.6.1 Primary Data

Three groups of respondents were utilized as a primary source of data. The first groups were selected households from the study area. The second group of data source was key informant interviewees comprises of people that are believed to represent and reflect the opinion of the community members. The third source of primary data was participants of FGD. It is composed of individuals with the experience of flooding and the non victims of flooding.

1.6.2 Secondary Data

Different literatures that are relevant for the research were reviewed. These include books, research works, Journals, discussion papers, reports and others. In addition secondary data from DDAC and NMA were used in this study. They are meant to augment the data to be collected from primary sources.

1.7 Data Collection

1.7.1 Data Collection Instruments

As to data collection instruments structured and semi-structured questionnaire that contains open and closed-ended questions, checklists and interview guide line were employed. The questionnaires were made to generate data on:

- Demographic characteristics;

- General environmental concerns and experiences;
- Environmental issues that most concern them;
- About their perceptions of changing weather patterns, and about experiences of flooding;
- Awareness and knowledge in relation to climate change;

Checklists were prepared aiming at eliciting the required information through FGD. Every effort had been made to create a favorable condition in which participants could feel free and fully participate during the discussion. The discussion points were largely focused on issues about their perceptions of changing weather patterns, and about experiences of flooding, awareness, knowledge, and impacts in relation to climate change.

An interview guide was developed for the purpose of conducting the interview. The broad topics that were covered in the interviews were:

- Understanding of climate change (including causes and impacts);
- Responsibility for tackling climate change;
- Actions taken to mitigate climate change.

In addition, flood victims were asked about their:

- Experiences of flooding and what they had learnt from it;
- Actions they had taken as a result of being flooded, on an individual or community basis.

1.7.2 Data Collection Procedure

First, contact was made with the concerned Dire Dawa Administrative Council officials to get permission and support for the research. Then, a visit to the selected kebeles was made to establish a common understanding with the officials. Furthermore, during the visit, informal discussion was conducted with representatives of kebele briefing them on the objectives of the study, and building trust and confidence so that they would cooperate and provide information.

Prior to undertaking the actual data gathering activities, the draft questionnaire were pre-tested taking four respondents from sample population. After completion of the pre-test, the responses were checked whether the respondents understand the questionnaire properly. On the basis of the feed back from the pre-test, some amendments were made prior to duplication. Finally, the adjusted questionnaires were distributed among sample respondents.

Enumerators were selected and trained on how to fill the developed questionnaire. This had enabled the enumerators to have a clear idea of what is required from households and how to efficiently administer the questionnaire at the household level and generate the required information.

1.8 Data Analysis

The analysis of the quantitative data gathered through household survey was coded and entered into a computer for analysis for the software program, SPSS. The specific methods of data analysis involved the use of descriptive statistics such as frequencies, percentages of computations and cross tabulation.

The analysis of qualitative data went along side with the data gathering process in the field, this procedure helped to accomplish data reduction and preparation by way of verbatim transcriptions of an audio tape and organization of notes taken from the field.

1.9 Significance of the Study

Perception of local communities towards climate change in Ethiopia has not been systematically studied and documented so far. However, the impacts of climate change in the country seems to be on the increase and associated with land degradation, soil erosion, deforestation, loss of biodiversity, desertification, recurrent drought, flooding, water shortage, and air pollution. Therefore, this assessment of local community's understanding of climate change could be used to inform and indicate policy makers to

take possible intervention methods in order to raise the awareness of the community towards implementing local solutions to climate change.

The study also gives a bird's eye view to researchers, development practitioners and local development actors.

Finally, an obvious path to take in relation to further research is to implement and test the findings and recommendations forwarded in this thesis.

1.10 Scope of the study

This study attempted to assess local community understanding of and response to climate change in four kebeles of Dire Dawa Administrative Council. Despite the wide-ranging use of climate change perception in fields like Metrology, the study only focused on the perception of households with due emphasis on the major factors such as temperature change, precipitation change, causes of climate change, impacts of climate change, responsibility to tackling climate change, etc. Moreover, the analysis of the nature of temperature and rainfall variability using different models is beyond the scope of the study. As a result, the study relied mainly on the perceptions of local people towards weather change and hence climate change in the study area. Since there are a number of difficulties in developing a framework for exploring local community understanding of and response to rapid climate change, the research was not designed around any particular theory or theories.

1.11 Limitations of the Study

The current study has faced the following limitations:
First, to the researcher's knowledge, the research undertaken in Dire Dawa is limited to 107 sample size and focused on four kebele residents of Dire Dawa which might affect the applicability of the findings to a wider contexts. Future research should extend an in-

depth analysis of local community understanding and response to climate change to a representative nation-wide study.

Second, while the number of studies on the perception of and impacts of climate change in the world is growing, not much has been done in Ethiopia. So far, there has not been any major study to address the awareness, social, economic and environmental impact of climate change in Ethiopia and analyze the adaptation measures that communities implement to mitigate the potential adverse impact of climate change. Thus, there is very limited literature to cite with respect to the problem under investigation. As a result, the study was forced to rely more on empirical findings obtained from abroad.

1.12 Organization of the Thesis

The study is organized in five chapters. The first chapter deals with some backgrounds of the study and study design. Chapter 2 reviews the research that has been conducted to date on the local communities understanding of and response to climate change. Chapters 3 describe the socio economic and geographical location of the study area. Chapter 4 discusses the findings from this study. Finally, Chapter 5 summarizes the key findings and arguments of this thesis, and offers recommendations.

Chapter Two

Review of Related Literatures

2.1 Global Trends of Climate Change

Climate change refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean annual temperature and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forces, or it may be due to persistent anthropogenic (due to human activities) changes in the composition of the atmosphere. Climate change has been defined as:

> "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (UNFCCC, 2007:13).

There is now scientific consensus that the global climate is changing. Global mean temperature increased by 0.6 ^{0}C in the last century, with the hottest years ever in record occurring after 1990. The IPCC, in its 1995 report, projected an increase in global surface temperature of 1 to 3.5 degrees Celsius over the next century, which compares with the observed increase of 0.3 to 0.6 ^{0}C over the past 100 years. This warming of the world climates has been linked to a higher concentration of greenhouse gases in the atmosphere, the consequence of which can be manifested in the higher frequency of extremes, such as floods, droughts and cyclones (WHO, 2003:3).

The latest Intergovernmental Panel on Climate Change (IPCC) report suggests that the increase in temperatures over the next century could be between 1.4 and 5.8 ^{0}C. Patterns of precipitation will also change, affecting the hydrological cycle. Sea levels will rise by 9cm to 88cm, mainly through the thermal expansion of the ocean. Sea level is rising and extreme climatic events, such as floods, droughts, heat waves etc, are becoming frequent, extensive and intensive. There is no doubt that nations have become more vulnerable to extreme climatic events from time to time (IPCC, 2007). But what is causing the world to heat up? The following section discusses the cause of climate change.

2.2 Causes of Climate Change

Earth's climate is the result of complex interaction between the sun's radiation and the atmosphere surrounding the earth, oceans, cry-sphere (e.g. sea ice, ice sheets), land surface and biosphere. Earth's surface absorbs a portion of the sunlight and reradiates it as long-wave (infrared) radiation. Some of this infrared radiation is absorbed by atmospheric green house gasses (GHGs)[4] and reradiated back to earth, thereby warming the surface of the earth by more than would be achieved by incoming solar radiation alone. The gasses, acting like the glass of a green house, trap some of the heat of the sun and warm the earth. The greenhouse effect produced by the gasses insulates our earth, resulting in the mild temperature that we are accustomed to, at least up until the recent changes in the climate system (UNEP, 2006a:111). It is this warming process that raises the average temperature of the earth to its present 15°C. Without this warming, earth's diurnal temperature range would increase dramatically and the average temperature would be about 33°C colder (WHO, 2003:19).

It therefore follows that, as much as these gases play a vital role in making our planet habitable, increasing concentration of GHGs due to natural and/or anthropogenic causes will end up in an unfavorable condition in the climate system. At a balanced state the gasses are vital for the sustenance of all forms of life on earth. On the contrary a change in the delicate balance of the concentration of these gasses in the atmosphere brings about the phenomenon that is commonly referred to as climate change (UNEP, 2006a:112).

Climate change occurs as a result of both internal variability within the climate system and external factors. The external causes may be natural or induced by human activity (WHO, 2003:21). Anthropogenic forcing results from the gases and aerosols produced by fossil fuel burning and other GHG emission sources, and from alterations in the earth's surface from various changes in land use, such as the conversion of forests into agricultural land. In addition, regional temperature and precipitation can be influenced because of changes in vegetation cover (WHO, 2003:21). Increases in the concentration

[4] GHGs are a collection of a thin layer of gasses covering the earth, basically composed of carbon dioxide, water vapor, ozone, sulfur hexafluoride, methane, nitrous oxide, chlorofluorocarbons, per fluorocarbons and hydro fluorocarbons.

of GHGs will increase the amount of heat in the atmosphere. The major contributors, amongst the green house gasses, for the change in climate are: water vapour[5], carbon dioxide[6], methane (CH_4)[7], nitrous oxide[8], Ozone (O_3)[9] and Aerosols[10].

Most of the observed warming of the past 50 years is attributable to human activities (IPCC, 2001). The Third Assessment Report (TAR) of the (IPCC, 2001) report gave evidence that a substantial part of the emissions of the gasses (about ¾ of the total concentration) of the anthropogenic emissions of CO_2 during the past 20 years is due to fossil fuel burning, mainly for industrial and household purposes. This has been the situation since the dawn of the industrial revolution some 150 years ago. The atmospheric carbon dioxide concentration has since increased by about 35% and the global average

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[5] Water vapour is the major GHG, contributing a positive forcing ten times greater than that of the other gases (GHGs). Clouds (condensed water) produce both positive and negative forcing: positive by trapping earth's outgoing radiation at night, and negative by reflecting sunlight during the day. Understanding how to measure accurately and simulate cloud effects remains one of the most difficult tasks for climate science.

[6] Carbon dioxide, which is released when fossil fuels such as coal, oil and gas are burnt, currently contributes the largest portion of anthropogenic positive forcing. Most of climate's change is directly attributed to our fossil energy consumption. A major removal process of atmospheric CO_2 depends on the transfer of the carbon content of near- surface waters to the deep ocean, on a century time scale, with final removal stretching over hundreds and thousands of years. Natural processes currently remove about half the incremental man-made CO_2 added to the atmosphere each year; the balance can remain in the atmosphere for more than 100 years.

[7] Methane (CH_4) contributes a positive forcing and is estimated to contribute about half the emission compared to that of CO_2. It is released from activities such as rice cultivation; raising domestic animals (such as cows, pigs, sheep); disposing waste and sewage in landfills; burning biomass; and operating leaking gas pipelines. It is estimated that the atmospheric concentration of methane has increased 151% since 1970.

[8] Nitrous oxide is emitted by both natural and anthropogenic sources. The atmospheric concentration of nitrous oxide has increased steadily since the Industrial Revolution and is now about 16% larger than in 1970. Nitrous oxide has a long atmospheric lifetime.

[9] Ozone (O_3) is not emitted directly but formed from photochemical processes involving both natural and anthropogenic causations. Ozone remains in the atmosphere for weeks to months. Its role in climate forcing depends on altitude: in the upper troposphere (Troposphere is part of the atmosphere surrounding the earth and extends up to about ten kilometers from the earth's surface) it contributes a small positive forcing, while in the stratosphere it caused negative forcing over the past two decades. Based on limited observations, global tropospheric ozone has --increased by about 35% since pre-industrial times.

[10] Aerosols are microscopic particles or droplets in air. Their major anthropogenic sources are fossil fuel and biomass burning. They can reflect solar radiation and can alter cloud properties. Depending on their size and chemistry, aerosols contribute either positive or negative forcing. For example, sulphate particles scatter sunlight and cause cooling. Soot (black carbon particles) can warm the climate system by absorbing solar radiation. Aerosols have a lifetime of days to weeks and so respond fairly quickly to changes in emissions. They are less well measured than GHGs.

temperature has risen by about 0.6°C (IPCC, 2001). The following section summarizes key findings regarding the impacts of climate change on systems, sectors and regions.

2.3 Current and Projected Impacts of Climate Change

Impacts of climate change are visible in many parts of the world. The last two decades of the 20th century were the hottest in 400 years and possibly the warmest for several millennia (Daniel, 2007:9). It is reported that 10 of the hottest years on record occurred in the last 14 years. It is predicted that in 2100, the rise in temperature could be as much as 5°C (Al gore, 2003).

Though, the likely effects of climate change are diverse and complex, they are summarized in the following manner:

1. The world's coasts will face increasingly severe storms and floods, with the inundation of coastal areas displacing millions of people,
2. Salt-water intrusion from rising sea levels will impact the quality and availability of freshwater, worsening the world's growing water crisis,
3. As warmer conditions alter forests, wetlands and rangelands, the damage to the Earth's ecosystem will be far reaching and irreversible. Some 25 % of mammals and 12 % of birds could become extinct over the next few decades,
4. Shifting agricultural lands and creeping desertification will leave many areas unfit for crops or grazing,
5. Warmer and wetter conditions may accelerate the spread of new varieties of infectious diseases such as malaria and yellow fever (UNEP, 2006b).

Future scenarios, based on different economic, social and technological development paths, suggest that annual emissions of carbon dioxide could be as much as five times their current level by 2100, resulting in a global temperature rise of 1.4°C to 5.8°C (IPCC, 2001). Recently, more comprehensive analysis of a range of climate change scenarios has indicated this figure may be as high as 11°C globally. The effects of this global warming encompass social and economic as well as environmental impacts, including more extreme weather events, rising sea levels, droughts, flooding, extinction

of species, and impacts on agriculture and human health. Some beneficial impacts from climate change may also occur in some regions, such as increased crop yield and reduced winter mortality. More disastrous scenarios have also been suggested, where the planet soon becomes uninhabitable. Given that climate systems often do not respond to change in predictable ways, it is also possible that unexpected events (such as releases of methane stored under the Arctic) may trigger a sudden and uncontrollable acceleration of climate change (Hillman, 2004a). In fact, the urgency of the issue has recently been emphasized by European scientists, who warn that action must be taken now to stabilize climate if catastrophe is to be avoided (Meinshausen, 2005).

There is considerable variation regionally in terms of the nature and severity of projected impacts, and of the vulnerability of species and human communities to these impacts. Africa is one of the most vulnerable continents to climate change and climate variability, a situation aggravated by the interaction of 'multiple stresses', occurring at various levels, and low adaptive capacity. Africa's major economic sectors are vulnerable to current climate sensitivity, with huge economic impacts, and this vulnerability is exacerbated by existing developmental challenges such as endemic poverty, complex governance and institutional dimensions; limited access to capital, including markets, infrastructure and technology; ecosystem degradation; and complex disasters and conflicts. These in turn have contributed to Africa's weak adaptive capacity, increasing the continent's vulnerability to projected climate change (IPCC, 2007). In the Fourth Assessment Report of the Intergovernmental Panel on Climate Change on Africa (IPCC, 2007), it is reported that:

- A number of countries in Africa already face semi-arid conditions that make agriculture challenging, and climate change will be likely to reduce the length of growing season as well as force large regions of marginal agriculture out of production. Projected reductions in yield in some countries could be as much as 50% by 2020, and crop net revenues could fall by as much as 90% by 2100, with small-scale farmers being the most affected. This would adversely affect food security in the continent (IPCC, 2007).

- Climate change and variability are likely to impose additional pressures on water availability, water accessibility and water demand in Africa. Even without climate change, several countries in Africa, particularly in northern Africa, will exceed the limits of their economically usable land-based water resources before 2025. About 25% of Africa's population (about 200 million people) currently experience high water stress. The population at risk of increased water stress in Africa is projected to be between 75-250 million and 350-600 million people by the 2020s and 2050s, respectively.

- Climate change, interacting with human drivers such as deforestation and forest fires, are a threat to Africa's forest ecosystems. Changes in grasslands and marine ecosystems are also noticeable. It is estimated that, by the 2080s, the proportion of arid and semi-arid lands in Africa is likely to increase by 5-8%. Climate change impacts on Africa's ecosystems will probably have a negative effect on tourism as, according to one study, between 25 and 40% of mammal species in national parks in sub-Saharan Africa will become endangered.

- It is likely that climate change will alter the ecology of some disease vectors in Africa, and consequently the spatial and temporal transmission of such diseases. Most assessments of health have concentrated on malaria and there are still debates on the attribution of malaria resurgence in some African areas. The need exists to examine the vulnerabilities and impacts of future climate change on other infectious diseases such as dengue fever, meningitis and cholera, among others.

Societies can respond to climate change by adapting to its impacts and by reducing GHG emissions (mitigation), thereby reducing threat and magnitude of change. The following topic focuses on global response to climate change.

2.4 Global Response to Climate Change

Scientists began to attract the attention of policy-makers' to the global warming issue as an emerging global threat in the early 1970s. However their appeals were initially ignored. And, as economies grew, more fossil fuels were burnt, more forested areas were cleared for agriculture and more halocarbons were produced. It took a further 20 years of continuous effort by scientists, non-governmental organizations (NGOs), international organizations and several governments to get the international community agree on a coordinated action to address climate change (UNEP, 2006b).

The Stockholm Conference is generally regarded as the starting point for international efforts on climate variations and climate change. This Conference was a meeting of the international community that was convened in Stockholm, Sweden in the year 1972 with a view to resolving the alarming environmental issues of the time. In 1979, the first World Climate Conference in Geneva expressed concern about the atmospheric commons. This event was reportedly attended primarily by scientists and received little attention from policy-makers. In the 1980s, a series of conferences and workshops were held in Villach, Austria, where scenarios for future emissions of all of the significant greenhouse gases were considered. At the 1985 Villach meeting, an international group of scientific experts reached a consensus on the seriousness of the problem and the danger of significant warming (UNEP, 2006).

As a result of growing public pressure and the implications of the report by the Brundtland Commission[11], the problem of global climate change moved onto the political agenda of several governments. A major event was the 1988 UN Toronto Conference on the Changing Atmosphere which culminated in bringing about a recommendation calling on developed nations to reduce their CO_2 emissions by 20% from 1988 levels by the year 2005. The UN General Assembly determined that "climate change is a common concern of mankind which required urgent action by all states" opening the door for an

[11] The Brundtland Commission was formed to figure out the essential relationships between environment and development. It brought about the report commonly referred to as 'our common future' in 1987 wherein it gave the authoritative definition of the new term - 'sustainable development'. The commission was referred to as the 'Brundtland's Commission' because of the person that led the commission.

international regime to address the climate change issue (UNEP, 2006). The year also saw the formation of an international group of scientists to record and continuously monitor the developmental changes in the climate system. This team, known as the Intergovernmental Panel on Climate Change (IPCC), was established and cosponsored by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP, 2006b).

The IPCC consists of over 2000 scientific and technical experts. However, it does not conduct new research. Instead, its mandate is to assess published scientific literature on how human-induced changes to the atmosphere, caused by an increase in the emission of greenhouse gases, are likely to influence world climatic patterns; how this in turn would affect a range of systems and processes important to human societies; and what range of economic and social response options exists (WHO, 2003).

The IPCC has produced a series of assessment reports, special reports, technical papers and methodologies that have become standard works of reference for climate change policymakers, experts, and students. The Panel is organized into three Working Groups:

- Working Group I (WG I) focuses on the scientific information on climate change;
- Working Group II (WG II) focuses on impacts, vulnerability and adaptation; and
- Working Group III (WG III) focuses on formulation of response strategies including mitigation measures.[12]

The IPCC's First Assessment Report (FAR) was completed in 1990. The FAR described the likely threats of climate change and helped to inspire the deliberations between states that led to the adoption of the 1992 United Nations Framework Convention on Climate Change (UNFCCC). It dealt with the anthropogenic alteration of the climate system through CO_2 emissions, potential impacts and available cost-effective response measures

[12] Mitigation is a term used to describe human interventions to reduce greenhouse gas emissions and to enhance "sinks" (forests, oceans and other natural systems that can absorb carbon dioxide from the atmosphere and store it).

in terms of mitigation, mainly in the form of carbon taxes without much concern for equity issues (IPCC, 2001).

Its Second Assessment Report (SAR) was published in 1996 and played a role in the Kyoto Protocol negotiations. A move was also made to reorganize Working Groups II and III. WG II dealt with adaptation and mitigation, and WG III dealt with the socio-economic cross-cutting issues related to costing climate change's impacts and providing cost-benefit analysis (CBA) for use in decision-making. The socio-institutional context was emphasized as well as the issues of equity, development, and sustainability (IPCC, 2001).

The 2001 Third Assessment Report (TAR) was published in 2001 and concentrated on new findings since 1995 and paid special attention to what is known about climate change at the regional level. Working Groups II and III were again reorganized to deal with adaptation and mitigation, respectively. The concept of mitigating capacity was introduced, and the focus attention was shifted to sustainability concerns. Four cross-cutting issues were identified: costing methods, uncertainties, decision analysis frameworks, and development, equity and sustainability (IPCC, 2001).

The Fourth Assessment Report (FAR) summarizes the information contained in previous IPCC reports - including the IPCC special reports on Carbon Dioxide Capture and storage, on safeguarding the Ozone Layer and on the Global Climate System published since TAR - and assesses the scientific literature published since 2000. Although the structure of FAR resembles the macro-outline of the TAR, there are distinct differences between them. The FAR assigns greater weight to:-

(1) A more detailed resolution of sectoral mitigation options and costs;

(2) Regional differentiation;

(3) Emphasizing previous and new cross-cutting issues, such as risks and uncertainties, decision- and policy-making, costs and potentials and the relationships between mitigation, adaptation and sustainable development,

air pollution and climate, regional aspects and the issues related to the implementation of Article 2 of the UNFCCC; and

(4) The integration of all these aspects.

2.4.1 The UN Framework Convention on Climate Change

The United Nations Framework Convention on Climate Change (UNFCCC) was adopted in May 1992 in New York as a response to the worldwide concern over the climate change issue. It is supposed to be the main vehicle for promoting international responses to climate change. It entered into force in March 1994 and has achieved near universal ratification by more than 190 countries of the UN member states (UNFCCC, 2001).

The convention has set the objective of preventing dangerous interference with the climate system and hence the stabilization of atmospheric GHG concentrations at levels that would prevent dangerous anthropogenic interference with the climate system and within a time frame that would achieve this objective. The criteria that specify the risk of dangerous anthropogenic climate change include: food security, protection of ecosystems and sustainable economic development (UNFCCC, 2001).

In achieving this aim, parties to the convention are to be guided by a range of principles that reflect the understanding of global environmental responsibility, including principles of intergenerational equity, the precautionary approach,[13] the right to sustainable development and the principle of common but differentiated responsibilities (UNFCCC, 2001).

The convention provides that all parties make general commitments regarding:

- The establishment of national inventories of GHG emissions and sinks;
- The promotion of scientific and technical cooperation;
- The sustainable management of forests; oceans and ecosystems; and

[13] UNFCCC, article 3.3. The Precautionary Principle under this Article is based on Principle 15 of the Rio Declaration on Environment and Development. It states that "where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures, taking into account that policies and measures to deal with climate change should be cost effective so as to ensure global benefits at the lowest possible cost."

- The integration of climate change considerations in national social, economic and environmental policies.

The convention has also classified certain parties as Annex I countries and give them additional commitments to return their anthropogenic emissions to 1990 levels by 2000,to fulfill this objective, Annex I (developing countries) are required to adopt national policies and measures to mitigate the negative effects of GHGs and by protecting GHG sinks (UNFCCC, 2001). Being a framework treaty, the UNFCCC contained only a non-binding recommendation for industrialized countries to return to the 1990 emission levels of CO_2 and other greenhouse gases by the year 2000. However, most of them have not returned anthropogenic emissions of greenhouse gases to 1990 levels. In general, global emissions of almost all anthropogenic greenhouse gases, particularly CO_2, continue to increase. This reflects the inadequacy of national and international policies and measures to address climate change (UNEP, 2006b).

The Conference of the Parties (COP) to the UNFCCC serves as the principal supervisory institution for the Convention, and meets regularly to review the adequacy and implementation and effectiveness of the Convention and other legal instruments initiated based on the convention (UNEP, 2006a).

2.4.2 The Kyoto Protocol to the UNFCCC

In its Second Assessment Report (SAR), the IPCC stated that the 'balance of evidence suggests that there is a discernible human influence on global climate' (IPCC, 1996). This unequivocal statement provided the scientific basis for the adoption of the Kyoto Protocol, the first addition to the United Nations Framework Convention on Climate Change (UNFCCC), in December 1997.

The protocol contains, for the first time, greenhouse gas reduction targets for most industrialized countries. The targets, however, range from an obligation to reduce emissions by 8% (for the European Union and many Central European countries) to a permission to increase emissions by 10% (Iceland) and 8% (Australia). Overall, industrialized countries are required to reduce their aggregated emissions to at least 5 per

cent below the 1990 level in the period 2008–12. No new obligations were introduced for developing countries (UNEP, 2006a).

The pivotal point in the global discussion occurred in March 2001 when the US government decided not to introduce any legal restrictions, as implied by the Kyoto Protocol, on anthropogenic emissions of greenhouse gases. The US administration thus declared its opposition to the Protocol, stating that it believed it to be 'lethally flawed' as it would damage the US economy and it exempted developing countries from fully participating. This decision meant that the United States a major emitter of CO_2 would not ratify the Kyoto Protocol (UNEP, 2006a).

The Protocol was negotiated and adopted by consensus at COP3, in Kyoto[14] in 1997, and entered into force on 16 February 2005. This was preceded by the detailed negotiation of the implementing rules and agreements for the Protocol – the Marrakech Accords – that were concluded at COP-7 held October-November 2001 in Marrakesh, n,lMororcco and adopted in Montreal at COP11. The climate change negotiators in Marrakesh, Morocco (COP-7 held October- November 2001) finalized outstanding issues such as a compliance system, the 'Kyoto mechanisms', accounting, reporting and review of information under the Kyoto Protocol, and others (the so-called 'Marrakesh Accords').

The Marrakesh Accords contain extensive and complex provisions to guide the practical implementation of the 1997 Kyoto Protocol. These provisions cover the 'flexible mechanisms', the establishment of the compliance mechanism among others.

Meeting the Kyoto targets will be just a first step in coping with the problem of climate change. It has been calculated that even if the Protocol were ratified and fully implemented, it will not moderate an expected warming trend of 1.4° C by 2050 by more than 0.05° C. In contrast, an immediate reduction of 60-80% below the level of carbon dioxide emissions in 1990 is needed just to stabilize atmospheric greenhouse gases concentrations at a safe level. Even if, in the long-term, a stabilization of atmospheric

[14] Kyoto is a city in Japan where the final round of negotiations for the Kyoto Protocol took place.

greenhouse gases concentrations is achieved, warming will continue for several decades, and sea levels will continue to rise for centuries with serious consequences for millions of people (IPCC, 2001).

As of December 2006, the Protocol has been ratified by 165 countries. While Australia and the United States, both parties to UNFCCC, signed the protocol, both have stated an intention not to ratify. The Kyoto Protocol would never have come into force if other developed countries had adopted the same position (IPCC, 2007).

Developing countries (e.g., Brazil, China, India and Mexico) that have undertaken efforts for reasons other than climate change have reduced their emissions growth over the past three decades by approximately 500 million tones CO_2 per year; that is, more than the reductions required from Annex I countries by the Kyoto Protocol. Many of these efforts are motivated by economic development and poverty alleviation, energy security and local environmental protection (IPCC, 2007).

Perception about the causes, impacts and the necessary response mechanisms to cope with climate calamities is important for any population in a given community. The general awareness of such communities will determine the extent of implementation mechanisms that needs to be taken to tackle the problem. Lower perception will make local intervention mechanisms to be very slow and untargeted. The following section presents local community understanding of climate change.

2.5. Local Community Understandings of Climate Change

Despite the scientific warnings of earlier decades, climate change did not become a significant public issue until 1988 - at that time the hottest year since the middle of the nineteenth century and the year in which Dr. James Hansen, director of the NASA Goddard Institute of Space Studies and a leading climate modeler, testified before the U.S. Congress that "the greenhouse effect has been detected and it is changing our climate now" (Christianson, 1999). Hansen's testimony became front-page news around

the world. Since 1988, numerous public opinion polls have found that Americans, Europeans, and Japanese are increasingly aware of and concerned about global climate change and supportive of a wide range of mitigation and adaptation policies.

Regular assessment of local community attitudes on general environmental concern began, both in the United States and other countries, in the 1970s. These surveys demonstrated increasing local community knowledge and concern towards the environment (Dunlap & Scarce, 1998). Many social analysts argue that there has been a world-wide revolution in environmental awareness to the degree that traditional ways of understanding the world have been replaced by a 'New Environmental Paradigm' (Dunlap & Van Liere, 1978). Interest in and concern for the specific issue of climate change ('the greenhouse effect') is a relative latecomer as a survey topic. Surveys including climate change items surfaced in the early 1980s and full-blown interest emerged in the late 1980s and continued. Questions generally focus on some or all of the following: levels of awareness, actual knowledge, degrees of concern, perceived risk, and willingness to pay or sacrifice to mitigate and adapt to potential negative impacts.

To date, however, there have been only a few in depth studies of local community climate change risk perceptions (Bostrom et al., 1994:959). Unfortunately, very little is known about international local community opinion or behavior regarding climate change, in large part because only a few multi-national surveys have included even a single question on the issue (Leiserowitz, 2005:1433). Local community opinion is critical because it is a key component of the socio-political context within which policy makers operate. Local community opinion can fundamentally compel or constrain political, economic and social action to address particular risks. For example, local community support or opposition to climate policies (e.g., treaties, regulations, taxes, subsidies, etc.) will be greatly influenced by local community perceptions of the risks and dangers of climate change. Further, successfully mitigating or adapting to climate change will require changes in the behavior of billions of human beings, who each day make individual choices that collectively have enormous impacts on the Earth's climate (Brechin, 2003:106).

2.5.1 Beliefs and Knowledge about Climate Change

In 1999, Globe Scan asked respondents, "How convinced are you that human activities are significant causes of changes to the earth's climate and long-term weather patterns?" They found that a large majority of respondents around the world were somewhat to totally convinced. However, the United States, the dominant emitter of greenhouse gases, was relatively less convinced with 21% of respondents saying they were either not very (14%) or not at all (7%) convinced. This is because acceptance of this fact is likely a critical determinant of support for mitigation policies and willingness to engage in individual emissions reduction.

By comparison, a number of developing countries, including Argentina, Egypt, Kazakhstan, India, and China were all much more likely to say they were totally convinced (Leiserowitz, 2007a:14). The preliminary evidence from a number of African countries also revealed that large numbers of agriculturalists already perceive that the climate has become hotter and the rains less predictable and shorter in duration. The data indicate that across the countries studied significant numbers of farmers believed average temperatures had increased. The majority of farmers also believed that rainfall levels had decreased. They also witnessed a change in the timing of the rains (Maddison, 2006).

2.5.2 Knowledge on Climate Change Causes

A 2002 national survey (Leiserowitz, 2003) asked Americans to identify the primary cause of climate change. A large plurality (47%) said that damage to the ozone layer is the primary cause, confirming that many Americans (and others around the world) continue to confuse and conflate these two different environmental issues. By contrast, only 23% of Americans correctly identified the burning of fossil fuels as the primary cause of climate change. Fortunately, relatively few identified nuclear power plants, toxic waste, or aerosol spray cans as the (incorrect) primary cause, yet a separate question in this same study found that many Americans incorrectly believe that these also contribute to climate change (50%, 66%, and 70% respectively). According to this study the understanding of the causes of climate change remains quite limited in the United States.

2.5.3 Seriousness of Climate Change Issues

Awareness of the problem is a necessary, but insufficient condition to motivate an individual or collective response. Meanwhile, social science research has demonstrated that risk perceptions are critical components of local community and social responses to hazards. In-depth studies often assess local community perceptions of the likelihood and severity of potential consequences. Unfortunately, no in-depth study on international risk perceptions of climate change has yet been conducted, so very little is known about how the global or diverse national local communities perceive this issue (Brechin, 2003:107).

There are, however, limited data on the perceived seriousness of climate change. In a 2000 survey of 34 countries, Globe Scan asked respondents, how much climate change is perceived as a serious a problem. They found that majorities in each country said that climate change was a somewhat to very serious problem. It is interesting to note that many developing countries viewed this global risk as more serious than most developed countries (Leiserowitz, 2007b:45). Global concerns about climate change, however, may be increasing.

In 2006, Globe Scan resurveyed many of these same countries and found that the percent of respondents saying climate change was a "very serious problem" had increased significantly in many countries. This may be for a variety of reasons, ranging from increased scientific certainty, media and policymaker attention, observed impacts around the world, or the diffusion of basic awareness of the problem worldwide. However, stating that a problem is "very serious" is not the same as stating that it is an urgent or high priority, as discussed below. Based on the limited data currently available, it appears that climate change remains a relatively low priority globally, compared to other, more pressing issues /war, poverty, unemployment, etc. (Leiserowitz, 2007b:47).

In 2001, Globe Scan asked respondents how believable they found the following statement: "Climate change will pose a direct threat to me and my family over the next decade." Respondents from developing countries tended to be much more convinced that climate change would be a direct threat than respondents from developed countries. Over

the long term this perception may be accurate, as many developing countries are likely to suffer greater impacts of climate change, in part because they often lack the adaptive capacity of developed countries. At the same time, the perception of many developed country respondents that they are not personally vulnerable in turn contributes to the perception that climate change is a geographically distant threat that will primarily impact people and places far away (Leiserowitz, 2005:1433). Thus climate change may remain a relatively low priority for many in developed countries until they understand or begin to witness climate change impacts closer to home.

The 2006 Pew Global Attitudes Survey asked respondents "How much do you personally worry about climate change?" and found levels of worry generally lower than perceived seriousness and greatly varying across countries. The greatest levels of worry were found in Japan, India, and Spain, while the United States, China and Egypt reported the lowest levels of worry. The United States in particular also had the largest proportion of respondents who said they don't worry at all about climate change (21%). These results may help explain, among many other reasons, why many political leaders in the United States have not felt compelled to address the issue (Leiserowitz, 2007b:7).

Beyond these general measures of perceived seriousness and worry, in 2001, Globe Scan asked respondents in 30 countries the possible impacts of climate change that most concerns them personally, if any. Worldwide, the potential impacts of climate change on human health were the single most cited, followed by drought and water shortages, species loss, and extreme weather events (Leiserowitz, 2007b:11).

Developed countries, however, were generally less concerned about the human health impacts than developing countries. Meanwhile, substantial numbers of respondents from Brazil (45%), China (29%), and South Korea (26%) were concerned primarily about drought and water shortages, while many from India (28%), Argentina (26%), Chile (22%), and Canada (22%) were primarily concerned about species loss. By contrast, many Japanese (31%) and Thai respondents (23%) were most concerned about extreme weather events, while many Nigerian respondents (26%) were concerned about the

potential economic impacts. Interestingly, however, sea level rise, which receives a great amount of media attention, was rarely selected, with the slight exceptions of Great Britain (15%) and Germany (12%). As the impacts of climate change will be geographically heterogeneous, these results at least suggest that different national local communities are beginning to think about how climate change may specifically impact them (Leiserowitz, 2007b:11).

2.5.4 Concern about Climate Change

Previous international studies demonstrate that concern for climate change has, over the past two decades, become widespread (Thompson & Rayner, 1998). Yet while most people in England (80%), Scotland (67%) and Wales (66%) say they are fairly or very worried about climate change, this issue is not one of the local community's main environmental concerns (Poortinga & Pidgeon, 2003). Even in terms of future environmental issues, traffic and air pollution are rated more concerning than climate change (DEFRA, 2002). In Scotland, concern about climate change has dropped significantly over the last ten years relative to other environmental concerns (Hinds et al., 2002).

Furthermore, concern varies amongst different demographic groups. Women and middle-aged people tend to be more concerned about climate change. More women than men are convinced that climate change is happening, is caused by human activities (O'Connor et al., 2002). Women are also more likely to be 'very worried' about climate change (DEFRA, 2002; Bibbings, 2004a), and to see it as a serious threat (Norton & Leaman, 2004). These gender differences may be a result of socialization, in which contextual awareness tends to be fostered more amongst females than males (Stern et al., 1993). Gender differences may also arise from differences in power relations with, and trust in, risk-producers and risk-handlers (Gustafson, 1993). The variation in concern by age is more ambiguous. Recent studies indicate that younger people are less concerned than older age groups about climate change (Bibbings, 2004a). These apparent incongruities suggest a need for more qualitative approaches to explore concern for climate change amongst different age groups.

2.5.5 Priority of Climate Change

Overall, the world local community appears largely aware of and concerned about climate change. While many view it as a critical threat, how does it compare to the many other pressing issues vying for world attention and action? Unfortunately, we have very limited data about how climate change ranks compared to other issues.

In a 2005 survey of 22 countries, however, Globe Scan asked respondents to volunteer answers to the question, "What do you think is the most important problem facing the world today?" After grouping similar answers, they found that war and conflict led the list, followed by poverty, economic issues, terrorism, unemployment and then general concerns about the environment. On average, only 1% of respondents specifically mentioned climate change, or the greenhouse effect as the world's most important problem. While this question did not allow people to directly rank climate change relative to other issues, it does demonstrate that climate change is not an issue that comes readily or immediately to mind and strongly suggests that it remains a relatively low global priority compared to many other world issues. But how does climate change rank compared to other environmental issues? Again, no one has ever asked multinational respondents to directly rank environmental issues by priority. In a 2000 survey of 34 countries, however, Globe Scan asked respondents to rate the seriousness of several environmental problems. Large majorities worldwide selected the strongest response possible ("very serious") for seven of the eight problems measured (Leiserowitz, 2007a:28).

The results of the study conducted in Kenya also lead us to conclude that the respondents do not perceive climate change to be a very significant problem in relation to other threats to socioeconomic security in Nairobi. This perception is not limited to the ordinary citizens but is also reflected in the priorities delineated by the new government, which is focusing primarily on poverty alleviation, fighting graft, improving education and fighting crime. The issue of climate change therefore looks like a mere drop in the oceanic context of unemployment, poverty, corruption, insecurity, street children and a generally degraded human condition in the city of Nairobi, Kenya (Shisanya & Khayesi,

2007:281). Worldwide, people may be concerned about the potential impacts of climate change on human health, followed by water shortages, species loss, or extreme weather events. Many individuals in Ethiopia, however, do not personally worry that much about the issue. The following two sections discuss the climate of Ethiopia and its potential impacts on different systems.

2.6 The Climate of Ethiopia

Climate is often described by the statistical interpretation of precipitation and temperature data recorded over a long period of time for a given region or location. Mean annual rainfall distribution over the country is characterized by large spatial variation which ranges from about 2000 mm over some pocket areas in the Southwest to less than 250mm over the Afar and Ogaden low lands (NMSA, 1996; NMSA 2001).

In Ethiopia, during the last 50 years the annual average minimum temperature has increased by about 0.2°C every decade. The phenomenon is a major concern for Ethiopia since its economy depends on rain fed agriculture, which is highly sensitive to climate variations. Unfavorable shifts in rainfall belts caused series of droughts, which nowadays recur every two years especially in the lowlands of Ethiopia. Erratic rainfall and excessive evapotranspiration due to extended drought season is causing drastic crop yield reductions, or crop failures, decreased biomass yield and carrying capacity of grazing lands and loss of biodiversity. Consequently, food shortage and associated health problems, climate induced disruption of agricultural systems, migration of people to urban areas, flooding and siltation of lakes and watercourses have become the common scenarios of recent years in Ethiopia (NAPA, 2007:28).

Causes for vulnerability of Ethiopia to climate variability and change include 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, lack of awareness, etc (NAPA, 2007:29).

2.7 Impacts of Climate Change in Ethiopia.

2.7.1 Impacts on the Ethiopian Weather Condition

One of the direct impacts of global climate change on Ethiopia is the change in local weather condition. Having significant proportion of its population dependant on agriculture and below poverty line, even a little alteration in the local weather condition, would result in unimaginable repercussions on the biophysical and socioeconomic environment of the country (Daniel, 2007:9).

The primary impact of global warming, proven by many research centers, is the rise in minimum, maximum and mean temperature coupled with an increase or decrease in the amount of rainfall. This, in turn, would exert great pressure on the functioning of various ecosystems, making the environment more vulnerable to degradation and expose it to various forms of natural hazards (Daniel, 2007:9). Studies show that Ethiopia ranks 7th among countries in Africa in terms of vulnerability to impacts of climate change (Vincent, K 2004). Another study has revealed that 25% of Africa's total area would be the most affected by climate change and Ethiopia, as a country located in the African continent, is most likely to be affected (Thornton et al., 2006).

2.7.1.1 Impacts on Rainfall

The Initial National Communication of Ethiopia, probably the first comprehensive report on the impact of climate, rather than its future change pattern, has undertaken a retrospective assessment of rainfall and temperature in the country. It is stated that, averaged nationally, the amount of rainfall in Ethiopia has been constant for over five decades (UNFCCC, 2001). However, there were diverse patterns between different agro-ecological regions of the country, such as, a declining trend of rainfall in the northern parts of Ethiopia, an area corresponding to massive degradation of environmental resources and disrupted ecological balance. This area already has environmental problems such as expansion of aridity, abandonment of farmlands due to losses in the productivity of lands, enhancement of food insecurity problems, triggering of

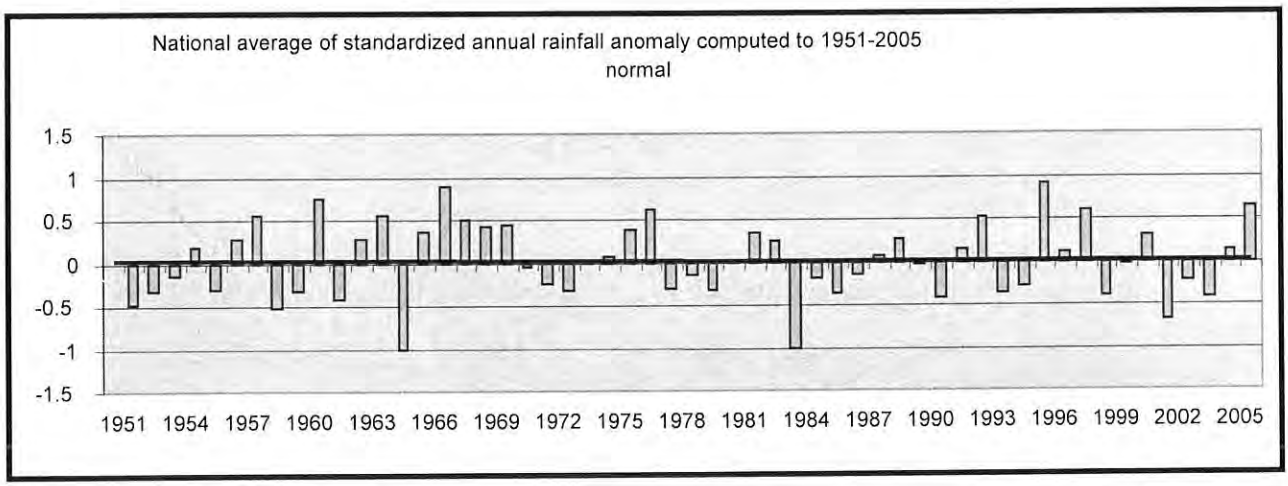
environmental refugees and creation of tension among competing societies for limited natural resources, etc. Further decline of rainfall in this region would only exacerbate the aforementioned existing problems (Daniel, 2007:5). It was also noted that there is a declining trend of rainfall in the southeast and northeast Ethiopia, locations where water insecurity exists (Funk et al., 2005).

On the contrary, the central parts of Ethiopia have experienced an increasing trend of rainfall. This part of the country is characterized by its very dense population, both human and livestock. Its land resources have been subjected to intense degradation due to inappropriate land management practices; up to 150 tones of topsoil are lost per hectare of a farmland. If the amount of rainfall continues to increase, a chain of repercussion are likely to follow. For example, the amount of rainwater stored in the soil profile would be very little which would enhance surface runoff, followed by further soil losses. This in turn would increase the seasonality of streams, with increased chances of river outburst in the rainy season. Such phenomena would likely trigger flooding hazards, especially in the lowland parts of the country (Daniel, 2007:6).

Apart from changes in the rainfall amount, significant negative impacts could result due to high variability of rainfall distribution. Surveys conducted in the central and north-central Ethiopia demonstrated that about three to four decades ago, distribution of rainfall was less variable especially during the crop growing period. Such distribution pattern was considered very suitable for dependable crop production in those parts. However, recently, farmers have witnessed significant increase in the intensity and variability of rainfall, affecting the predictability of the onset and cessation of the rainy seasons. Besides, as water shortage is already the major problem of pastoral areas in the lowlands of Ethiopia, the declining of rainfall amount in those areas would exacerbate the existing challenge (Daniel, 2006). Baseline climate was developed using historical data of temperature and precipitation from 1951- 2005 for selected stations. Figure 1 shows the year-to-year variation of rainfall over the country expressed in terms of normalized rainfall anomaly averaged for 42, stations. As it can be seen from the figures, the country has experienced both dry and wet years over the last fifty five 55 years. Years like 1952,

1959, 1965, 1972, 1973, 1978, 1984, 1991, 1994, 1999 and 2002 were dry while 1958, 1961, 1964, 1967, 1968, 1977, 1993, 1996, 1998 and 2006 were wet years (Figure 1).

Figure 1: Year to Year Variability of Annual Rainfall and trend over Ethiopia expressed in Normalized Deviation.



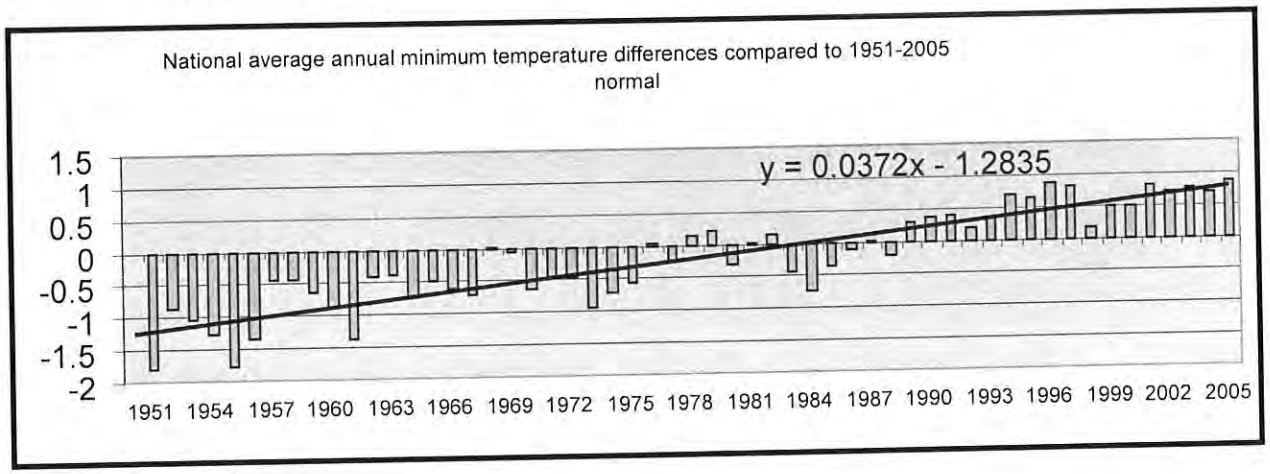
(Source NMA, 2007:3)

2.7.1.2 Impacts on Temperature

Studies show that there has been a general trend of atmospheric warming in Ethiopia. Average annual minimum and maximum temperatures have been increasing at 0.25^0C and 0.1^0C per decade, respectively (UNFCCC, 2001). In connection with this, another study also reported an increasing trend of 0.3^0C per decade for the mean minimum and maximum temperature in the Ethiopian highlands (Muna, 2006). The continuing increase of temperature has implications especially in the low-lying areas of the country. Coupled with the declining rainfall amount in those parts, the increasing trend of temperature would exacerbate the existing level of water stress which in turn leads to the depletion of grazing lands and desertification. The year to year variation of annual minimum temperatures expressed in terms of temperature differences from the mean and averaged over 40 stations is shown in Figure 2. As it can be seen from the Figure, the country has experienced both warm and cool years over the last 55 years. However, the recent years are the warmest compared to the early years. Figure 2 clearly reveals that there has been a

warming trend in the annual minimum temperature over the past 55 years. It has been increasing by about 0.37 ^{0}C every ten years.

Figure 2: Year to Year Variability of Annual minimum Temperature over Ethiopia expressed in temperature difference.



(Source NMA, 2007:3)

2.7.2 Impacts on Ecosystems

Changes in climate are reported to significantly affect the already sensitive global ecosystem (IPCC, 2002). Among several, wetlands are the prime susceptible ecosystems to be affected by climate change. Other than providing fundamental ecological functions and harboring significant varieties of biological diversity, wetland function as water storage, groundwater recharge, storm protection, flood mitigation, shoreline stabilization, erosion control, and retention of carbon, nutrients, sediments and pollutants (Dugan, 1990:95). Wetlands also act as hydrological buffer as in floodplain wetlands store water when rivers over-top their banks, reducing flood risk downstream (IPCC, 2002).

In Ethiopia wetlands cover about 2% of the total area. They are found mainly in the south-western parts of the country, where head waters of several rivers are found (Abebe & Kim, 2003). The predicted increase in temperature would ultimately enhance the amount of evaporation from these wetlands affecting their existence. Such trend would also likely affect the various ecological functions of wetlands and exacerbate the environmental degradation of the country.

The high mountain ecosystem is the next sensitive area to be affected by climate change. Because of their shape and size, mountains support a wide range of climatic conditions. Every rise in altitude generates different climatic conditions, supporting many varieties of ecosystems with some of the world's unique variety of plant and animal life. In Ethiopia, mountain ecosystems (above 1,500 m) make up 40% of the total land mass. It makes Africa's largest mountain complex, distinguished by a diversity of climatic conditions of both natural and cultivated plant life. As the world heats up, the conditions on the mountains would change. Especially in the recent decades, there has been an upward advance of tree lines in response to rising temperatures all over the world. Consequently, many species of plants are potentially affected (Nkomo et al., 2006).

Many of the endemic mammals of Ethiopia are found in mountainous areas. These endemic species have specific habitat requirements which could significantly shrink if warming continues. The change in the temperature of the mountains has twofold implications. First, it would enable the cropping of several crops which were not possible before due to the low temperature conditions. Second, the process would significantly shrink the size of habitat suitable for highland plant and animal species (Puff, 2003). While the former is the positive implication of climate change, the later implication is a loss to the ecosystem.

2.7.3 Impacts on Water Bodies

The likely impact of climate change on water bodies (their use potential, flow characteristics, volume, etc) located in Ethiopia is an area where adequate studies have not been made upon. Ethiopia is rich in water resources having both local and international significance. Abay and Awash Rivers are among the water bodies upon which assessment has been made. While the study made on Awash River reveals the fact that the river is highly sensitive to the climate change (Kinfe, 1999), runoff in Abay basin is predicted to decrease up to 33.6% due to climate change (Deksiyos, 2000). Such predictions warrant the sustainability of the hydropower resources of the country since it is predictable that several small streams would disappear while bigger rivers are likely to shrink. Such phenomena would also have repercussions on the security of the Horn of

African countries since the impact of declining water resources in Ethiopia affects the existence of nations downstream.

Climate change also affects the availability of water resources by depleting underground and surface water potential. Water availability is changing fast in Ethiopia. Some areas that used to be covered by water have now become grazing areas due to climate change. The water level has been seriously depleted and rivers are now drying up because of metrological droughts thereby affecting the economy. For example, the Tis Issat waterfall (a spectacular waterfall on the Blue Nile River), which was an attractive tourist site on the Blue Nile River, has been significantly affected partly due to climate change. In addition, many rift valley lakes are drying up fast as a result of climate change, the consequences of which are depleted fishery resources (Abebe and Kim, 2003).

The other problem is deviation in the onset of rainy seasons. This phenomenon has a great effect especially on water bodies. There are river areas where flood is a seasonal phenomenon and the people were well aware of the timing and prepare for it. However, flood incidences are increasing in different areas of the country like Tigray (Central and Western), Amhara (North Gondar, North Showa), Oromia (North West Showa and Hararge zones, SNNPR (North Omo, Gurage, Sidama and Hadiya zones) and other urban centers like Dire Dawa because of the deviation of the rainy season where the surrounding people were not prepared (DPPC.1997:29). Such type of flooding is a typical characteristic of the local impacts of climate change (Endalkchew et al., 2004).

2.7.4 Impacts on Agriculture

Agriculture is the main pillar of the Ethiopian economy. 85% of the population is dependant on the sector in terms of employment and livelihood. It also contributes about 50% of the country's gross domestic product (GDP); generates about 88% of the export earnings; and supplies around 73% of the raw material requirement of agro-based domestic industries. However, the sector, due to many factors, has failed to bring about the desired effect on the economic development of the country (MoFED, 2006).

The output of the agricultural sector is most likely to be affected by the impacts of climate change, mainly, due to increased temperature and reduced rainfall. The study made at Debrezeit, and Addis Ababa from Central Ethiopia and Kulumsa from Southeast, which are considered as major wheat producing areas in the country indicated that crop maturity period would decrease (ranging from –10.6% to-18.5%) under climate change scenarios. A decrease in maturity period by about 16% at Debrezeit and 17% at Kulumsa and Addis Ababa was observed (NMSA, 1996).

2.7.5 Impacts on Biodiversity

Biodiversity in Ethiopia is particularly high and unique. However, its gradual degradation has become a threat. The genetic diversity of Ethiopia's unique flora and fauna are increasingly eroded because of the long history of disruptive interventions by the state coupled with increasing population. Adding to these, the impact of climate change will make the pace of biodiversity erosion would be phenomenal (EPA, 1997a). This does not mean that climate change directly poses extinction to the biodiversity but it rather forces species to migrate. If migration is, for whatever reason, not possible, the species will get extinct. According to the studies made by (Negash, 2000), under changed climate scenarios, changes of forests from one type to another, shifting of forests from old to new habitat, reduction of areas of forest coverage, fragmentation of forest life zones, disappearance of montane and lower montane wet forest and subtropical desert scrub are expected (Negash, 2000).

2.7.6 Impacts on Health

Change in world climate would influence the functioning of many ecosystems and the biological health of plants and animals. Likewise, there would be health impacts on human populations. As a result of climate change, the increment in temperature and an increased amount of rainfall, diseases such as malaria, dengue fever, cholera, dysentery and respiratory diseases are expected to be more pronounced due to climate change (Lindsay and Martens, 1998:33). According to reports, the most prevalent illness in Ethiopia is malaria, followed by diarrhea (MoFED, 2006). These two diseases are directly related to climate change. There is a significant increase in the occurrence of

malaria in Africa, particularly in areas that did not have previous incidences of malaria, such as the east African highlands (Githeko and Ndegwa, 2001:54). Due to climate change impacts, a ratio of 109.4 deaths/ million over the last years was computed out of which climate change killed over 50,000 people in Ethiopia alone between 2000 and 2006 (Mcmichael et al., 2004:1543).

The impact of climate change on the biodiversity would also have indirect implications on health. The majority of rural population in Ethiopia, which makes up 85% of the total population, uses medicinal plants as the primary sources of health care. The gradual depletion of biodiversity resources would reduce the availability of medicinal plants, putting the health condition of rural population at a precarious situation where modern medicines are inaccessible (Mcmichael et al., 2004:1544).

Recognizing that climate change and its impacts are real, Ethiopia has attempted to set up the possible mechanisms, in order to cope with the likely consequences. The following topic discusses the national response to climate change.

2.8 National Responses to Climate Change

The amount of GHGs emissions contributed by Ethiopia is quite negligible. The little amount of emission from the country is identified to be linked to agricultural practices[15]. Thus, the sector being the most dominant in the country is identified to account for a major portion of national anthropogenic gas emissions in Ethiopia (NAPA, 2007). Despite the low national emission, the country has demonstrated its alliance in the global combat against climate change. This is done through incorporating policy provisions with directions on concrete steps. Besides this, the country has ratified both the UNFCCC and the Kyoto Protocol.

[15] Acording to the GHG inventory undertaken in 1994, the agricultural sector accounted for 80%, of total CO_2 equivalent emissions in Ethiopia.

2.8.1 Environment Policy of Ethiopia

This is a policy document adopted by the Council of Ministers in April 1997. One of the 10 sectoral policies adopted within this government document focuses on "Atmospheric Pollution and Climate Change". It states that the Ethiopian government foresees to:

a. promote a climate monitoring program as the country is highly sensitive to climatic variability;
b. recognize that even at an insignificant level of contribution to atmospheric greenhouse gases, a firm and visible commitment to the principle of containing climate change is essential and to take the appropriate control measures for a moral position from which to deal with the rest of the world in a struggle to bring about its containment by those countries which produce large quantities of greenhouse gases (EPA, 1997b).

2.8.2 Ratification of the Climate Regime

This expressed will is further substantiated by the ratification of the United Nations Framework Convention on Climate Change and its Kyoto Protocol[16]. These instruments were ratified by Proclamation number 97/1994 and Proclamation number 439/2005 respectively. According to the latter law, the Environmental Protection Authority (EPA) is the national institution vested with the task of coordinating efforts and taking the necessary actions to implement the Kyoto Protocol (EPA, 1997a).

2.8.3 Measures taken by the Ethiopian Government

Due to lack of technological and financial capacity, Ethiopia cannot on its own undertake mitigation and adaptive measures to address the adverse environment and socio-economic costs of climate change. Therefore, the country has to collaborate with the developed world to halt the situation through efficient technology transfer as stipulated under the United Nations Framework Convention on Climate Change (UNFCCC). The Convention urges developed countries to promote, facilitate, and finance, the transfer of, or access to, environmentally sound technologies and know-how to developing countries, to enable them to implement the provisions of the Convention. Ethiopia has undertaken a 'Technology Needs Assessment' (TNA) in the Agriculture, Industry, Energy, Waste,

[16] The UNFCCC is ratified on 2 May 1994 and the Kyoto Protocol on 21 February 2005.

Land use and Forestry sectors. The TNA is a prioritized list of technology needs to address national impacts of climate change (NAPA, 2007).

There are already a number of existing national policy initiatives, sectoral policies, programs and strategies that may directly or indirectly address climate change adaptation. Accordingly, the most important policy and program documents that have relevance to climate change adaptation include Plan for Accelerated and Sustainable Development to end Poverty (PASDEP), Environmental Policy of Ethiopia, Agriculture and Rural Development Policy and Strategy, Water Resources Management Policy, Health Sector Development Policy and Program, National Policy on Disaster Prevention and Preparedness, National Policy on Biodiversity Conservation and Research, Science and Technology Policy, Population Policy and National Agricultural Research Policy and Strategy (NAPA, 2007:31). 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. 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. Moreover, climate change and adaptation issues are crosscutting issues like poverty, which should be addressed in a holistic approach through ensuring the participation of all the relevant sectors (NAPA, 2007:31). The better attention given to natural resource, environment and climate change in recent years was also cited as an encouraging move. For instance, there are standing committees in the parliament such as natural resource protection standing committee, pastoralists standing committee and agriculture and rural land standing committee. Moreover, environmental issues have been accorded serious attention during the Millennium celebration ceremony. An initiative of two trees at the millennium has created special moment in which the nation focuses on natural resource conservation. Accordingly, about one billion seedlings were planted though the survival rate of the millions of tree seedlings planted remains low (DFID, 2007).

A number of articles on climate change have been produced on newspapers, magazines and newsletters. It is worth mentioning that Agazen, a bi-annual environmental newsletters/bulletin published and distributed freely to high school students, featured climate change prominently in one of its issues.

Talks about climate change have been given in many environmental clubs established in secondary schools, teacher training institutions and in environmental forums organized by NGOs as well as in distance education programs by radio of the Ministry of Education (NMSA, 2001).

In section 2.7 attempts has been made to present the likely impacts of climate change in Ethiopia and the governments policy initiation and measures that has been made to cope with climate change. It is revealed that:

1. There were diverse patterns between different agro-ecological regions of the country, such as, a declining trend of rainfall in the northern parts of Ethiopia, an area corresponding to massive degradation of environmental resources and disrupted ecological balance.
2. There has been a general trend of atmospheric warming in Ethiopia
3. Water availability is changing fast in Ethiopia.
4. Flood incidences are increasing in different areas of the country

According to this thesis attempts has been made to assess local community understanding of and response to climate change focusing on flood hazard/ risk, which is one of the climate change calamities. To this effect, Dire Dawa town, which is one of the flood prone areas, is selected as a study area. Accordingly, the following section presents a general discussion on flood and a brief account of increasing flooding scenario in Ethiopia and Dire Dawa in particular.

2.9 Flooding: An Overview

Flooding is the inundation of land by the rise and overflow of a body of water (IFRCS, 2006). This happens usually when there is excessive rainfall or precipitation which exceeds the retention capacity of the soil causing run-off. Flooding is recognized as the major natural hazards that by far exceed other natural hazards in terms of frequency of occurrences and damage. According to some official reports, flood kills many people and it inflicts a huge amount of economic loss on a global scale (Munich, 1997, Blaikie et al., 1994). For instance, the International Federation of Red Cross and Red Crescent Societies in its annual world disaster report states that floods have affected more than 75% of the total people reported to be affected by disasters in the same decade (IFRCS, 2001).

2.9.1 Causes of Flooding

The major and direct cause of floods is the run-off water on land. This, however, is in turn caused and aggravated by a number of interrelated natural and man-made factors (UN, 1977). Nevertheless, it is generally accepted that the process of hydrological cycle, which is responsible for the creation of precipitation is at the root of the occurrence of flooding. Precipitation is in the form of rain or snow reaches the ground to either infiltrate into the soil or run directly into water bodies, depending on vegetation cover, the absorption capacity of the soil, and the nature of the terrain in an area. Moreover, human interface or economic activity on the environment, often aggravate the frequency and intensity of floods. Human interface including deforestation which increases run-off by clearing the vegetation cover that helps to intercept and absorb the power of down pours; inappropriate farming techniques that aggravate soil erosion; overgrazing; expansion of physical infrastructure such as asphalted roads, building etc can be mentioned as factors that reduce the infiltration of water into the ground, and thus, contribute to increased flooding (UN, 1997: 12).

2.9.2 The Effects of Flooding on Peoples' Livelihoods

Floods as a recurrent climatic shocks have both short-term and long-term impacts on people and their livelihoods. In this regard, (Cannon, 1990) notes that flooding can induce problems of assets loss or destruction, ill-health, loss of income and loss of food security. The typical effects of flood hazard include death of people, physical damages on houses, public infrastructures such as roads, schools and hospitals and the associated economic losses and damages on crops, food and water supplies.

However, flooding like any other disasters has varied impacts as dictated by their socio-economic positions. Thus, flooding can have a serious effect on the livelihoods of the poor in developing countries like Ethiopia (Cannon, 1990).

Various studies made on the socio-economic impacts of flooding reveals that as the occurrence of flooding rise, peoples vulnerability to associated hazards appear to be on the increase. Chan and parker (1996:313) in their study of flood hazard factors in Peninsular Malaysia, the flood affected livelihood and economic development in the area through asset destruction, crop damage and income losses. A similar study made in China also reveals that in the 1990's the economic losses incurred as a result of severe flood have reached about 67 billion USD, which is a clear indication of the extent of flood damage on the livelihoods of millions of people (UN, 19997).

The literature on flood-hazard response suggests different flood control and mitigation measures ranging from forecasts to the construction of flood control structures. In this regard, (Lansigan, 2007) suggests a wider flood management approach to flood hazard mitigation that incorporate flood plain zoning, forecasting, insurance and relief and rehabilitation. Moreover, they also suggest the construction of dykes, levees, channels, reservoirs and the diversion of flood waters as part of the solution for alleviating the problem of flooding. However, the general effectiveness of these measures is doubt full, when viewed from the stand point of households and communities that have to live with the risk of facing prolonged disasters as such measures only postpone the occurrences of the much devastating disasters to a later period (Shaw, 2006:72).

2.9.3 Climate Change and Increasing Flooding Scenario.

In recent decades, flooding is showing an increasing trend in terms of its frequency and severity. According to IFRCS (2006:94), floods have accounted to about 40% of all hydro metrological disasters that have occurred in the years from 1996 to 2005. Moreover, the same source disclosed that " the number of reported natural disasters was up to 15% from 2004, mainly due to a 50% increase in floods"(IFRCS, 2006: 95). Thus, as a result of this recurrent climatic shock, the number of people affected has increased to 7.5 million worldwide.

Thus, the increasing frequency and severity of the recent floods has been attributed to several interrelated causal factors. However, despite the problem of attributing the incidence of flooding to one factor with a level of certainty, the issue of climate change has, over the year, stood out as a major causal factor for the increasing floods. For instance the IPCC, asserted that floods will increase in their frequency and severity pertaining mostly to the effects of climate change- a fact that can no longer continue to be a debated issue as its presence is strongly felt (IPCC, 2001). Others attribute the frequency and severity of floods to human activities related with economic development, particularly to urbanization and industrialization which in general have reduced infiltration and increased the speed in which water runs-off, leading to a more frequent and higher flood (Miller, 1997:20).

2.10. Flood Disasters in Ethiopia

The available scant historical records on the incidence of flooding indicate that there are well-known flood-prone areas in the country that are frequently been affected by the floods. These areas are almost entirely located in and around the major river-basins, including area around Lake Tanna (DPPC, 1994). Moreover, flooding caused by excessive seasonal rainfall is noted as a perennial adverse event, in the highlands that frequently causes a certain level of damage on the livelihoods of the people. However, little is known and documented about these flooding and the extent of damage they cause.

The earliest flood damage has been rerecorded in the period between 1955 and 1960, where flooding has killed several people and destroyed assets in places like Wello, Debre Markos, Jimma, Arsi, Bale Goba, Debre Berhane and Bahir Dar (DPPC, 1994). Flooding damages have also been recorded from 1961 to 1978, in several areas in the country, where it has killed people, livestock and destroyed property and public infrastructures (DPPC, 1994).

Although there is lack of documentation related to flooding and its damages after 1978, it is possible to assume that flooding associated with the rainy seasons is a regular event having a certain impacts on livelihoods. In this context, the worst flooding have been recorded in 2006, affecting more than 428,800 people in five regions of the country (DPPA, 2007).

Table 2: Number of Population affected by flooding in 2006 in Ethiopia

Region	Affected	Displaced Casualties	Casualties
Dire Dawa	9,927	9,927	256
SNNPR	106,666	28,775	368
Amhara	97,824	37,863	3
Somali	361,619	125,000	80
Oromia	20,156	3,392	10
Afar	42,100	4,050	-
Gambella	30,915	30,915	2
Tigray	582	582	-
Harari	3475	-	-
Total	**674,479**	**241,699**	**719**

Source: Briefing note for DAG-DPPA meeting (General Director Simon Mechale)

2.10.1 Types and Causes of Flooding in Ethiopia

According to some studies, reverine and flash floods are recognized as the two types of floods that frequently occur in Ethiopia (Ashenafi, 1978; DPPC, 1997; DPPA, 2007). Reverine flooding is caused by the overflow of water flow from river banks to adjacent lands, while flash floods are caused by sudden, heavy and torrential rains with relatively short duration in limited areas, causing a high run off (DPPC, 1997). Areas in the Afar Region along the Awash River, in the Somali Region along the Wabi Shebele River and in the Gambela Region along the Baro-Akobo River, in the Southern Region along the Oomo-Gibe River, Bahirdar Zuria and Fogera areas along the Abbay River in the Amhara Region are prone to seasonal river floods (Endalkchew et al., 2004).

A study made by DPPC (1997:29), also claimed that flash floods is a problem in most parts of the country and identifies the most frequently affected regions as Tigray (Central and Western), Amhara (North Gondar, North Showa), Oromia (North West Showa and Hararge zones, SNNPR (North Omo, Gurage, Sidama and Hadiya zones) and other urban centers like Dire Dawa. In this thesis, however, Dire Dawa's flood history, its causes and attempts so far made is discussed.

2.11 Flooding in Dire Dawa

Flood hazards are not new to Dire Dawa. Surrounded by the highland areas, the town has been repeatedly devastated by powerful flood disasters in the past. Available evidences indicate that since 1953 Dire Dawa has been affected by flood (Tsegaye, 2006:5).

In April 1981 flash flood from Dire Dawa catchments occurred three times (once in the night and twice day time). The flood caused damage in areas called Koka, Ginfille, Addis Ketema, Ashawa, Dechatu and Kezira, (including damage on medical items and medicines in Dil Chora Hospital), Rail Way Station, residential houses, and offices as well as household and office items. There is no detail secondary data that indicate the magnitude of damage. In 2001 also the flood damaged the same flood prone areas in Dire Dawa. As per information from some community members collected by Dire Dawa Information and Public Relation Bureau, the flood caused destruction of one Coffee

Export Project, Real State Development Project and Rail Way Bridge in Dire Dawa. But there is no secondary data to get more recorded information. In May 2005, the flood which occurred in the evening (between 6:00 and 7:00 PM) still affected the same places. The death of 42 people was confirmed by Dire Dawa Police. The flood caused about birr 10,000,000 property lose which include total lose of 3 trucks, one small car, 1 scania Lobed and damage on 6 trucks, houses and household items (Daniel et al., 2006:28). The devastating flood in August 6, 2006 caused death of 256 people, displaced 9,956 and 244 people missing. The flood has made 2,685 households homeless. Out of the displaced people, 5,524 are in temporary shelter while 4,432 living with their relatives and friends. The flood has inflicted huge damages on urban infrastructures. Roads, bridges and houses were destroyed. Electric poles, water pipes and sanitation facilities were also damaged. Investors, traders, small and peaty traders have lost 30,054,275 Birr estimated property. In addition, other than the houses totally destroyed, the flood entered in to 1000s of Dire Dawa houses and damaged household items, even though they are not displaced (DAAC, 2006).

Figure 3: The effects of the 2006 flooding in Dire Dawa

Source: Dire Dawa Road Authority, Oct. 2006

2.11.1 Causes of Flooding in Dire Dawa

The flood problem in Dire Dawa is the result of natural and man-made factors. These factors could also be classified into location and physiographic conditions, vis-à-vis topography, soil, as well as land degradation, intensity of rainfall and man made factors (Bezuayehu et al., 2006:52). Many people have been associating floods and flash floods of Dire Dawa with the torrential rainfall occurring in the main rainy season (i.e. late July -early Augusts). Others reported that it was a combined effect of massive agricultural land degradation, extensive cultivation on steep slopes, runoff from roads, and quarrying of stones and sand collection inappropriate settlement and construction (Daniel et al., 2006:27).

2.11.2 Attempts made so far to Reduce Flood Risks

This catastrophe draws government attention for proper planning and immediate response for Dire Dawa Urban Flood Alleviation. The administration of the city in collaboration with neighboring regions has plans for watershed management programs to be implemented during the national water sector development program. This intervention is expected to reduce flood risks in the city. The planned watershed management programs comprise construction of check-dams and weirs for water conservation and retaining floods, construction of terraces along mountain slopes to reduce runoff and encourage ground water recharge, and reforestation along the slopes draining towards Dire Dawa. As most of these slopes are part of neighboring regional states, the planned projects will be jointly implemented by these states and Dire Dawa administration. These plans are to be implemented during the period of the WSDP, which started in 2002 and will continue for 15 years (Ephrem, 2006).

Thus overall, awareness, concern, and support for significant action to deal with climate change appears to be gaining momentum among the worldwide local community, although there are many obstacles remaining, including our limited understanding of the current status of global local community opinion and the unknown potential for rapid social change to dramatically reduce global greenhouse gas emissions at a rate fast enough to forestall large-scale climate disruptions.

Ethiopians need to be made well aware about the commitments of the country under the Convention, the impacts of climate change, adaptation and mitigation options as well as about measures that can be taken at the individual level to combat climate change.

However, local community awareness (and understanding) of climate change does not seem to have advanced in recent years and hence, there is little awareness of the contribution of everyday individual actions to the problem, and a tendency to place responsibility for tackling climate change with international organizations rather than at the level of the individual. Therefore, the following section presents the study area description and analysis and discussion of the major findings.

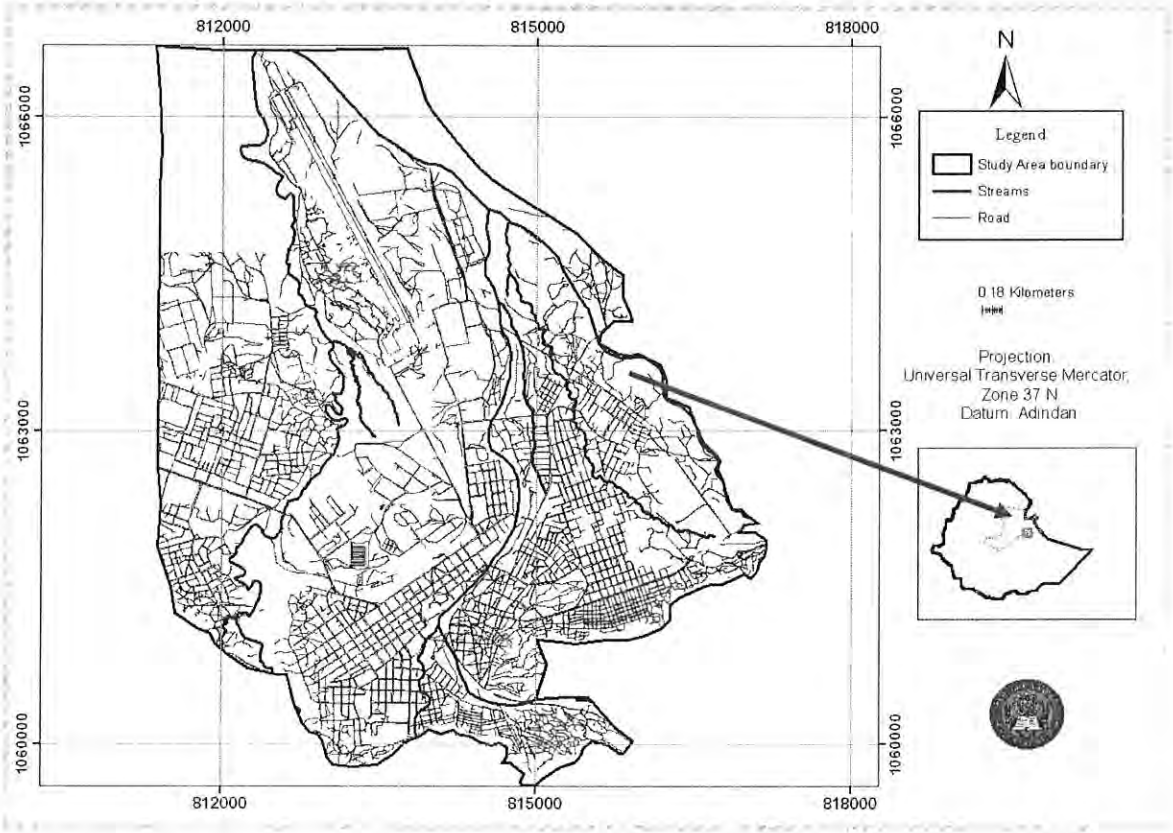
Chapter Three

Description of the Study Area

3. 1. Location and Access

The Dire Dawa Administration Council (DDAC) is located at the eastern part of Ethiopia approximately between $9^0$27' and $9^0$49' North latitudes and longitudes $41^0$38' and $42^0$19' East, particularly at the margin of the Rift valley. The capital of the Administration /study area/ is accessible by airplane, train, and cars, and is about 520 kms road distance from Addis Ababa. A network of dry weather roads crosses various parts of the DDAC, making most parts of it accessible by four-wheel drive vehicles. Most of the roads are crossing the wide riverbeds and are used only in dry season (DDAC, 2003).

Figure 4: Location Map of Dire Dawa Administrative Council.



Source: DDAC, 2007

3. 2. Area

The total area of the administration council has an estimated area of 128,802 hectares; out of these urban accounts for 2,684 ha of which 2% urban and the balance 98% is rural (DDAC, 2007).

3. 3. Population

According to the 2008 census, the total population of Dire Dawa Administrative Council was 338,462. The urban residents of the administrative council number 228,856 of which 116,000 are males and 116,654 females. Besides, there were 75,693 households in Dire Dawa administrative council with an average of 4.3 persons per household (CSA, 2008)

3. 4. Governance

Dire Dawa Administrative Council consists of the city of Dire Dawa and the surrounding rural areas. There are 9 urban kebeles and 25 rural kebeles. Government offices are organized under municipality and government Executive organs or Bureaus (DDAC, 2007).

3. 5. Ecology and Natural Resources

3. 5.1. Ecology

Ecologically the region is lying a in desert and semi-desert scrub shrub land ecosystem bounded by dry ever green montane forest ecosystem in south and south west, and Acacia Commiphora Wood Land Ecosystem in the northeast and south part of the region (NBDSAP, 2004). The broad agro-climatic category of the regional ecosystem, fall in the hot semi arid zone. Thus, because of the climatic stress farmland accounts for only 9% of the total land area. The vast regional ecology is believed to be more important for its various environmental services and products mainly, fuel wood, charcoal, fodder, edible fruit, and rangeland. Moreover, it is a habitat and corridor for wild life and eco-tourism.

3. 5.2. Climate

The study area has a warm dry climate, which is a characteristic of semi-desert climate. The altitude in the administration varies from 950 ms to 2260m above mean sea level. Both temperature and precipitation is the function of altitude. Only two meteorological stations, Dire Dawa and Hurso, are found in the administration. There is other three nearby meteorological stations (Alemeya, Dengego, and Kulubi) outside the Administration boundary. The mean annual temperature of the area can be approximated between 16 ^{0}c at Dengego and 27 ^{0}c at Hurso. Similarly, the smallest mean annual rainfall also varies from 479mm at Hurso and 1009.2 mm at Kulubi. The mean annual rainfall and temperatures computed at Alemaya, Dengego and kulubi are (813mm, 16^{0}c), (775mm, 16^{0}c), and (1009.2mm, 15.7^{0}c) respectively. The mean annual temperature and precipitation is about 25.3^{0}c and 640mm respectively in the capital of the Administration, Dire Dawa (NMA, 2007). The table that summarizes ten years rain fall and temperature data of Dire Dawa is shown in annex 4 & 5.

3. 5.3. Natural Resources

3.5.3.1 Vegetation

Vegetation development in the study area is mainly governed by physiography/altitude, climate, etc besides other factors. Vegetation in the study area is scanty except along the intermittent streams. The natural vegetation is largely scanty acacia trees and cactus. On the patchy rock outcrop areas in the town and its surroundings there is very weak vegetation development since there is no soil development (DDAC, 2006).

The dominant vegetation cover of the region's ecosystem consists of deciduous shrubs mostly Acacia species often interspersed with less frequent evergreen shrubs and succulents such as Euphorbia, Aloe, Caralluma, Opuntia, and Dracaena spp. on rocky out crops. The low land and flood plains are dominantly covered by species of Acacia, Azadirachta, Delonix, Ziziphus and Prosopis juliflora. The grass species are widely distributed in patchy and Plateau land escapes. High mountain areas in the southern part are covered by the remnants of dry evergreen montanae forest such as, Juniperous procera, Cordia africana, Cupressus lusitanica and Olea europea (DDAC, 2006).

3.5.3.2 Wildlife

Though there is little information available on the status of wildlife resources of the region, the ecosystem is known to be habitat for various wildlife in relatively dense shrubs and bushy low land areas of the region that includes many game animals such as unique Antelopes [Beia, Dibatag and Gazelle], Mongoose, Warthogs, Anubis Baboons, greater and lesser Kudu and predators like Lion, Cheetah, Fox, and Hyenas (DDAC, 2006).

3.5.3.3 Mineral Resources

As described below under the section environmental geology different mineral resources have been reported from different areas of the Administration. The study is at its rudimentary level with out detail exploration study. Lead, rare metals and associated gemstones, construction and industrial minerals of different types are reported from different sites. Construction and industrial minerals are found in the vicinity of the Dire Dawa City in large volume. Limestone, sandstone, sand, travertine, basalt, gneiss, diorite, etc. are found in and around the City (WWDSE, 2003).

3.5.3.4 Water Resources

As described above there is no perennial river in the administration, and the intermittent streams or wadis, which are not gauged so far. The surface runoff potential in the Administration has been estimated for the entire watersheds as well as for project sites by WWDSE (2003). Accordingly, the total surface water potential of all the watersheds is estimated as 211.2 Mm^3 per annum. It is important to note that in some of the watersheds, particularly those on the eastern part of the Administration; most of the runoff comes from parts of the watersheds, which lie outside the boundary of the Council in the south.

The Administration is endowed with groundwater resources abstracted mainly from upper sandstone and Hamanelei limestone aquifers that act as reservoir of the groundwater of the Administration (major aquifer). The current utilization of this resource is by far less than the estimated annual recharge. The abstractions from all type of water schemes (deep and shallow boreholes including dug well, springs) are 18.85

Mm^3/year (597.8 l/sec) while existing annual recharge estimated is 38.8 Mm^3/year (1233 l/sec) (WWDSE, 2003).

3.5.3.5 Energy Resources

There are no existing potential energy resources in the Administration in relation to hydroelectric power development. There are also limited resources regarding biomass fuel. No report has been made so far on the existence of fossil fuels in the Administration. In spite of the potential to develop solar and wind energy in the area very few attempts has been made regarding these alternative energy sources.

According to WWDSE (2003) from the total energy consumption in 2002 in Dire Dawa, it is estimated to be about 2924 tera joules (TJ) of which 58 percent comes from biomass fuels (50 percent woody biomass, 4 percent charcoal and 4 percent agricultural residue), 37 percent from petroleum fuels, and 5 percent from electricity. WWDSE reported that energy consumption by sector is as follows: households (72 percent), commercial services (6 percent), industry (8 percent), and transport (14 percent).

3.5.3.6 Soil

The major soil types of Dire Dawa Administrative Council exhibit a general relationship with altitude and slopes. Shallow and infertile soils are the characteristics of the mountains and hills, whereas the deep and fertile soils are the major properties of valley bottoms, river terraces and flat plains. Generally, the soils of the valley are developed on recent alluvial colluvial sediments derived from the adjacent mountain ranges. Fluvisols and Vertisols are generally dominating the region and particularly lowland flat plains, valley bottoms and river terraces. Texturally these soils are sandy loam and sandy clay respectively. Shallow Leptisols are the dominant type of soils found in the mountain and hills of the region (WWDSE, 2004).

3.6 Land Degradation

Land degradation is a serious concern in the Dire Dawa Administration. The problem has its root causes to man made and natural factors:

- The soil loss rate of 0.4 – 21.8tons/ha/year is by far higher than the annual soil formation rate of 0.4 – 0.5 ton/ha/yr resulting in continuous soil erosion and thus about 75% of the region is severely degraded by soil erosion.
- Deforestation due to unbalanced fuel wood demand and supply is about 150,000 and 34,550 tons/year respectively.
- Overgrazing (carrying capacity of the grazing land is limited to 75% of the livestock population)
- Lack of appropriate land use policies and regulations
- Poor afforestation i.e. less than 1%
- Low stocking, which is equal to 0.19 – 4.49 tons/ha/year and low incremental yield, which is equal to 0.0135 – 0.27 tons/ha/year
- Decrease in stream and spring discharges, which are manifested by driving up of streams in peri urban areas (IDP, 2006).

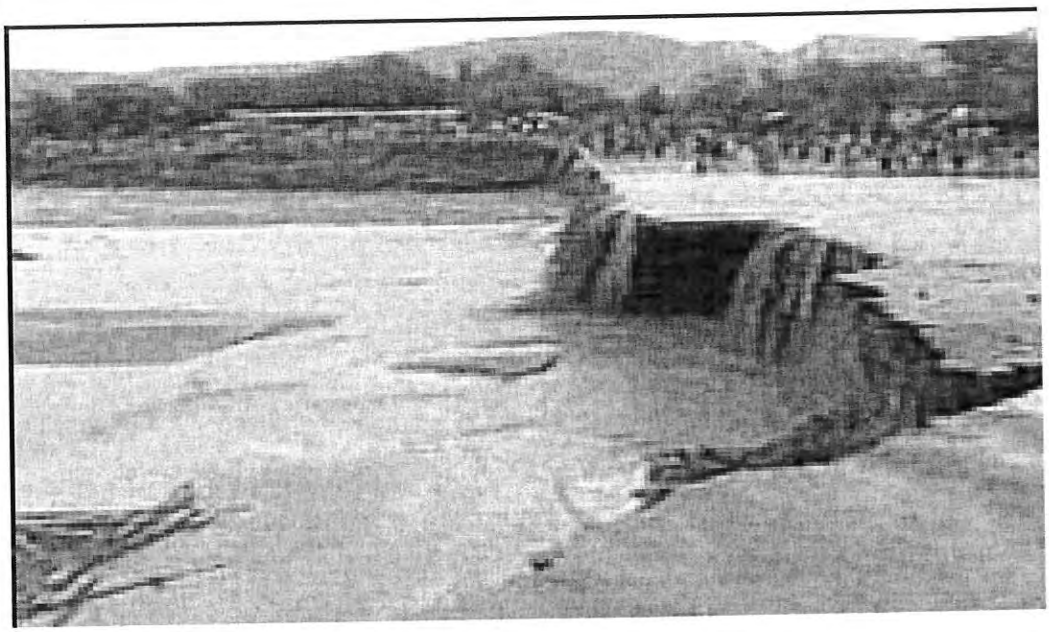
3.7 Flood and Related Facts

Dechatu is the major devastating river as it passes through the middle of the city. Dechatu River is named after the three rivers joins together at the gauging station. The three major rivers which come together are Laga Chrichi, Laga Anani, and Laga Gogoiyti and they originate from the highlands of Kersa, Lange, Dengego and Alemaya catchments respectively (Ephrem, 2006). The flood damage sites by lege Chiri River outside Dire Dawa town are shown in Fig 5 scouring of the left embankment of the main road near by Harla Belina village and flood damage in Dire Dawa in Augustt 2006 due to the over flow of Dachatu River is shown in figure 6.

Fig 5: Complete damage of the main highway at Hego Village on the main Dengego - Dire Dawa road by Chirichi River

Source: DDAC, 2007

Fig 6: Flood in the City of Dire Dawa August 2006.



Source: DDAC, 2007

Chapter Four

Data Presentation, Discussion and Findings

4.1 Demographic Characteristics of Sample Households.

This section gives analysis and discussion of the major findings on the demographic and socio economic characteristics of the respondents in four selected kebeles of Dire Dawa Administrative Council. From the sampled households, different data were generated such as sex, age, religion, marital status, educational status, family size, etc. The demographic and socio-economic characteristics of the sample households are summarized as follows:

4.1. 1. Sex

Sex is one of the important variables in the demographic and socio-economic studies because many social and economic conditions are a function of sex. Sex distribution of household heads as illustrated in Table 3 is largely dominated by males, which accounts for 59.8 percent of the sampled households. Female headed household accounts for 40.2 percent only.

Table 3: Distribution of respondents by sex (N=107)

Sex	Number	Percent
Male	64	59.8
Female	43	40.2
Total	**107**	**100.0**

Source: Household survey

4.1.2. Age

The age composition of the respondents indicate that out of the 107 cases, the overwhelming majority 90.7% are below the age of 50, and those below 41 accounts 63.6% of the total respondents. The minimum age of household heads was 20 and the maximum 70. The number of permanent household members in the respondents' household ranged from 1 to 10 with average household size 4 persons.

Table 4: Distribution of respondents by age (N=107)

Age category	Frequency	Percent
20-25	14	13.1
26-30	17	15.9
31-35	18	16.8
36-40	19	17.8
41-45	16	15.0
46-50	13	12.1
51-55	5	4.7
56-60	3	2.8
61-65	1	0.9
Above 66	1	0.9
Total	**107**	**100.0**

Source: Household survey

4.1.3 Marital Status of the Household Head

At the time of the survey, 80.4% of the respondents were married while 5.6% and 12.1% were divorced and remained single respectively.

Table 5: Marital status of household head (N=107)

Marital Status	Frequency	Percent
Single	13	12.1
Married	86	80.4
Widowed	2	1.9
Divorced	6	5.6
Total	**107**	**100.0**

Source: Household Survey

4.1.4 Educational Status of the Household Head by Sex

Looking at the educational status of sample households as one component, the findings of the survey reveals that the majority (94.4%) of respondents are literate (See table 6). The remaining 5.6% of the household heads are illiterate. The level of illiteracy among the

female household heads is found to be 11.7% while it was 1.5% for male household heads.

Table 6: Educational status of household heads by sex (N=107)

Educational Status	Respondents				
	Male		Female		Total
	Number	Percent	Number	Percent	
Illiterate	1	1.5	5	11.7	6
Read and write	1	1.5	3	6.9	4
Grade 1-4	12	18.7	8	18.6	20
Grade 5-8	5	7.8	7	16.3	12
Grade 9-10	9	14.3	3	6.9	12
Grade 11-12	18	28.1	6	13.9	24
Above grade 12	18	28.1	11	25.7	29
Total	**64**	**100**	**43**	**100**	**107**

Source: Household Survey

4.2 Local Communities Understanding of Climate Change

4.2.1 Perception of respondents on weather (temperature and precipitation) change

Climate and weather are two different concepts. Climate change refers to changes in the average weather, such as changes in average temperatures, precipitation, wind conditions, humidity, and all other aspects of the Earth's climate over a long period ranging from decades to millions of years. It is expressed in the form of long term variation in rainfall, temperature, precipitation levels, wind velocity and directions, etc. Weather is the specific temperature at a specific place and time or day (NAPA, 2007). Ethiopia experiences mild temperatures for its tropical latitude because of topography. Mean annual temperature distribution over the country varies from about 10^0C over the high lands of Northwest, Central and Southeast to about 35^0C over North-eastern lowlands. Mean annual rainfall distribution over the country is characterized by large spatial variations, which range from about 2000 mm over some pocket areas in the Southwest to less than 250 mm over the Afar and Ogaden low lands (NMSA, 1996, NMSA 2001).

In view of this therefore, the nature of weather in the study area in terms of temperature and precipitation change and then climate change is discussed. Alongside with this, by drawing together the findings from the household survey, the FGD and interviews with key informants the perceptions of the respondents on weather and climate change of Dire Dawa is discussed below.

The first question presented to the respondents was whether they believe that the temperature of Dire Dawa is changing or not for the past ten years (question number 13). 57 percent of the respondents believed that the temperature is changing while 38.3 percent of them respond otherwise and 4.7 percent do not know whether the temperature is changing or not as shown in table 7.

Table 7: Respondents feeling on temperature change (N=107)

Do you feel that the temperature of Dire Dawa has increased for the past ten years?	**Number**	**Percent**
Yes	61	57.0
No	41	38.3
I don't know	5	4.7
Total	**107**	**100.0**

Source: Household Survey

The key informants also pointed out that the pattern of temperature of Dire Dawa was changed. For example, one informant explained:

> "I lived here in Dire Dawa for about 61 years. I can tell you that the temperature of Dire Dawa before twenty years is totally different from that of today. For instance, this year we expected the month of October to be colder but it became hot. When we expect the month to be hot it becomes colder and when we expect the month to be hot it will be colder." *[Retired male]*

As a result of change in temperature the respondents were also asked in (question no 14) the change that has occurred. They responded that the increasing trend of temperature

exacerbated drying up of streams, rivers and traditional wells in the area. For example, one informant explained:

> "Dire Dawa is not blessed by large rivers, which flow through out the year as that of the other regions of the country. In the past the region had springs with different water discharging capacity and perennial and intermittent streams. The most important intermittent and perennial streams that drain the Dire Dawa region are Dechatu, Butiji, Lega Hare, Dube, Goro and Elbah. In the past we used to swim, wash cloth with it and fetch water from Butuji River. 'Ashewa masi masi inaregina wuha inteta neber' meaning we dig the sand and drink water simply." *[Government Employee]*

Another informant also added:

> "When temperature increases it might lead to reductions in crop yield."

In consistent with this finding, the National Metrological Agency of Ethiopia, demonstrated that in all the parameters of temperature i.e., annual mean temperature, maximum and minimum temperature, and daily temperature is above normal and observed to show a tendency to increase over time (NMA, 2007).

Respondent were also asked their feeling of precipitation change of Dire Dawa for the past ten years. Accordingly, the majority of the respondents (73.8%) felt that the precipitation has changed over the last ten years, where as (17.8%) felt that the precipitation was not changed. (8.4%) do not know whether it is changing or not.

Table 8: Respondents feeling on precipitation change (N=107)

Do you feel that the precipitation of Dire Dawa has changed for the past ten years?	**Number**	**Percent**
It is changed	79	73.8
It is not changed	19	17.8
I don't know	9	8.4
Total	**107**	**100.0**

Source: Household Survey

FGD participants disclosed that the timing of rainfall has changed, the rainfall variability could not be predicted and there has been a change in the amount and frequency of rainfall.

According to one participant of the FGD;

> "Rainfall in the recent past, with the exception of 2006, has been declining in both duration and intensity." *[Retired male]*

The finding is consistent with (Funk et al., 2005) which has noted that there is a declining trend of rainfall in the southeast and northeast Ethiopia, locations where water insecurity exists even though Dire Dawa is found at the eastern part of the country.

Monthly rainfall data obtained from NMA (*annex 4*), which spans from 1998 to 2007 for Dire Dawa station has confirmed the perception of the respondents. When responding to the open ended question number 17 (What change has occurred as a result of change in precipitation?) They mentioned drought, crop failure, decreased recharge of ground water, etc has occurred due to lack of rainfall. The majority of the respondents were in a position to mention the occurrences of flooding during heavy rain. According to one informant:

> "Flooding has been occurring and it is a common phenomenon in the area when ever there is a heavy rainfall. For instance, in Dire Dawa city, flooding had occurred in 1944, 1981, 1985, 2005 and 2006. *"[Government employee]*

In general the data indicates that significant numbers of respondents believed that temperature had increased. The majority of respondents believed rainfall levels had decreased. Most participants of FGD and key informants felt that the timing of rainfall had undergone changes and the region is getting drier and drier. This findings is consistent with studies of UNFCC, 2001 which shows that there has been a general trend of atmospheric warming in the region where average annual minimum and maximum temperatures have been increasing at 0.25^0C and 0.1^0C per decade, respectively (UNFCCC, 2001). In connection with this, Muna, (2006) also reported an increasing trend of 0.3^0C per decade for the mean minimum and maximum temperature in the

Ethiopian highlands, and this continuing increase of temperature has implications especially in the low-lying areas of the country like Dire Dawa.

The other question presented to the respondents is whether they feel that the pattern of weather is changing in Dire Dawa (Question number 18). Accordingly, 84.1 percent of the respondents felt that the weather is changing, 10.3 percent felt that it is not changing and 5.6 percent do not know it.

Table 9: Respondent feeling on weather change (N=107)

Do you feel that the pattern of weather is changing in Dire Dawa for the past ten years?	**Number**	**Percent**
Yes	90	84.1
No	11	10.3
Don't know	6	5.6
Total	**107**	**100.0**

Source: Household Survey

Awareness about cause of weather change is the other area of investigation. 53.3 percent of the respondents think that weather is changing solely due to anthropogenic (human activity) causes. 14.4 percent believe that the cause of weather change is linked with some kind of a supernatural phenomena or the wrath of God. Still 23.3 percent of respondents believe that the change in climate is just one event in the natural processes.

Table 10: Cause of weather change in Dire Dawa (N=90)

What do you think is the cause for weather change?	**Frequency**	**Percent**
Human action	48	53.3
Natural processes	21	23.3
Wrath of God, curse etc.	13	14.4
I do not know	18	20.0
Total	**90**	**100.0**

Source: Household Survey

Some people consider adverse weather conditions as punishments for human wrong doings. They identified various spiritual and social causes of weather change. Spiritual explanations of weather change are incompatible with scientific explanation. In linking weather change with some kind of supernatural phenomena one informant explained:

> "...I think the cause for weather change is due to our sinful nature. God said if you keep my promise I will open to you the good treasury of the heavens, to give the rain for your land in its season and to bless all the works of your hands, I bless your children, your wealth, you will never get hungry. God is closing the sky because of our sin. The sun has changed to fire and is firing us. Had we obeyed God we could have got proper rain from God. Can any one say I can bring or abandon the rain from its authority?" *[Retired male]*

4.2.2 Awareness and Knowledge of Climate Change

One of the current issues with climate change is that we hear about the term and concepts in virtually every media outlet, be it on TV, radio, or newspaper. Awareness about climate change, its causes, impacts and the necessary response mechanism to cope with climate calamities is 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 perception will make local intervention mechanisms to be very slow and untargeted.

One of the investigation areas of this research is whether respondents' have heard about climate change or not. In Dire Dawa, out of the total 107 sample (57.9 %) of respondents have heard of climate change and (42.1%) of the total sample said they had not heard of climate change (see table 11). In Dire Dawa, it appears that although majorities of the local community have heard of climate change, some, remain unaware of this issue, and, thus, the finding shows that, the local community awareness (and understanding) of climate change does not seem to have advanced in recent years and hence, there is little or no awareness of the issue of climate change among some members of respondents.

Table11: Respondents awareness of climate change (N=107)

Have heard about climate change?	**Number**	**Percent**
Yes	62	57.9
No	45	42.1
Total	**107**	**100.0**

Source: Household Survey

The result from the qualitative inquiry also indicated that participants of FGD and informants have heard about climate change. Two key informants explained as follows:

> "...There's a lot of talk going on, today on the radio, television about climate change, different meetings are being held at international and national level, but I do not know the detail. *"[Government employee]*

> "... Last night I heard when the prime Minster of Ethiopia is addressing the issue of climate change to the parliament and a means to tackling the impacts of climate change through increasing development interventions."*[House wife]*

At the same time, others felt under-informed about the issue. For example one women interviewee explained that: *"...I don't know about these things and I do not have heard of it."[House wife]*

When respondent awareness of climate change is investigated in relation to sex, the proportion of women who have heard of climate change in the study area is 46.5 percent and 53.5 percent of women do not have heard of climate change. 65.5 percent of men respondent have heard of climate change as shown in table 12 below.

Table12: Respondents' awareness of climate change by sex (N=107)

Have you heard of climate change?	**Sex of household head**			
	Male	Percent	Female	Percent
Yes	42	65.6	20	46.5
No	22	34.4	23	53.5
Total	**64**	**100**	**43**	**100**

Source: Household Survey

When respondents' awareness of climate change is investigated in relation to their educational status, as the level of their educational level increases, their awareness of climate change also increases as shown from table 13 below.

Table 13: Educational status attained by household head and awareness of climate change

Educational Status	Have you heard of "climate change"?			
	Yes	Percent	No	Percent
Illiterate	2	3.2%	4	8.8%
Read and write	2	3.2%	2	4.4%
Grade 1- 4	8	9.7%	6	15.6%
Grade 5 - 8	8	12.9%	4	12.9%
Grade 9 -10	12	19.4%	6	13.3%
Grade 11 - 12	13	21.0%	11	26.7%
Above Grade 12	17	27.4%	12	26.7%
Total	**62**	**100%**	**45**	**100%**

Source: Household survey

When we see the relative importance of and the seriousness of climate change in terms of sex of the survey respondents, 98.4 percent of men and 97.7 percent of women tend to see the importance of climate change personally. The survey sought that, there is no significant difference between men and women in relation to the relative importance about climate change (*See table 14*). Even though, there is no significant difference between men and women in relation to the relative importance about climate change, women tend to be more worried about climate change issues and these findings is consistent with the findings of Barnett (DEFRA,2002 & Bibbings, 2004a)).

The respondents, were also asked, "Do you consider climate change as a very serious problem?" It was found that, (76.6%) of men and (83.3%) of women consider climate change as a very serious problem. Another key measure of perceived risk is the degree of personal worry respondents have regarding climate change. The respondents were then

asked "How much do they personally worry about climate change?" and found levels of worry generally higher than perceived seriousness and greatly varying across sex The greatest levels of worry were found among women with 93 percent and men 90.6 percent (See table 14). The justification for this is women have less access to information and resources even tough it requires further research on this issue.

Table 14: Personal importance, seriousness and personal worry of climate change by sex (N=107)

Climate change perceived as important and serious problem	**Response**	**Sex of household head**			
		Male	Percent	Female	Percent
How important is the issue of climate change to you personally?	Very important	63	98.4	42	97.7
	I do not know	1	1.6	1	1.3
	Total	**64**	**100**	**43**	**100**
Do you consider climate change as a very serious problem?	Yes	49	76.6	35	83.3
	No	13	20.3	4	10
	I do not know	2	3.1	4	6.3
	Total	**64**	**100**	**42**	**100**
How much do you personally worry about climate change?	A great deal	58	90.6	40	93
	Not at all	6	9.4	3	7
	Total	**64**	**100**	**43**	**100**

Source: Household survey

When we see the seriousness of climate change issue with respect to the age of the respondents the survey studies indicate that younger people are less worried than older age groups about climate change as shown in table 15. These apparent incongruities suggest a need for more qualitative approaches to explore seriousness for climate change amongst different age groups.

Table 15: Respondents' age and the seriousness of climate change issue.

Age category	Do you consider climate change as a very serious problem?						Total
	Yes	Percent	No	Percent	I do not know	Percent	
20-25	11	78.6%	3	21.4%	0	.0%	100%
26-30	11	73.3%	1	6.7%	3	20.0%	100%
31-35	13	72.2%	5	27.8%	0	.0%	100%
36-40	17	89.5%	2	10.5%	0	.0%	100%
41-45	12	80.0%	3	20.0%	0	.0%	100%
46-50	11	84.6%	2	15.4%	0	.0%	100%
51-55	5	100.%	0	.0%	0	.0%	100%
56-60	2	66.7%	1	33.3%	0	.0%	100%
61-65	1	100.%	0	.0%	0	.0%	100%
Above 66	1	100.%	0	0%	0	.0%	100%
Total	**84**	**80.8%**	**17**	**16.3%**	**3**	**2.9%**	**100 %**

Source: Household survey

The survey sought, in particular, to examine the influence of flooding experience on the awareness and understanding of climate change and how much important is the issue of climate change of the study area. Half of survey respondents (50.4%) had experienced flood damage, and (49.5%) are without the experience of flooding. The survey found that 55.6 percent of flood victims have heard of climate change while 44.4 percents of the flood victims do not have information about climate change. Where as, 60.4 percent of the non-victims of flooding have heard of climate change and 39.6 percent do not have heard about climate change. In this regard, results from the household survey indicated that there is no significant difference between those with experience of flooding and the non-flooding in terms of the awareness and understanding of the climate change issue. Also, with the relative personal importance of the issue of climate change the flood victims generally do not differ from the non-victims as shown in *table16* below.

Table16: Respondents awareness of climate change and personal importance of the issue of climate change by experience of flooding, (N=107)

	Response	Experience of flooding			
		Flood victims		Non flood victims	
		Number	Percent	Number	Percent
Have you heard of climate change?	Yes	30	55.6	32	60.4
	No	24	44.4	21	39.6
	Total	**54**	**100**	**53**	**100**
How important is the issue of climate change to you personally?	Very Important	53	98	52	98
	I do not know	1	2	1	2
	Total	**54**	**100**	**53**	**100**

Source: Household Survey

4.2.3 Perception on Causes of Climate Change

What is causing the world to heat up? Human activities, primarily involving energy use and fossil-fuel consumption (oil, coal, and natural gas), transportation, agriculture, and deforestation, are producing greenhouse gases (GHGs) in greater abundance. There is acceptance by most people that climate change is a human-caused problem and a general awareness of the main causes (Hargreaves et al., 2003). When prompted, most people can 'correctly' identify destruction of forests, carbon dioxide emissions, emissions from transport, and emissions from power stations as contributors to climate change (DEFRA, 2002; Hinds et al., 2002;).

The knowledge and awareness of respondents towards climate change can be assessed through assessing their understanding of the cause of climate change. Accordingly, respondents were then asked to identify the main cause of the climate change from a list of options. Only, 8.4 percent of the respondents could correctly identify "the use of fossil fuels, such as oil, gas and coal" as the main cause of climate change (*See table17*). Further, the single most identified "cause" was deforestation which is identified by 75.7 percent of the respondents to be the main cause of climate change. The second most identified cause of climate change was "air pollution from factories and cars." In general,

then, a large part of the respondents has not fully understood that global climate change is being caused primarily by the release of an invisible gas, carbon dioxide into the atmosphere through the burning of coal, oil and gas. Because they frequently lack accurate information about the causes of global climate change, often people offer only vague solutions to this problem or endorse solutions that are ineffective.

Table17: Respondents perceptions on the cause of climate change (N=107)

Cause of climate change	Frequency	Percent
The use of fossil fuels	9	8.4
Depletion of ozone layer	4	3.7
Air pollution from factories	13	12.5
Loss of forests	81	75.7
Total	**107**	**100**

Source: Household Survey

Identified causes for climate change at local level as perceived by the FGD participants in the study area include:

- Deforestation as a result of land use change,
- Increase in population,
- Punishment from God,
- Lack of awareness, and people are not aware of their environment,
- Shortage of land,
- Lack of alternatives to the poor and
- Poverty

Respondents were also asked whether they believed that the earth is getting warmer mostly because of human activity. They reported that about 81.3% of them were totally convinced that human activities "contribute" to recent changes in climate. By contrast, the survey found that 18.7% said no. They stated that these changes were "mostly due" to other processes such as internal variability within the climate system as well as external factors. Some attributed the cause of climate change for God's/Allah's wrath against our

sin as shown in (*table 18*) below. Thus respondents appear broadly willing to accept the idea that human activities contribute to climate change, but many are not yet convinced that human activities are the primary cause.

Table18: Respondents perceptions of human beings as the cause of climate change

Do you feel that human activities are the main cause to climate change?	**Number**	**Percent**
Yes	87	81.3
No	20	18.7
Total	**107**	**100.0**

Source: Household Survey

4.2.4 Understanding about the Impacts of Climate Change

Climate change will have wide-ranging effects on the environment, and on socio-economic and related sectors, including water resources, agriculture and food security, human health, terrestrial ecosystems and biodiversity. Changes in rainfall pattern are likely to lead to severe water shortages and/or flooding. Rising temperatures will cause shifts in crop growing seasons which affects food security and changes in the distribution of disease vectors putting more people at risk from diseases such as malaria and dengue fever. Temperature increases will potentially severely increase rates of extinction for many habitats and species. The understanding of the impacts of climate change is one of the areas of investigation of the thesis. As shown in (*Table 19*), the most commonly-mentioned impact of climate change is flooding (67.3%). Increase in temperature (53.3%) was the next most popular response. Reduced rainfall (45.8%), loss of water (36.4%), loss of biodiversity (30.8%), increased disease (25.2%), was also mentioned respectively.

Table 19: Respondents understanding of the impacts of Climate Change (N=107) (Multiple responses).

Impacts of climate change	**Frequency**	**Percent**
Flooding	72	67.3
Increased temperature	57	53.3
Reduced rainfall	49	45.8
Loss of water	39	36.4
Loss of biodiversity	33	30.8
Increased disease	27	25.2

Source: Household Survey

Note: Percentages total more than 100 percent because more than one response from each person is included.

Identified impacts of climate change at local level as perceived by the FGD participants and key informants in the study area include:

- The drying up of streams, rivers and even traditional wells,
- The change in local weather condition. i.e., the rise in temperature coupled with a decrease in rainfall,
- Loss of main crop of the area especially in rural kebeles,
- Decreased water table (the depth was only 5to 7 meters before but now goes down to 15-18 meters, and
- Flooding

When asked if they have personally observed evidence of climate change, 88.8 percent of the respondents believe they have personally seen evidence of climate change while 8.4 percent believe otherwise (*see table20*). The FGD participants have reported that flooding is a common phenomena observed in the study area. Moreover, the frequency and extent of damage has increased in recent years due to deterioration of the environment.

Table 20: Respondents evidence of climate change (N=107)

Have personally observed evidence of climate change?	**Number**	**Percent**
Yes	95	88.8
No	9	8.4
Do not know	3	2.8
Total	**107**	**100**

Source: Household Survey

4.3. Local Community Understanding of Flood Risk

Natural hazards such as floods and droughts often expose communities to vulnerabilities that can be investigated from two dimensions. (1) External dimensions or vulnerability context which can be expressed as the exposure to circumstances beyond people's control, including shocks. (2) Internal dimensions which refers to mainly to socio-economic systems, access and use of resources to the extent to which peoples' livelihood is affected by the exposure to external factors (IFRCS,2007; Blaikie et al., 1994).

In view of this therefore, the nature of flooding in the study area in terms of its cause, severity, frequency and the link it has with climate change is discussed. Alongside with this, by drawing together the findings from the household survey, the FGD and interviews with key informants on the effect and perception of flooding are discussed.

4.3.1 The Nature of Flooding in Dire Dawa

Dire Dawa lying at the foot of a mountain range is subjected to annual flooding by runoff from the mountain during torrential rains. From the records the last four major flood event occurred during in April 1981, 1994 and last year in May, 2005 and August, 2006. The last year flood which occurred in May 2005 has caused loss of 35 human lives as well as an estimated amount of 10 million birr damages to property. According to Ephrem, (2006) the flood history is changed and the most devastating flood in the history of Dire Dawa occurred on the fifth day of August, 2006. This flood is the worst of its

kind which resulted for the loss of more than 240 human lives. Property damages is also more than ever before.

The respondents were then asked the environmental problems that they have observed due to the changing climate. Flooding incidences were pointed out as one of the indicators of the local impacts of climate change. 81.3 percent of the respondents have witnessed the occurrence of flooding in the last one or two years while 43.9 percent of them tell that they saw deforestation as one of the major environmental problems in their area as shown in (*table 21*) below.

Table 21: Environmental problems that have observed by respondents (N=107)

(Multiple response)

	Frequency	**Percent**
Soil erosion	36	33.6
Deforestation	47	43.9
Land degradation	36	33.6
Water pollution	28	26.2
Flooding	87	81.3

Source: Household Survey

4.3.2 The Magnitude and Frequency of Flooding in Dire Dawa

The existing literature on flood disasters indicates that magnitude of the flooding along with its frequency is an important factor that determines the rate at which flood risk turn in to a disaster (UN, 1977). In view of this therefore, the study attempted to look into the magnitude and frequency of flooding in the study area.

In this regard, results from the household survey indicated that 22.4 percent of the respondents were of the opinion that the respective events or calamities occur on an annual basis. 11.2 percent and 19.6 percent, are however, attesting to the fact that the incidences of dangers related to climate change are evidenced to occur once in 2 and 5 years time respectively. 21.2 percent of the respondents have given other time periods for

the frequency of the occurrence of the event/s. Among the total respondents, 38.3 percent stated that the occurrences were not predictable as shown in (*table 22*) below.

Table 22: Frequency of occurrence of flooding (N=107)

How frequently have flooding occurred in your locality?	**Frequency**	**Percent**
Every year	24	22.4
Every 2 years	12	11.2
Every 5 years	21	19.6
Every 10 years	6	5.6
Every 12 years	1	.9
I do not know	2	1.9
Unpredictable	41	38.3
Total	**107**	**100.0**

Source: Household Survey

The result from the qualitative inquiry also indicated increasing trends in the magnitude, frequency of flooding in Dire Dawa. Most informants indicated that the magnitude of flooding increased since 1994 with increasing adverse effects on people's lives and livelihoods.

During the discussion, it was indicated that flooding happen all the time in the study area, however, some severe floods have occurred in the past that are associated with heavy rainfall in the highlands. For instance, the floods of 2006 were mentioned by the FGD participants as the most severe floods that hit the area.

A change in the severity of floods was also noted by FGD participants. They felt that flooding is more severe and frequent than in the past. Most of them came to understand that the population pressure, deforestation and the associated farm land expansion have contributed to increasing flood risk.

The other question raised to respondents was whether they personally experienced any form of damage to their home, garden or the community in the last five years and how they are affected by the flooding. Accordingly, 50.5 percent of the respondents which are the victims of flooding had experienced flood damage whereas almost half of the respondents the non-victims of flooding (49.5%) had not.

Table 23: Respondents experience of flooding (N=107)

Have you in the last 5 years, experienced any form of flood damage?	Respondents				Total
	Flood victims		Non flood victims		
	Frequency	Percent	Frequency	Percent	
Yes	54	50.5	0	0	54
No	0	0	53	49.5	53

Source: Household Survey

4.3.3 The Effect of Flood Damage in Dire Dawa

Flooding has been affecting Dire Dawa for years. The devastating flood in August 6, 2006 caused death of 256 people, displaced 9,956 and 244 people missing. The flood has made 2,685 households homeless. Out of the displaced people, 5,524 were forced to live in temporary shelter while 4,432 are living with their relatives and friends. The flood has inflicted huge damages on urban infrastructures. Roads, bridges and houses were destroyed. Electric poles, water pipes and sanitation facilities were also damaged. Investors, traders, small and peaty traders have lost 30,054,275 Birr estimated property. In addition, other than the houses totally destroyed, the flood entered in to 1000s of Dire Dawa houses and damaged household items, even though they are not displaced (DAAC, 2006).

Respondents were asked the effects that the flooding inflicted on them and accordingly, 81.5 percent of the flood victims have lost their household property and savings and damage to house occurred to 74.1 percent of the respondents. Also 70.4 percent of the respondents were dislocated and forced to live in temporary shelters. The flood caused death to 48.1 percent of respondents household members or relatives and loss of services

such as roads, schools etc. The incidence of diseases and exposure was rated by 35.2 percent of the respondents during the flood damage. Results from the household survey and the various qualitative interviews and FGD indicate that flooding in the study kebeles cause frequent economic and social losses to the households.

Table 24: The effects that the flooding inflicted on flood victims (N=54) (Multiple responses)

What are the effects of the flooding?	Frequency	Percent
Suffered death of household member	26	48.1
Damage to house	40	74.1
Lost household property and savings	44	81.5
Exposed to diseases like AWD, malaria	19	35.2
Dislocated and forced to live in temporary shelter	38	70.4
Loss of services such as roads, schools, water etc	23	42.6

Source: Household Survey

Note: Percentages total more than 100 percent because more than one response from each person is included

4.3.4 Cause of Flooding in Dire Dawa

According to the study made by Bezuayehu, (2006), flooding is caused by two major factors, viz, physical and socio-economic. Dire Dawa area is observed to be topographically steep with degraded vegetation and extensive cultivation that often generate flash flood. Besides, drainage from newly constructed roads has contributed for the flooding. Socio-economic factors include cultivation on steep slopes, deforestation, overgrazing, quarrying, and stones and sand collection. With regard to the cause of the 2006 flood disaster in Dire Dawa, 58.9 percent of the survey respondents believed that the inappropriate construction of flood canals was the main cause of flooding in Dire Dawa in 2006. 42.9 percent of the respondents argue that massive agricultural land degradation in East Hararge was the cause for flooding in Dire Dawa. Climate change was only rated by 31.8 percent of the respondents to be the cause of flooding in Dire Dawa. 25.2 percent of the respondents associate the 2006 flooding in Dire Dawa with God's or Allah's wrath against their sin.

Table 25: Cause of the 2006 flooding (N=107) (Multiple responses)

What was the cause of flooding?	Frequency	Percent
Massive agricultural land degradation in east Hararge.	46	42.9
Extensive cultivation on steep slopes	22	20.6
Inappropriate settlement and construction	45	42.1
God's/Allah's wrath against our sin	27	25.2
Unsustainable utilization of Dechatu River.	12	11.2
Inappropriate construction of flood canal	63	58.9
Due to climate change	34	31.8

Source: Household Survey

Note: Percentages total more than 100 percent because more than one response from each person is included

Factors that contribute to and aggravate the flooding in the area were also revealed by the FGD and key informant interviews.

Deforestation: This made the highland barren by exposing the top soil to heavy erosion and increasing the run of rain water from the highland area to the low areas. Periodic change in the amount and intensity of rainfall aided by the lack of vegetation cover in the highlands also help in aggravating the run-off and the flooding in the area.

Inappropriate cultivation practice in the highlands was mentioned as factor that causes and accentuates the rate of run–off in the study area. Some local farming practices such as tilling hilly lands have increased the problem of run-off and there by contributed to increase flooding in Dire Dawa.

In general, Dire Dawa's geographic location, and topography aggravated by the effects of human intervention such as deforestation, inappropriate cultivation practices, inappropriate settlement and construction were found to cause or exacerbate flooding in Dire Dawa.

4.3.5 Coping Strategy to Flooding in Dire Dawa by Government

Household and the local government employ different ways of coping with the impact of natural hazards such as floods (Ephrem, 2006). According to the FGD participants, the Dire Dawa Administrative Council in alliance with different government and non government institutions is undertaking some urban flood protection works. This includes construction of gravity retaining walls along some of the eroded banks of Dechatu and Goro Rivers to stabilize the slopes and protect property on top of the banks from being washed out into the river. The emergency response unit did river channeling; sandbag protection work and sand bund to protect the left side dwellers from further flood damage. Permanent gravity retaining wall was constructed starting from the point where the maximum flood level touches the left abutment.

4.3.6 Household Coping Strategy to Flooding in Dire Dawa

Households in the study area were not new to flooding. They have experienced flood disasters and developed various ways of protecting their life and livelihood in ways that reflect their capacity to cope with the problem by using their own resources and skills. Some of these strategies are discussed as follows:

- **Local dyke construction.** This was found to be one of the technical coping strategies employed by households in the study kebeles. Similarly, it was found out that households in the study areas construct houses with raised plinths to prevent flood waters from entering into their houses.
- At the time of disasters and soon after, people largely count on their kinship networks, mutual aids and, self help groups and indigenous organizations to secure help and support. In the case of the 2006 flooding of Dire Dawa, it has affected the majority of the people in neighboring kebeles so much so that it was impossible to get help from kinship networks. Thus, as one key informant explained, they were forced to 'rely on relief to sustain their life.'
- Apart from these coping strategies discussed above, it was also found that households in the study area use 'relocating dwellings to higher grounds' during the flooding as a means of coping with the flood.

4.3.7 Climate Change and Dire Dawa Flooding Scenario

The increasing frequency and severity of the recent floods has been attributed to several interrelated causal factors. However, despite the problem of attributing the incidence of flooding to one factor with a level of certainty, the issue of climate change has, over the year, stood out as a major causal factor for the increasing floods. For instance the IPCC, asserted that floods will increase in their frequency and severity pertaining mostly to the effects of climate change - a fact that can no longer continue to be a debated issue as its presence is strongly felt (IPCC, 2001). According to Jonatan, (2008:114) the recurrent floods in Ethiopia are definite sign that climate change is indeed impacting on Ethiopia.

In this study 12.1 percent of the respondents felt that the incidence of flooding is due to climate change. On the other hand, 57 percent do not at all see the connection between climate change and flooding. 30.8 percent stated that they do not know whether the two have any cause and effect relationships as shown in (*table 26*) below.

Table 26: The connection between flooding and climate change (N=107)

Was the flooding due to climate change?	**Number**	**Percent**
Yes	13	12.1
No	61	57.0
Don't know	33	30.8
Total	**107**	**100.0**

Source: Household Survey

4.4 Concern and Personal Importance of the Climate Change Issue in relation to other environmental problems.

Studies demonstrate that concern for climate change has, over the past two decades, become widespread (Thompson & Rayner, 1998). Respondents were asked how important is the issue of climate change to them personally? Accordingly, (98.1%) respondents feel climate change is very important to them personally

Table 27: Personal importance of the climate change issue (N=107)

How important is the issue of climate change to you personally?	Number	Percent
Very important	105	98.1
I do not know	2	1.9
Total	**107**	**100.0**

Source: Household Survey

Overall, the local community appears largely concerned about climate change. While many view it as a critical threat, how does it compare to the many other pressing issues vying for world attention and action. The following section explains the issue of climate change in relation with other environmental issues.

4.4.1 Relative Environmental Concerns of Climate Change

Previous research has indicated that in surveys the majority of people claims to be concerned or worried about most environmental issues (DEFRA, 2002; Bord et al., 2000). This research, therefore, examined concern about climate change relative to other environmental issues. Question number 34 of the survey asked respondents to select the three environmental issues that concerned them most from a list of six. (*Table 28*), below, shows the proportion of all respondents selecting each of the environmental concerns listed. The most popular environmental concern, selected by 82.2% of respondents, is flooding. Climate change was only rated a concern for 37.4%.

This disparity may be due to the wording of this question, which forced people to select three environmental concerns from a list. Respondents not selecting climate change may still have been concerned about it. 40.2% is also concerned about poor waste management.

Table 28: Environmental issues that concerns the most (N=107) (Multiple response)

Which environmental problems concern you the most?	**Frequency**	**Percent**
Flooding	88	82.2
Pollution	29	27.1
Poor waste management	43	40.2
Climate change	40	37.4
Extinction of species	34	31.8
Water shortage	26	24.3

Source: Household Survey

Note: Percentages total more than 100 percent because more than one response from each person is included

When asked why they were concerned about climate change, one key informant with experience of flooding replied:

> "...Yes I am very much concerned about it. Because it is repeatedly stated that poor countries like Ethiopia are at risk of climate change and expected to suffer most from climate change than the rich countries. At local level we have faced flooding, drought etc for several times and that is why I am concerned about it." *[Government employee]*

In explaining why they feel climate change is important to them during FGD, the participants explained as follows:

> "The issue of flooding is mentioned as a reason why climate change is important to them, and most responses related to climate change impacts, particularly weather/ temperature, impacts on the environment, water, wildlife and biodiversity. Others stated concern or responsibility for future generations as the reason for considering the issue important."

In general the findings from the survey, FGD and key informants described in this section indicate that respondents are concerned about climate change when taken alone. When examined in the context of other personal, social and environmental concerns, climate change could not be amongst the most pressing issues for the local community as discussed in this section.

4.4.2 Perceived Threat from Climate Change

The low ranking of climate change amongst peoples' concerns is reflective of a widespread perception that climate change does not pose a direct, personal threat on them. While there is acceptance that climate change is beginning to manifest in changing weather and flooding, there seems to be a prevailing belief in the community that climate change is essentially a distant and future problem (Norton & Leaman, 2004). Studies made by (Bord et al., 2000) also have indicated that, climate change is not generally considered as a direct personal risk. It is more often conceptualized as distant in space and time, with impacts affecting the wider environment and future generations.

The respondents were then asked if climate change is something that is affecting or is going to affect them personally. Accordingly, it was found that 67.3 percent of survey respondents feel that climate change is something that is affecting or is going to affect them personally while 14 percent do perceive that climate change will not affect them personally.

Table 29: Perceived threat from climate change by respondents (N=107)

Do you feel that climate change is something that is affecting or is going to affect them personally?	**Frequency**	**Percent**
Yes	72	67.3
No	15	14.0
Do not know	20	18.7
Total	**107**	**100.0**

Source: Household Survey

When asked how they feel climate change does or will affect them, during the FGD they referred explicitly to adverse effects of climate change such as: Flooding, health, warmer weather etc.

4.5 Perception of Respondents on Controlling/Adapting to Climate Change

4.5.1 Is it possible to control/ adapt? Who Is Responsible? Who Should Act?

Climate change is a global problem that demands international solutions, and as such individuals feel impotent to effect change through their own actions (Uzzell, 2000). If climate change is a serious problem, who do people think is responsible for it happening? And who do they think can and should take action to deal with this problem? Several studies indicate that people often blame societal institutions, especially government, for climate change, and tend not to blame themselves. Many also blamed business and the general public (Lorenzoni and Langford, 2002).

In line with this, the survey attempted to determine the level of optimism in controlling the devastating impacts of climate change. 87.9 percent of the respondents think that climate change can somehow be controlled. 12.1 percent of the respondents, on the other hand, have of the opinion that there is no way in which climate change could be controlled.

Table 30: Adapting/controlling climate change (N=107)

Do you think it is possible to avert or adapt to the impacts of climate change by actions in your locality?	**Frequency**	**Percent**
Yes it is possible	94	87.9
No it is not be averted through local actions	13	12.1
Total	**107**	**100.0**

Source: Household Survey

Those who are positive about exerting a control on the change indicated mechanisms of doing it. 100 percent of the respondents give afforestation /reforestation as the proper mechanism to avert or adapt to the impacts of climate change. 25.5 percent feel that halting activities of hillside cultivation will avert impacts of climate change, while 50 percent state the need to undertake conservation practice such as terracing (See table 31). These categories of respondents agree that such endeavors will greatly help in adapting to or averting the impacts of climate change at local level.

Table 31: Local control mechanism of climate change (N=94) (Multiple responses)

Local control mechanism	Frequency	Percentage
Afforestration	94	100
Cleaning the environment	44	46.8
Stop cultivation of hillsides	24	25.5
Agricultural practices such as terracing	47	50
Using & expanding renewable energy sources	27	27.7

Source: Household Survey

Note: Percentages total more than 100 percent because more than one response from each person is included

Respondents were then asked to choose, from a list of 5 options, which organization or group they feel has the main responsibility for tackling climate change (question number 42). As table 32 demonstrates, by far the largest proportion of respondents (80.9%) believes responsibility for tackling climate change lies principally with national or local governments. Again, (73.4%) consider individuals to have the main responsibility. Even (47.9%) place the main responsibility with international organization.

Table 32: Responsibility for tackling climate change (N=94) (Multiple responses)

Responsibility	Frequency	Percentage
International organizations	45	47.9
National/local governments	76	80.9
Environmental organizations	39	41.5
Individuals	69	73.4

Source: Household Survey

Note: Percentages total more than 100 percent because more than one response from each person is included

4.5.2 Personal Actions Taken

The study also focused whether respondents are engaged in any of the local actions in order to avert or adapt to the impacts of climate change. Consistent with their concern and perceived threat in relation to climate change, and their belief that it can be tackled,

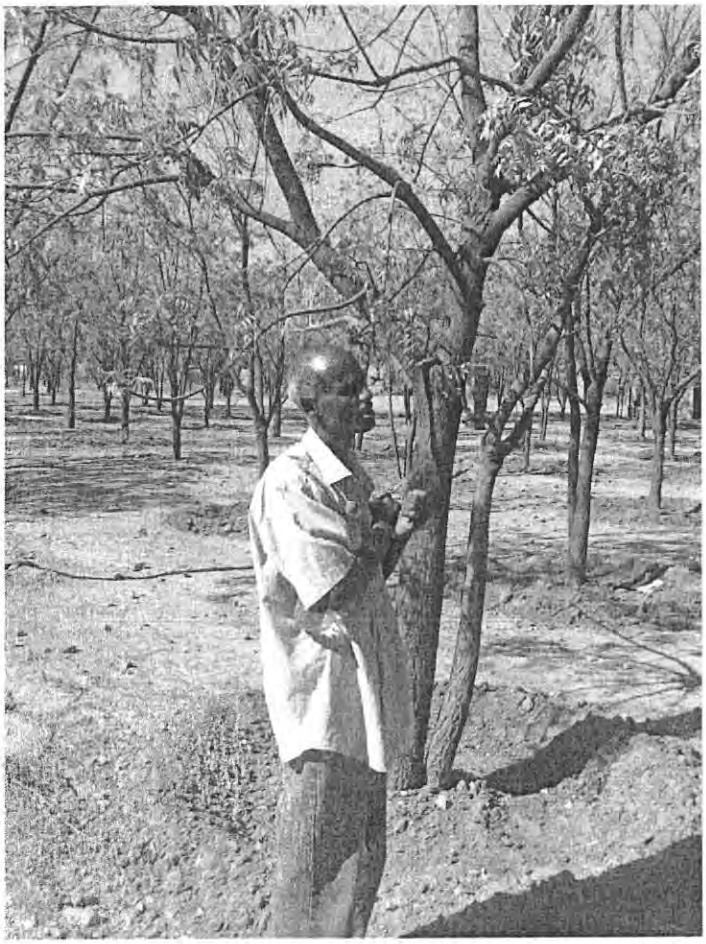
about 69 respondents which are 73 percent of survey respondents state they take, or have taken, action explicitly out of concern for climate change (Question number 44).

Figure 7: Respondents actions taken out of concern for climate change (N=94)

Source: Household Survey

The interview result also indicates that people who believe changes in climate and weather can be tackled or mitigating them have reported that they are taking some measures to tackle the impacts of weather condition at their locality. As one (older) man commented;

Figure 8: A man taking measures to tackle the impacts of weather change at his locality.



"...It is almost nine years since I have started planting trees. I do not know how I started doing it. People used to call me '***Abdala is mad***'. People advice me to build a house than planting trees. Most people think that they are living by building house and destroying forests. But we are destroying ourselves. People did not yet understand the benefit of forests. We have good air, good environment but we are talking of poverty. When I sit under my trees they talk to me and I am satisfied with it and go home like a rich people. People should be taught and encouraged in order to plant trees. I have planted so many trees in different areas. Plants are like human beings. They need proper care and I am giving care for my plants. *"[A farmer and Medal winner at Federal level]*

Another 65 years old woman who believed that changes in climate and weather can be tackled commented as follows:

Figure 9: A woman taking measures to tackle the impacts of weather change at her locality.

"...I am not a farmer but I like and used to plant different species of plants in a small compound that you are observing. Even I have medicinal plants in my garden. It looks like a recreational area and when the weather is hot my neighbors come and stay with me. I did my best and if all do the same I think we can tackle the impacts of weather change in Dire Dawa."*[House wife informant]*

4.5.3 Programs Held to Raise the Awareness of the Local Community

Programs held to raise awareness on climate change; its impacts, vulnerability, adaptation etc will presumably play great roles in controlling, adapting to and averting impacts of climate change. When respondents were asked if there have been programs held to raise the awareness of respondents, 43.9 percent of the respondents say that there have been programs held to raise awareness on climate change and issues relevant to the subject matter. On the other hand, 56.1 state that no such awareness programs were ever held in their locality.

Table 33: Programs held to raise awareness on climate change. (N=107)

Has any program ever been held to boost awareness on climate change?	Frequency	Percent
Yes	47	43.9
No	60	56.1
Total	**107**	**100.0**

Source: Household Survey

For those who validate the awareness program, the focus of the awareness programs have been confirmed by 61.7 percent of the respondents to be on general concepts, 34 percent on the impacts of climate change, 48.9 on vulnerability aspects, 76.6 percent on the need for adaptation and 44.7 percent on the concept of early warning.

Table 34: Focus of the awareness program (N=47) (Multiple responses)

Focus of the awareness	Frequency	Percentage
General Concept	29	61.7
Impact	16	34.0
Vulnerability	23	48.9
Need for adaptation	36	76.6
Early warning	21	44.7

Source: Household Survey

***Note**: Percentages total more than 100 percent because more than one response from each person is included*

Chapter Five

Conclusions and Suggestions

5.1 Conclusion

This chapter presents what has been learned from the study as conclusion and forwards suggestions for various stakeholders to address the issues of climate change.

Very recently the term "climate change" has become a catchphrase in the global and regional forums. It has captured the attention of several governments, businesses and civil societies of the world. The issue was also the top agenda in the G8 Summit. The African Summit in Addis Ababa, too, has dedicated its 8th ordinary session to climate change.

Climate change refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer.

The earth's climate is changing and is projected to continue to change under a variety of emissions scenarios. It is projected that average temperatures will continue to increase, rainfall patterns will change, and as a result sea levels will rise. Extreme weather events (hurricanes, storms, flooding, drought, heat waves) are likely to become more common (i.e., increased frequency), more widespread spatially, and of increased severity.

The primary impact of global warming, proven by many research centers, is the rise in minimum, maximum and mean temperature coupled with an increase or decrease in the amount of rainfall. One of the direct impacts of global climate change on Ethiopia is the change in local weather condition. This research has revealed that out of 107 respondents, 61 of them which are (57%) believed that *average temperatures had increased.* Also, (79) respondents which are (73.8%) also believed that *rainfall levels had decreased in Dire Dawa.* In addition to this most key informants and focus group participants felt that *the timing of rainfall had undergone changes and the region is getting drier and drier.*

The findings also confirmed that weather is changing solely due to *anthropogenic (human activity) causes.* It was also believed by some respondents that the cause of weather change is linked with some kind of a *supernatural phenomena or the wrath of God,* although spiritual explanations of weather change are incompatible with scientific explanation. Still it was identified that the change in climate is just one event in the natural processes.

Based on the survey result, it appears that although 62 respondents which are (57.9 %) of the 107 respondents are aware and heard of climate change, however, (42.1%) of the respondents said they had not heard of climate change. *In this study, it appears that although majorities of the local community have heard of climate change, some, remain unaware of this issue, and, thus, the finding shows that, the local community awareness (and understanding) of climate change does not seem to have advanced in recent years and hence, there is no or little awareness of the issue of climate change among some respondents.*

When respondent awareness of climate change is investigated in relation to sex, the proportion of women who have heard of climate change in the study area is 46.5 percent while that of men respondent is found to be 53.5 percent. In this study it was found that *men are generally more informed than women about climate change.* This is due to men are likely to obtain information about climate change and have more access to media than women. The survey also sought that, there is no significant difference between men and women in relation to the *relative importance* of climate change; but it is interesting to note that women viewed climate change issues *more serious* than men and the greatest levels of *worry* were found among women. Climate change is a global phenomenon, but its consequences will impact differently on women and men. Women tend to have less access to valuable resources and less informed to help them develop their adaptive capacity to potential threats and to avoid or minimize the negative impacts of climate change. Results from the household survey indicated that *there is no significant difference between those with experience of flooding and the non-flooding in terms of the awareness and understanding of the climate change issue.* Also, with the relative

personal importance of the issue of climate change the study identified that the flood victims generally do not differ from the non-victims. Both groups viewed climate change issues important to them.

Climate change occurs as a result of both internal variability within the climate system and external factors. The external causes may be natural or induced by human activity. The finding of the study substantiated by 81 respondents which are (75.7%) is that *deforestation* is the most identified causes of climate change. The second most cause of climate change identified by respondents (12.5%) was *air pollution from factories and cars. In general, then, a large part of the respondents has not fully understood that climate change is being caused primarily by the release of an invisible gases into the atmosphere through the burning of coal, oil and gas.* Because they frequently lack accurate information about the causes of global climate change, often people offer only vague solutions to this problem or endorse solutions that are ineffective. Causes for climate change at local level as perceived by the FGD participants in the study area also include: *Deforestation as a result of land use change, increase in population, punishment from God, lack or low level of awareness and people are not aware of their environment, shortage of land, lack of alternatives to the poor, and poverty.* The respondents also appear broadly willing to accept the idea that human activities contribute to climate change, but many are not yet convinced that human activities are the primary cause.

Climate change will have wide-ranging effects on the environment, and on the socio-economic and related sectors, including water resources, agriculture and food security, human health, terrestrial ecosystems and biodiversity. Changes in rainfall pattern are likely to lead to severe water shortages and/or flooding. Rising temperatures will cause shifts in crop growing seasons which affects food security and changes in the distribution of disease vectors putting more people at risk from diseases such as malaria and dengue fever. Temperature increases will potentially severely increase rates of extinction for many habitats and species. *The most commonly mentioned impact of climate change acknowledged by the survey respondents is flooding (67.3%). Increase in temperature (53.3%) was the next most popular response. Reduced rainfall (45.8%), loss of water*

(36.4%), loss of biodiversity (30.8%), increased disease (25.2%), were also mentioned respectively. Identified impacts of climate change at local level as perceived by the FGD participants and key informants in the study area also include: *The drying up of streams, rivers and even traditional wells, the change in local weather condition. i.e., the rise in temperature coupled with an increase or decrease in rainfall, loss of main crop of the area especially in rural kebeles, decreased water table (the depth was only 5 to 7 meters before but now goes down to 15-18 meters and flooding.*

Flooding incidences were pointed out as one of the indicators of the local impacts of climate change. About 87 respondents which are (88.8%) of the total respondents have witnessed the occurrence of incidence/s of *flooding* as the main environmental problems observed in the study area. The result from the qualitative inquiry also indicated increasing trends in the magnitude, and frequency of flooding in Dire Dawa. Most informants indicated that the magnitude of flooding increased since 1994 with increasing adverse effects on people's lives and livelihoods. The study also identified that Dire Dawa's geographic location, and topography aggravated by the effects of human intervention such as deforestation, inappropriate cultivation practices, inappropriate settlement and construction were found to contribute and cause flooding.

The increasing frequency and severity of the recent floods has been attributed to several interrelated causal factors. However, despite the problem of attributing the incidence of flooding to one factor with a level of certainty, the issue of climate change has, over the year, stood out as a major causal factor for the increasing floods. For instance the IPCC, asserted that floods will increase in their frequency and severity pertaining mostly to the effects of climate change-a fact that can no longer continue to be a debated issue as its presence is strongly felt (IPCC, 2001). And yet, in this study *with regard to the connection between flooding and climate change, 61 respondents which are (57%) of the total respondents do not see the connection between climate change and flooding.*

Studies demonstrate that concern for climate change has, over the past two decades, become widespread. The findings of this study substantiated that respondents feel *climate*

change is very important to them personally, although in relation to other environmental concerns, climate change does not rank as high as more tangible and immediate threats to well-being, such as flooding or poor waste management. The issue of flooding is mentioned as a reason why climate change is important to them, and some of them related to weather/ temperature change, future water shortage, wildlife and biodiversity loss as to why the issue of climate change is important to them. Others stated concern or responsibility for future generations as the reason for considering the issue of climate change as important. There is also acceptance by respondents that climate change is beginning to manifest in changing weather and flooding and is affecting or is going to affect them personally. *Generally, most people think that climate change has begun and a great many acknowledge that it is a serious problem. However, compared to other problems, the community has not ranked climate change among its top concerns.*

While people generally recognize that climate change is a serious problem, most have only vague and often have incorrect ideas about effective ways to deal with the problem. In fact, many people mention measures like, reforestation is helpful to counter climate change. Many are not clear that the emission of carbon dioxide, caused by the burning of fossil fuels (primarily oil, coal, and natural gas), is the primary human-made cause of climate change. Most respondents blame government and businesses most for not doing more to combat climate change. They think these institutions especially government should do more. Most people recognize that they, as individuals, and their local community also make some contribution to climate change and many feel uneasy about their own role.

5.2 Suggestions

Current climate change is already imposing a significant challenge to Ethiopia by affecting food security, water and energy supply, poverty reduction and sustainable development efforts, as well as by causing natural resource degradation and natural disasters. For example floods in 2006 caused substantial human life and property loss in many parts of the country. These challenges are likely to be exacerbated by anthropogenic cause of climate change. However, local community awareness (and understanding) of climate change in Ethiopia does not seem to have advanced in recent years and hence, there is little awareness of the contribution of everyday individual actions to the problem. In view of this, the study suggests the following possible suggestions and interventions:

- Creating and expanding awareness among the population and policymakers about climate change, its causes and its consequences by providing reliable and up-to-date information to the public is needed in order for them to take appropriate adaptive measures.

- In order to conserve the natural resource base of the area, there should be a need to further develop and implement an integrated water shade management plan in the area. Specifically, activities like soil conservation, afforestration/reforestration and terracing should be given more attention with the view of reducing environmental degradation and hence flooding. Flood protection structures such as dykes, flood diversion structures etc should be constructed and maintained so that it could help households to protect their asset during flooding.

- Convince people of the great seriousness of the problem of climate change by making clear the magnitude of the possible losses involved (including those that are immediate and personal) and the high probability of these losses occurring (including making clear the connections between recent memorable events and likely future events).

- Let people know what the most effective ways to counter climate change are. Make clear the specific types of social policies and specific kinds of personal actions that will help reduce deforestation, burning of fossil fuels, thus reducing CO_2 emissions and countering climate change.

- Promoting economic development is the best adaptation strategy to mitigate the adverse effects of climate change. Hence, efforts must be intensified to raise productivity levels and encourage intensification of production to minimize resource exploitation. In addition, nonagricultural employment opportunities need to be expanded in rural areas to minimize the burden on the land. Thus, considering the nature of the subject (climate change) as a crosscutting issue, it will be useful to incorporate some of the climate change/adaptation interventions into the on-going national programs like poverty reduction as a sub-component.

- Collective action by the international community, national/ regional governments and individuals is needed to tackle the impacts of climate change.

- The issue of climate change is more or less a recent phenomenon and has not been addressed by research or other interventions. Research and available information on environment is fragmented and not well coordinated. Therefore, further research need to be conducted.

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Annexes

Annex 1: Structured Questionnaire to be completed by Household Head

Title: Local community understanding of and response to climate change

The case of four kebeles of Dire Dawa Administrative Council.

My name is Adane Kitila., a graduate student of Addis Ababa University for the partial fulfillment of master's thesis in development studies. The purpose of the research is to understand local communities understanding of and response to climate change.

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 and will never be used in connection with any information you tell me.
- Please feel free to ask any questions you may have about the questionnaire.
- You have the right to obtain information about the findings of the research and about how they will be used after the research is completed.

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

Date_____

Household identification number/code number_____

Kebele of the household head_____

Name of data collector_____

Name of supervisor_____

Part I: Background information of household head

1. Sex of household head. 1. Male 2. Female
2. Age of household head_____
3. Religion of household head
    1. Muslim
    2. Christian (Orthodox)
    3. Christian (Protestant)
    4. Christian (Catholic)
    5. Other (specify)_____
4. Ethnicity of household head.
    1. Oromo. 4. Harari
    2. Issa 5. Somali
    3. Amhara 6. Other (specify)_____
5. Marital status of household head.
    1. Single 4. Divorced
    2. Married 5. Other (specify)_____
    3. Widowed
6. Place of birth of household head.
    1. Dire Dawa
    2. Other place (specify)
    Region ____ Zone ____ Woreda _____
7. Continuous duration of stay at current place of residence (year) _____
8. Have you ever attended formal school?
    1. Yes 2. No
9. Educational status attained by household head
    1. Illiterate 4. Grade 5-8
    2. Read and write 5. Grade 9-10
    3. Grade1-4 6. Grade 11-12
    7. Above Grade 12
10. Number of permanent household members at time of survey including household head.
    Male_____
    Female_____
    Total
11. Current occupation of the household head
    1. Farmer 4. Government employee
    2. Daily laborer 5. Others (specify) _____
    3. Trader
12. Household income/month_____

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

13. Do you feel that the temperature of Dire Dawa has changed during the past years?
    1. Yes 2. No 3. Don't know
14. What change has occurred as a result of increased temperature?

_____

_____

_____

15. How about the precipitation?
    1. It is changed 2. It is not changed 3. I don't know
16. Is there a change in the timing of the rains?
    1. Yes 2. No 3. Don't know
17. What change has occurred as a result of change in rain?

_____

_____

_____

18. Do you feel the pattern of weather is generally changing in Dire Dawa?
    1. Yes 2. No 3. Don't know
19. What do you think is the cause?
    1. Human action
    2. Natural processes
    3. Wrath of God, curse etc.
    4. I do not know

20. Have you ***heard of "climate change"?***
    1. Yes 2. No 3. Don't know
21. Where have you ***heard about climate change?*** (Multiple answers are possible)
    1. Television 4. School/ college/
    2. Radio 5. Friends/ family
    3. Newspaper 6. Government agencies/ information
    7. Other *(Please write)* _____
22. How ***important*** is the issue of climate change to you personally?
    1. Very important 2. Not at all important 3. I do not know
23. Which of the following do you think is the main cause of climate change? (Multiple answers are possible)
    1. The use of fossil fuels, such as oil, gas and coal
    2. Depletion of the Earth's ozone layer
    3. Air pollution from factories and cars
    4. Loss of forests

24. How convinced are you that human activities are a significant cause of changes to the Earth's climate and long-term weather patterns?
    1. Very convinced 4. Not at all convinced

Part III: Local community understanding of flood risk

25. Have you personally observed evidence of climate change?
    1. Yes 2. No 3. Don't know

26. What problems have you observed due to changing climate? (Multiple answers are possible)
    1. More flooding
    2. Decline of rain fall
    3. Increased temperature
    4. Deforestation
    5. Drying up of water streams
    6. Disease incidence (such as malaria)
    7. Specify if others_____

27. How frequently have these changes occurred in your locality?
    1. Every year
    2. Every 2 years
    3. Every 5 years
    4. Specify if other than_____

28. If you have observed some problems; what do you think are factors that brought about these problems?
    1. God's/Allah's wrath against our sin
    2. Climate change
    3. Others (specify)_____

29. What should be done to avoid/prevent these problems?
    1. Pray to God/Allah
    2. Know the extent of the problem and react
    3. Nothing can be done

30. Have you, **in the last 5 years**, experienced any form of flood damage (including to your home, garden or community)?
    1. Yes 2. No 3. Don't know

31. If yes, please tell us how you were affected by the flooding. (Multiple answers are possible)

    1. Suffered death of household member
    2. Damage to house
    3. Lost household property and savings
    4. Exposed to diseases like AWD, malaria
    5. Dislocated and forced to live in temporary shelter
    6. Loss of services such as roads, schools, water etc
    7. Other (Specify) _____

32. What do you think is the cause of the 2006 flood disaster in Dire Dawa? (Multiple answers are possible)
    1. Massive agricultural land degradation in east Hararge.
    2. Extensive cultivation steep slopes
    3. Inappropriate settlement and construction
    4. Unsustainable utilization of Dechatu River.
    5. God's/Allah's wrath against our sin
    6. Runoff from roads

7. Climate change
8. If others please specify_____

33. Was flooding in Dire Dawa due to change in climate?
1. Yes 2. No 3. Don't know

***Part IV:* Concern and personal importance of the climate change issue**

34. Please look at the following list of environmental issues, and **circle** the **issues** that **concern** you the most. *Please only tick* the *issues from the list:*

1. Flooding
2. Pollution of the environment
3. Poor waste management
4. Climate change
5. Extinction of species
6. Frequent water shortage

35. Which environmental problems are very common in your area? (Multiple answers are possible)

1. Soil erosion
2. Deforestation
3. Land degradation
4. Water pollution
5. Flooding
6. Other specify_____

36. Do you consider climate change as a very serious problem?
1. Yes 2. No 3. I don't know

37. How much do you personally worry about climate change?
1. A great deal 2. Not at all

38. In your opinion what do you think are the impacts of climate change? (Multiple answers are possible)

1. Drought
2. Increased temperature
3. Reduced/heavy rainfall
4. Loss of water
5. Loss of biodiversity
6. Increased disease
7. If others specify_____

39. Which one of the following possible impacts most concerns you personally, if any?" (Multiple answers are possible)

1. Human health impact
2. Water shortage
3. Flooding
4. Loss of bio diversity
5.Others specify_____

40. Do you think climate change is something that is affecting or is going to affect you, personally?

1. Yes 2. No 3. Don't know

Part IV. Feeling of the people in the study area on who is responsible for tackling climate change, and how should it be tackled

41. Do you think it is possible to avert or adapt to the impacts of climate change by actions in your locality?
1. Yes it is possible 2. No it can not be averted through local actions

42. Who do you think should have the ***main responsibility*** for tackling climate change?

(Multiple answers are possible)

1. International organizations (e.g. the UN, NGO's)
2. The national and local government
3. Environmental organizations/ lobby groups
4. Individuals
5. Other (specify) _____

43. What local actions do you think are possible with in your capacity? (Multiple answers are possible)

1. Afforestation/ reforestation
2. Cleaning the environment
3. Stop cultivation of hillsides
4. Agricultural practices such as terracing
5. Using and expanding renewable energy source
6. Other (specify) _____

44. Are you engaged in any of these local actions?

1. Yes 2. No

45. Are you engaged in activities with the purpose of coping with local impacts of climate change?

1. Yes 2. No

46. Has any program ever been held to boost awareness on climate change, its impacts, vulnerability, adaptation etc?

1. Yes 2. No

47. If yes, what was the focus of the awareness program? (Multiple answers are possible)

1. General Concepts
2. Impact
3. Vulnerability
4. Need for adaptation
5. Early warning

48. How much do you favor or oppose the following proposals?

To address climate change, the government should:

A) Plant **trees** each year (for years).

1. Strongly favor 2. Strongly oppose

B) Spend money on campaigns to persuade people to clean their environment.

1. Strongly favor 2. Strongly oppose

Annex 2: Questions used in semi-structured interviews

No	Item
	Local communities understanding of climate change and its causes.
1	Do you feel the pattern of weather is generally changing in Dire Dawa? Why do you think this might be?
2	Have you heard of "climate change"? What do you know about it?
3	What do you think causes climate change?
	Extent of climate change perceived as a priority environmental concern, a personal risk, or an issue of personal importance.
4	Do you think climate change is something that is affecting or is going to affect you, personally, as a community? In what way(s) is it affecting you, or is it going to affect you?
5	What impacts, if any, do you think climate change may have? Which of these possible impacts of climate change most concerns you personally, if any? Why?
6	How important is the issue of weather change to you personally? Why is it important to you? How much do you personally worry about climate change? Why?
7	Have you experienced any form of flood damage (including to your home, garden or community)?
8	Would you tell me briefly about the nature of flooding in Dire Dawa, in terms of its coverage, seasonality, frequency and duration?
9	What do you think is the cause of flooding in Dire Dawa? Is the flooding due to change in climate?
10	What flood protection measures were taken by the government? By the community? What were people's main coping mechanisms to flooding? Which of these mechanisms seem sustainable?
	Responsibility to tackle the effects of climate change
11	Do you think anything can be done to tackle climate change? What do you think can be done to tackle climate change? Who do you think should have the main responsibility for tackling climate change?
12	What local actions do you think are possible with in your capacity to tackle climate change? Have you ever taken, or do you regularly take, any action out of concern for climate change? What did you do/ are you doing?

Annex 3: Guiding questions used for FGD

Good morning and well come to our group discussion. We are here today to discuss about issues related to local community understanding of and response to climate change. There is no right and wrong answer. All answers both positive and negative are welcome. Please feel free to disagree one with another. We would like to have many points of view. All comments are confidential and used for research purpose only. We will be happy to answer any question you have at the end of this discussion.

Discussion Topic	Guiding questions
Local communities understanding of climate change and its causes.	How was the vegetation cover of the highland part of Dire Dawa in the past years?
	Is there a change in temperature and rainfall patterns?
	Do you feel the pattern of weather is generally changing? Why do you think this might be?
	Have you heard of "climate change"? What do you know about it?
	How important is the issue of climate change to you as a group? Why is it important to you?
	What do you think **causes** climate change?
	What **impacts**, if any, do you think climate change may have?
Concern and personal importance of the climate change issue	Do you think climate change is something that is affecting or is going to affect you, personally, as a community? In what way(s) is it affecting you, or is it going to affect you?
	How important is the issue of climate change to you personally? Why is it important to you?
	What possible impacts of climate change most concerns you personally, if any? Why?
	How much do you personally worry about climate change? Why?
	Does climate change is something that is affecting or is going to affect you, personally?
	Have you experienced any form of flood damage (including to your home, garden or community)?
	Would you tell me briefly about the nature of flooding in Dire Dawa, in terms of its coverage, seasonality, frequency

	and duration?
	What do you think is the cause of flooding in Dire Dawa?
	What types of households are most vulnerable to flooding? Why?
Responsibility to tackle the effects of climate change	Do you think anything can be done to tackle climate change? What do you think can be done to tackle climate change?
	What do you think are the different adaptation strategies mechanisms to cope with climate change?
	Who do you think should have the **main** responsibility for tackling climate change?
	Have you ever taken, or do you regularly take, any action out of concern for climate change? What did you do/ are you doing?

Annex 4: Monthly Rain fall of Dire Dawa

Monthly Rain fall of Dire Dawa

Element	Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave
MonthlyRF	1998	SUM	93.9	29.3	75.2	64.7	87.3	17.1	100	134.1	215.2	59.1	9.1	0	73.70
MonthlyRF	1999	SUM	0	1.3	158.3	28.3	21.8	17.5	97.1	174.6	40.1	71.4	3.6	1.7	51.30
MonthlyRF	2000	SUM	0	0	13.8	26.5	7.1	20	71.9	112.4	93	24.7	23.6	43.6	36.40
MonthlyRF	2001	SUM	0	0	128.7	28	49.5	22.3	112	241.5	74.9	15.8	4.7	6	56.90
MonthlyRF	2002	SUM	34.8	0	80.9	83.1	33.3	9.7	49.4	126.8	65.8	18.7	0	30.2	44.40
MonthlyRF	2003	SUM	14.4	11.3	37	98.5	2.2	65.2	136	53.1	63.6	2.1	0.8	129.8	51.20
MonthlyRF	2004	SUM	39.3	0	44.3	130.1	0.3	12.6	54.5	111		85.6	23.3	5.7	46.10
MonthlyRF	2005	SUM	2.5	3.4	78.5	40.9	28.3	48.3	84.7	76.9	89.9	0	0	0	37.80
MonthlyRF	2006	SUM	10.7	4.9	94.2	163.4	29.4	5.1	87.3	145.8	70.2	13.3	0	71.7	58.00
MonthlyRF	2007	SUM	0	27.8	27.3	180	21	67.5	129	91.4	129.1	30.2	2.7	0	58.80

Source: National Metrological Agency (2007)

Annex 5: Monthly Mmaximum and Mminumun Temperature of Dire Dawa

Monthly Mmaximum Temperature of Dire Dawa

Element	Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave
Mmaximum Temp	1998	AVG	28	30	31.9	34	35	37	33.9	32.2	32.1	31.7	31	29.2	**32.11**
Mmaximum Temp	1999	AVG	30	32	30	34	35	36	33.2	32.5	32.8	30.9	31	28.9	32.16
Mmaximum Temp	2000	AVG	30	31	33.1	35	36	36	34.6	32.3	32.8	32.2	30	28.7	32.58
Mmaximum Temp	2001	AVG	28	31	31.6	35	36	36	34.1	31.4	32.6	33.7	31	29.8	32.43
Mmaximum Temp	2002	AVG	28	32	32	33	37	36	35.4	33.6	33.4	34.1	32	28.8	**32.95**
Mmaximum Temp	2003	AVG	29	32	32.8	34	36	35	33.3	32.3	33.2	33.9	31	28.5	32.64
Mmaximum Temp	2004	AVG	29	30	32.5	32	37	36	33.4	33.6	33.4	31.5	31	29.2	32.39
Mmaximum Temp	2005	AVG	30	33	33	34	35	36	33.1	33.6	33.6	33.5	32	29.6	32.93
Mmaximum Temp	2006	AVG	29.5	31.8	32.2	31.7	35.0	36.2	34.5	32.5	33.2	32.7	31.7	28.4	32.44
Mmaximum Temp	2007	AVG	28.8	31.8	34.3	34.1	36.5	35.3	32.9	32.3	32.7	33.5	31.0	29.5	32.73

Monthly Mminumun Temperature of Dire Dawa

Element	Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave
Mminimum Temp	1998	AVG	17	18	20.3	22	22	23	20.8	20.5	19.7	19.2	15	13.4	19.33
Mminimum Temp	1999	AVG	15	16	18.5	21	22	22	20.4	20.2	21.1	18.5	15	13.8	18.63
Mminimum Temp	2000	AVG	14	15	17.3	20	23	23	21.4	20.3	21.1	19	17	15.1	18.79
Mminimum Temp	2001	AVG	14	16	19.5	21	23	23	21.4	19.7	20.1	19.4	15	15	18.83
Mminimum Temp	2002	AVG	16	15	19.2	21	23	23	22.2	20.9	21.2	19.5	16	17.5	19.57
Mminimum Temp	2003	AVG	16	18	19.1	21	23	23	20.9	21.2	21.2	19.2	17	15.5	19.57
Mminimum Temp	2004	AVG	17	16	18.2	21	23	23	21.5	21.1	20.7	17.4	16	15.6	19.26
Mminimum Temp	2005	AVG	16	16	19.9	20	22	23	21.1	21.3	21.3	19.3	17	13.6	19.19
Mminimum Temp	2006	AVG	15.7	17.8	18.8	20.0	21.9	23.4	21.1	19.3	20.3	19.9	16.1	15.8	19.18
Mminimum Temp	2007	AVG	15.2	17.4	19.2	20.4	22.5	22.1	20.6	20.1	20.1	17.8	15.5	13.3	18.67

Source: National Metrological Agency (2007)

Annex 6: Persons Contacted for FGD

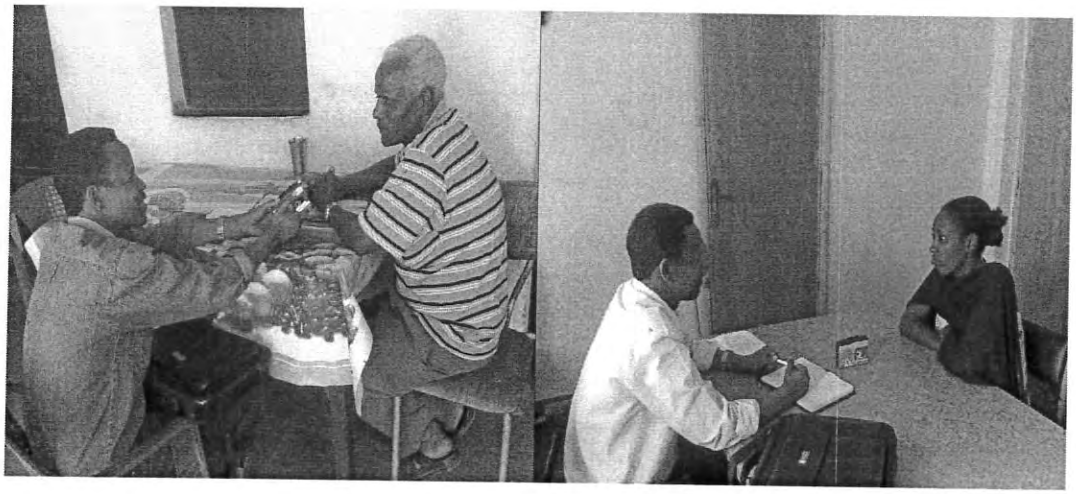
No	Name	Kebele	Sex
1	Ato Wondimu Alemu	05	Male
2	Ato Negash Kidane	05	Male
3	Ato Girma Biru	05	Male
4	Ato Akalu Tsige	05	Male
5	Ato Getahun G/Kidan	05	Male
6	Ato Solomon Bogale	05	Male
7	Ato Worku Azi	05	Male
8	Ato Isubalew Hailu	05	Male
9	Ato Tefera AAlemu	05	Male
10	W/o Tiruye Alemu	05	Female
11	W/o Alima Mohammed	05	Female
12	W/o Ainalem Legese	05	Female
13	Ato Anjebu Husen	04	Male
14	Ato Yimer Abate	04	Male
15	Ato Kasaye Yilma	04	Male
16	Ato Dereje Tsegaye	04	Male
17	W/o Tsehay zewudineh	04	Female
18	W/o Yeharerwork Desalegn	04	Female
19	Ato Gashw Ishetu	04	Male
20	Ato Tariku Girma	04	Male
21	Ato Tezera Kebede	04	Male

Persons Contacted for Interviews

No	Name	Kebele	Sex
1	W/o Rukiya Ahimed (Hoyoo)	03	Female
2	Ato Abdala Muse	05	Male
3	Ato Abebe Mekonnen	04	Male
4	Ato Abdala Mohamed	05	Male
5	Ato Ishetu Deribe	05	Male
6	Ato Tezera Kebede	04	Male
7	W/o Meseret Biru	02	Female
8	W/O Kelemua Kebede	02	Female

Participants of FGDs

Participants of interview



Declaration

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

Declared by:

Adane Kitila

Candidate

Confirmed by:

Advisor

Annex 7

Table: 33 A table that show sample size value determination

Population Size	Sample Size					
	Continuous data			Categorical Data		
	Low	Medium	High	Low	Medium	High
100	46	55	68	74	80	87
200	56	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: 45)