ADDIS ABABA UNIVERSITY

COLLEGE OF SOCIAL SCIENCE AND HUMANITIES

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

Vulnerability to climate change/variability and Local coping strategies in Ebinat Woreda, South Gondar Zone

By: Rediet Tsegaye

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TABLE OF CONTENTS

Content **pages**

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

In recent times, environmental change caused by climate variability is affecting the livelihood of people living in the country specially whose life is dependent on agriculture. However, the rate of vulnerability is varied within areas and households. Hence, the main purpose of this study is to understand the extent of the vulnerability of the local community of peoples of Ebinat Woreda to climate change and to assess their local copping strategies. The study attempted to examine the exposure of the area to climate change and its extremes, to assess the sensitivity and adaptive capacity of the local to the existing climate change impacts, to identify most vulnerable groups from the local people.

To achieve the objectives set, necessary data was collected from sample kebeles, which are agro ecologically, Kolla and Dega. From the information collected, the extent of vulnerability is assessed by using integrated vulnerability assessment to show both biophysical and socio-economic vulnerability.

As a result, the rainfall trend of the past three decades sowed slight decrease and the rate of variability in Meher season is high. In addition, drought is happening frequently in the area. The main source of income of the people is rain-fed crop production. Most of the people earn less than 100 birr per month, low level of assets and few number livestock. The adaptation and coping strategies are not sufficient and, cannot support the local people to sustain their life without external aids. Poor, landless, having large family and households without their own ox are the most vulnerable groups.

Therefore, from the result of the study it can be concluded that the area is exposed to climate extremes, highly sensitive to the adverse impacts of climate change and the adaptive capacity of the local a people is very low. Thus, the adaptive capacity of the local people needs to be improved and additional effective adaptation and coping strategies have to implement.

ACRONYMS

ACC	Air and Climate Change
CC	Climate Change
CDC	Center for Development Consultancy
CEEPA	Center for Environmental Economics and Policy in Africa
CO_2	Carbon dioxide
DA	Development Agents
ERO	Ethiopian Relief Organization
ERRC	Ethiopian Relief and Rehabilitation Commission
ETC	European Topic Center
FGD	Focus Group Discussion
FDRE	Federal Democratic Republic of Ethiopia
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GO	Governmental Organizations
HH	Household
HHH	Household Head
IPCC	Intergovernmental Panel for Climate Change
Km	Kilometers
NAPA	National Adaptation Production of Action
NGO	Non-Governmental Organization
NMA	National Meteorological Agency
ORDA	Organization for Rehabilitation and Development of Amhara
SCRA	Strengthen Emergency Response Abilities
SCTD	Schumacher Center for Technology and Development
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate
WB	World Bank

CHAPTER ONE

1. INTRODUCTION

1.1. Background

Climate change becomes a serious issue throughout the world. It is influencing the normal processes of major ecosystems of the world. Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, wide spread melting of snow and ice and rising global average sea level. Observational evidence from all continents and most oceans shows that many natural systems are being affected by climate changes, particularly temperature increases. Most of the observed increase in global average temperatures since the mid 20th century is very likely due to the observed increase in anthropogenic GHG concentrations. It is likely that there has been significant anthropogenic warming over the past 50 years averaged over each continent (except Antarctica). Anthropogenic warming over the last three decades has likely had a visible influence at the global scale on observed changes in many physical and biological systems. (IPCC, 2007)

However, the impact is highly pronounced on developing countries that have low adaptive capacity because of low income, technology and their reliance on climate sensitive economic sectors like agriculture. According to IPCC (2007), it has been projected that in Africa, 75 – 250 million people will be exposed to increased water stress due to climate change by 2020). In addition, in some countries, yields from rain-fed agriculture could decline up to 50%. Agricultural Production, including access to food, in many African countries is projected to be severely compromised. This would further adversely affect food security and exacerbate malnutrition. By 2080, an increase of 5 to 8% of arid and semi-arid land in Africa is projected under a range of climate scenarios. Accordingly, income and sensitivity speed up the impact of climate change on the life of people living in developing countries.

Ethiopia is one of African countries, which become vulnerable to climate change. Ethiopia is especially vulnerable to climate change because of its geographic coverage and complexity, low income, and reliance on climate sensitive economic sectors particularly agriculture and pastoralist. The livelihoods of millions of people in the country are critically dependant on climate. The impact of climate change in Ethiopia is highly manifested because of agriculture is expected to play a key role in ensuring food security and the country's economy (Aklilu A. & Dereje G., 2010). The system of agriculture, which is mostly rain-fed, is highly affected with late onset and early offset of rainfall during the main rainy season and in most cases total failure of the *Belg* season. This may result in drought and famine.

Climatic variations and extremes cause considerable damage to households, communities, natural resources and economies. In many places the damage is increasing, giving evidence of an adaptation deficit, meaning that practices in use to manage climate hazards are falling short of what can be done (Burton, 2004). The limited economic, institutional and logistical capacity to mitigate and adapt to climate change exacerbates the vulnerability of many people and communities to climate change and land use cover transformation. Impacts range from recurrent droughts and catastrophic flood to declining livestock and food production. (NMSA 2001, 2007 sited on Aklilu A. and Alebachew A., 2009). This study focused on the extent of vulnerability, vulnerable sectors and assessing the effectiveness of local to the impact in Ethiopian context.

1.2. Statement of the problem

In recent times, environmental change caused by climate variability, become a common phenomenon in Ethiopia. This is affecting the livelihood of people living in the country specially whose life is dependent on agriculture. This shows that most of the people are affected because above 85% of the population are agrarian.

Although Ethiopia is known for, having ample water resource agriculture is devastatingly dependent on the timely onset, amount, duration, and distribution of rainfall. Over 90% of the food supply comes from rain fed subsistent agriculture and rainfall failure means loss of major livelihood source that always accentuate food deficit (Adgolign, 2006). The sector is also

predominantly subsistent, hand to mouth, and characterized by poor Farming practices (less technology, less agricultural input and resource degradation) (Abate, 2009). In addition, rainfall decreases 'significantly' in June-July-August (JJA) over parts of the Horn of Africa, which is the main crop cultivation season in Ethiopia (Abate, 2009).

This fact clearly verifies the high sensitivity of Ethiopia for climatic problems and low adaptive capacity to respond to damages. The warming of few degrees and increase in frequency of extreme weathers will consequently strongly influence agricultural production and make the society victim of the events and decreases the future adaptive capacities.

Accordingly, Ethiopia's vulnerability to climate change is attributed to low adaptive capacity and exposure to external hazards and an inability to cope with those shocks. However, the extent of vulnerability varies within sectors, areas, agronomical zones and within different income levels of the community.

Amhara is one of the regions known by crop production in the country. Over 85% of the economically active population is engaged in this sector. The region is one of the surplus crops producing areas of the country and characterized by high rainfall from mid June until early September. However some parts of the region specially north east part of the region is exposed to shortage of rain fall which is less than 700mm (CDC, 2008) and shortage of food throughout the year.

So far, it is difficult to predict the extent of their vulnerability and conclude that all the local people are vulnerable equally because of different variables. In addition, the effectiveness of their local coping strategies is not yet studied. To this end, local studies are needed to understand the extent of vulnerability of peoples.

For this study Ebinat woreda which is one of drought prone areas in the region is chosen to identify the extent of vulnerability of the people to climate change and assess the effectiveness of the local people's coping mechanism.

1.3. Objectives of the study

The main objective of this study is to understand the extent of the vulnerability of the local community of Ebnat *Woreda* to climate change variability and to assess their local copping strategies.

Based on the general objective some specific objectives drown as below:-

- To observe the exposure of the area to climate change and its extremes;
- To examine the sensitivity and adaptive capacity of the local to the existing climate change impacts;
- To identify most vulnerable groups from the local people;

1.4. Research questions

This study aimed to answer the following questions.

1. Is the *woreda* exposed to climate-induced extremes?
2. How is the sensitivity of the system? What factors do make the local people more vulnerable to climate change?
3. How do the local communities adapt to or cope with the changing climatic conditions?
4. Who is the most vulnerable?

1.5. Significance of the study

As climate change is affecting in the whole world, different local studies are needed to assess how the problem is going on. Due to this reason, this study aimed to show the extent of vulnerability and adaptive capacity of the people in Ebinat *Woreda*.

Even though climate change is affecting the whole world, the extent differs from region to region and from locality to locality. Similarly, the coping mechanism differs from community to community. These together indicate the fact that local studies are necessary to understand the extent of vulnerability at different levels and different coping mechanisms that may be replicated and used as remedial measures in other similar occasions.

Therefore, the result of this study will serve to identify the problem happening to the local people, to provide more information for different institutions, donors and policy makers and it can be stepping-stone for those who are interested to extend it for further study.

1.6. Limitations

Some challenges had occurred while conducting this study. One of the main problems faced during the study was financial and time limitation. Some of respondents were not willing to give accurate and exact information specially about their income due to some cultural reasons. In addition, there was a problem to find the household head in some of the sample houses.

The other limitation is the meteorological station in the *woreda* is fourth level, having only rainfall data. In addition, the rainfall data is incomplete. As a result, lack recorded temperature data was occurred.

1.7. Organization of the paper

This paper organized in five chapters. The First chapter deals with the introductory part that contains Background of the study, Statement of the problem, Objectives, Research questions , Significance and Limitations and. Chapter two deals with the Literature Review and the Third chapter describes about the Research Methodology and Study area. The Forth chapter deals with Analysis and Interpretations. Then, the last Chapter contains Conclusion and Recommendations. In addition, the data collation tools and some other information attached as appendices.

CHAPTER TWO

2. REVIEW OF RELATED LITERATURE

2.1. Overview of Global climate change and its impacts

Climate change has become a real phenomenon, as it is evident from an increased world temperature, which is known as global warming while many factors continue to influence global warming (Cowie, 2007). Global average temperature has increased by about 0.6°C over the past 100 years, with a major warming upswing in the 1970s. Warming is the result, in part, of rapid increases in emissions of greenhouse gases (GHG), particularly carbon dioxide (CO_2), which is a byproduct of the combustion of fossil fuels, such as coal, oil, and natural gas, used for power generation and transportation(T. Prato and D. Fagre,2006). As IPCC 2007 reports the concentration of green house gases in the atmosphere has increased mainly science 1980's. The global surface temperature has increased over the past 50 years from 1956 to 2005 at the rate of 0.13^{o}c per decade. In addition to this, the average temperature of the ocean has increased to the depth of at least 3000m and that the ocean has been taking up over 80% of the heat being added to climate system since 1961.

Moreover other evidences showed that the atmospheric concentration of carbon dioxide and troposphere ozone have each increased by 35% during the last 50 years, the concentration of methane risen by about 0.6 ^{o}c. (Ennis and Marcus, 1993; IPCC,2007) Observed decreases in snow and ice extent are also consistent with warming. Satellite data since 1978 shows that annual average arctic sea ice extent has shrunk by 2.7 [2.1 to 3.3] % per decade, with larger decreases in summer of 7.4 [5.0 to 9.8] % per decade. Mountain glaciers and snow cover on average have declined in both hemispheres. (IPCC, 2007)

Those changes have an effect on different aspects in the whole world. Studies show that climate change adversely affects human and natural systems by reducing biodiversity, altering hydrological systems, impairing biological and chemical cycles, and making it more difficult to

restore degraded ecosystems. Agricultural and forestry management at northern hemisphere higher latitudes, such as earlier spring planting of crops, and alternatives in disturbance regions of forests due to fires and pests. Also on health wise, heat related mortality, infectious disease and allergenic pollen are seen in different parts of the world. (T. Prato and D. Fagre, 2006; IPCC, 2007)

Variations and extremes of climate disrupt production of food and supplies of water, reduce incomes, damage homes and property, impact health and even take lives. Humans, in an unintended revenge, are getting back at the climate by adding to heat-trapping gases in the Earth's atmosphere that are changing the climate. However, the changes are amplifying the hazards. In addition, we cannot in short order stop this. The physical and social processes of climate change have a momentum that will continue for decades and well beyond. (Burton, 2008)

The effects of climate change are substantial, particularly in developing world. These countries are highly dependent on climate sensitive natural resource. Sectors for livelihoods and incomes, and the challenges in climate that are projected for tropics and subtropics, where most developing countries are found, are generally adverse for agriculture(IPCC, 2001 and 2007a). Furthermore, the means and capacity in developing countries to adapt to changes in climate are scarce due to low levels of human and economic development and high rates of poverty. These conditions combine to create a state of high vulnerability to climate change in most of the developing world (Burton, 2008). Developing countries have lesser capacity to adapt and are more vulnerable to climate change damages, just as they are to other stresses. This condition is extreme among the poorest people. (IPCC, 2001)

Climate sensitive natural resources that livelihoods, economic activities and national incomes of developing countries depended are in a degraded state from combined pressures caused by human use, climatic and environmental variation and change. Their degraded state makes these resources, and the people who are dependent on them, highly vulnerable to the damages from climate change. Many regions and countries will be capable of adapting to climate change but

that the poorer countries regions will have difficulties responding to climate change. (Handmer et al, 1999) It is clear that climate change will in many parts of the world; adversely affect socio-economic sectors, including water resources, agriculture, forestry, fisheries and human settlements, ecological systems …, and human health …, with developing countries being the most vulnerable. (IPCC 2000)

2.1.1 Impacts of Climate change in Africa

According to the IPCC report on the regional impacts of climate change, *Africa is the continent most vulnerable to the impacts of projected changes because widespread poverty limits adaptation capabilities.* The importance of agricultural activities for the economies of most African countries, combined with the farming sector's reliance on the amount of rain during the rainy season, make countries in the region particularly vulnerable to climate change. Thus, from the point of view of food security, the increasing incidence of drought represents a very serious threat. It has been argued that, in Africa, drought hazard and vulnerability are likely to be the most damaging impacts of climate change (Downing et al. 1997)

Sufficient evidence shows that the average temperature rise in Africa is faster than the global average and is likely to persist in the future (Hulme et al. 2000). The warming is definitely hazardous for agricultural activities in the continent as many of the crops are grown close to the thermal tolerance limits (Collier et al. 2008). The warming of few degrees and increase in frequency of extreme weathers will consequently and strongly influences the agricultural production and make the society victim of the events and decreases the future adaptive capacities.

A recent study also shows that there was a dramatic decline in average rainfall conditions in all West African dry lands for the period 1960-1990 (Marcel Put *et al*., 2004:). "Some of the regions in the northern zone with semi-arid conditions in 1930-60 had clearly become arid (on average) in the 1960-1990 period, with unsuitable conditions for millet or sorghum production in most years. A considerable part of the sub-humid zone in the period 1930-1960 had become semi-arid

in 1960-1990 with considerable drought risks, certainly for crops which are less adaptable to drought stress (maize, cotton)" (Put *et al*., 2004).

As many scholars stated, climate change will lead to increased levels of drought in Africa if temperatures continue to rise. It can further lead to floods, starvation, landslides, drought and rising sea levels. According to the United Nations, climate change will affect Africa more than anywhere else will in the world due to extreme poverty levels, high rates of population 6 growth, over-reliance on rain-fed agriculture and over-dependence on natural resource-based livelihoods. Global temperature increase by the year 2100 will lead to less precipitation in Central Asia, the Mediterranean region, Africa, parts of Australia and New Zealand, associated with a greater probability of droughts (UNEP, 2007).

Furthermore, Africa suffers from climate or water-related diseases, such as yellow fever, cholera, river blindness, bilharzias, malaria and tuberculosis. In particular, climate change will create favorable conditions for malaria risk in Africa in the years to come. In tropical Africa, where malaria is highly endemic, prevalence may increase. The greatest sensitivity to climate change is in areas with currently low endemicity, where smaller changes in climate may have profound impacts on prevalence. (Hulme *et al*., 1995)

2.2. Issues related with Vulnerability

2.2.1 Definition

Vulnerability

IPCC (2000) defined vulnerability as the extent to which a natural or social system is susceptible to sustaining damage from climate change, and is a function of the magnitude of climate change, the sensitivity of the system to changes in climate and the ability to adapt the system to changes in climate. Hence, a highly vulnerable system is one that is highly sensitive to modest changes in climate and one for which the ability to adapt is severely constrained. Then on IPCC (2001),

defied as *''the degree to which a system is susceptible to, and unable to cope with adverse effects of climate change, including climate variability and extremes''* (IPCC 2001).

Looking at vulnerability from food security point of view, FAO publication at The State of Food Insecurity in the World (1999), defines vulnerability as "the presence of factors that place people at risk of becoming food insecure or malnourished." Clearly, this definition encompasses causes of food insecurity other than climate change (e.g., armed conflict, landlessness, etc.). Nevertheless, the concept of vulnerability includes hunger vulnerability, which refers to the vulnerability of individuals or households rather than that of regions or economic sectors.

The IPCC report, The Regional Impacts of Climate Change: An Assessment of Vulnerability (Watson et al.1998), argues that the vulnerability of a region depends largely on its wealth, and that poverty limits adaptive capabilities. According to the Second Assessment Report, vulnerability depends on the level of economic development and institutions. The report argues that socio-economic systems "typically are more vulnerable in developing countries where economic and institutional circumstances are less favorable" (Watson et al. 1996). The report continues that vulnerability is highest where there is "the greatest sensitivity to climate change and the least adaptability."

Though vulnerability differs substantially across regions, it is also recognized that even within, economic sectors and social group impacts, adaptive capacity and vulnerability will varies. This is due partly to the fact that changes in temperature and precipitation will occur unevenly, resources and wealth are distributed unevenly climate change impacts will be unevenly distributed around the globe. (IPCC, 2001)

Sensitivity

As Santiago Olmos (2001) defines, sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. In some way, Smite et al. (2000) define sensitivity as, the degree to which a system will be affected by, or responsive to, climate stimuli..

Exposure

IPCC (2001) defined Exposure as the, "degree of climate stress upon a particular unit of analysis; it may be represented as either long-term changes in climate conditions, or by changes in climate variability, including the magnitude and frequency of extreme events"

Adaptive Capacity

Adaptive capacity is defined as "the potential or capability of a system to adjust to climate change, including climate variability and extremes, to moderate potential damages, to take advantage of opportunities, or to cope with consequences" (Smit and Pilifosova 2001).

2.2.2 Factors determining vulnerability

Considerable attention has been paid to identifying characteristics that influence a system's ability to adapt (as part of impact and vulnerability assessment) and/or their priority for adaptation measures (as a basis for policy development) (Smit and Pilifosova 2001). A common theme in the climate change impacts and vulnerability literature is the idea that communities social groups, sectors, regions and nations differ in the degree of vulnerability to climate change, i.e. there exists *differential vulnerabilities* (Bohle *et al.* 1994).

The significance of climate variation depends on the degree of change and the characteristics of the society exposed to it. These characteristics determine the level of vulnerability of a system. Climate induced changes can have vastly different ramifications on communities, regions and nations because of differential vulnerabilities and coping strategies. Poor developing countries are more vulnerable to and have lesser adaptive capacities to than developed nations, due to;

- Overpopulation (relative to current productivity, income and natural resources),
- Debilitated ecological base (land degradation and fragmentation),
- Over-dependence on climate-sensitive sectors: agriculture, forestry, fisheries
- Low level of economic wealth

- Unequal in access to resources and wealth among groups
- Weak socio-cultural (rigidity in land-use practices, social conflicts) infrastructural, financial/market (uncertain pricing, availability of credit, lack of credit), legal and governance structures
- Technological, skills and human resource bottlenecks
- Poor pre-existing health conditions.

2.2.3 Assessing vulnerability

There are different conceptual approaches and methodologies in different literatures to assess vulnerability based on the objectives to be achieved and the methodologies employed. The major three conceptual approaches to analyzing vulnerability to climate change are the socio-economic, the biophysical (impact assessment), and the integrated assessment approaches. (Temesgen et.al, 2008)

Socioeconomic Approach

Socioeconomic vulnerability assessment approach mainly focuses on the socioeconomic and Political status of individuals or social groups (Adger 1999; Füssel 2007). Individuals in a community often vary in terms of education, gender, wealth, health status, access to credit, access to information and technology, formal and informal (social) capital, political power, and so on. These variations are responsible for the variations in vulnerability levels. In general, the socioeconomic approach focuses on identifying the adaptive capacity of individuals or communities based on their internal characteristics. However, socio-economic approach focuses only on variations within society (i.e., differences among individuals or social groups). In reality, societies vary not only due to socio-political factors but also to environmental factors. Two social groups having similar socio-economic characteristics but different environmental attributes can have different levels of vulnerability and vice versa. (Temesgen et.al,2008)

Biophysical Approach

The biophysical, or impact assessment, approach is mainly concerned with the physical impact of climate change on different attributes, such as yield and income (Füssel and Klein 2006). Kelly and Adger (2000) referred to the biophysical approach as an *end-point analysis* responding to research Questions such as, "*What is the extent of the climate change problem?"* and "*Do the costs of climate change exceed the costs of greenhouse gas mitigation*?"Although very informative, the biophysical approach has its limitations. The major limitation is that the approach focuses mainly on physical damages, such as yield, income, and so on. For Example, a study on the impact of climate change on yield can show the reduction in yield due to simulated climatic variables, such as increased temperature or reduced precipitation. (Temesgen et.al,2008)

The Integrated Assessment Approach

The integrated assessment approach combines both socioeconomic and biophysical approaches to determine vulnerability. Füssel (2007) and Füssel and Klein (2006) argued that the IPCC (2001) definition which conceptualizes vulnerability to climate as a function of adaptive capacity, sensitivity, and exposure accommodates the integrated approach to vulnerability analysis. According to Füssel and Klein (2006), the risk-hazard framework (biophysical approach) corresponds most closely to sensitivity in the IPCC terminology. Adaptive capacity (broader social development) is largely consistent with the socioeconomic approach (Füssel 2007). In the IPCC framework, exposure has an external dimension, whereas both sensitivity and adaptive capacity have internal dimension, which is implicitly assumed in the integrated vulnerability assessment framework (Füssel 2007).

Even though the integrated assessment approach corrects the weaknesses of the other approaches, it has its limitations. The main limitation is that there is no standard method for combining the biophysical and socioeconomic indicators. This approach uses different data sets, ranging from socioeconomic data sets (e.g., race and age structures of households) to biophysical factors (e.g., frequencies of earthquakes); these data sets certainly have different and yet unknown weights. (Temesgen et.al, 2008) The other weakness of this approach is that it does not account for the dynamism in vulnerability. Coping and adaptation are characterized by a

continual change of strategies to take advantage of opportunities (Campbell 1999; Eriksen and Kelly 2007); thus, this dynamism is missing under the integrated assessment approach.

2.3. Adaptation and coping strategies

Societies are dynamic and they use all possible strategies to reduce the vulnerability to climatic impacts. There are two kinds of responses across the temporal scale coping mechanisms and adaptive capacity. **Coping mechanisms** are the actual responses to crisis on livelihood systems in the face of unwelcome situations, and are considered as short-term responses (Berkes & Jolly 2001). **Adaptive strategies** are the strategies in which a region or a sector responds to changes in their livelihood through either autonomous or planned adaptation (ibid; Campbell 2008). Coping mechanisms may develop into adaptive strategies through times (Berkes & Jolly 2001).

For vulnerable groups such as developing countries, adaptation strategies are vital, as failure to adapt could lead to significant deprivation, social disruption and population displacement, and even morbidity and mortality (Downing, et al., 1997).

Indigenous people all over the world have used different strategies to respond and adapt to climate change, these includes:

- diversified resource base (to minimize the risk due to harvest failure, they grow many different crops and varieties, and they also hunt, fish, and gather wild food plants);
- change in crop varieties and species; change in the timing of activities (crop harvests, wild plant gathering, hunting and fishing);
- change of techniques;
- change of location;
- hangs in resources and/or life style(resorting to wild foods in the case of emergency situations such as droughts and floods);
- exchange (obtaining food and other necessities from external sources through exchange, reciprocity, barter, or markets in times of crises); and

- resource management (enhancing scarce and climate-sensitive resources management) (Jan Salick and Anja Byg, 2007)

2.4. Climate change in Ethiopia

In recent years environment has become a key issue in Ethiopia. The main environmental problems in the country include land degradation, soil erosion, and deforestation, loss of biodiversity, desertification, recurrent drought, flood and water and air pollution. This is due to their low adaptive capacity and high sensitivity of their socio-economic systems to climate variability and change. Sensitivity and adaptive capacity also vary between sectors and geographic locations, time and social, economic and environmental conditions within a country. Current climate variability 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.

As pointed out on NAPA (2007) the major adverse impacts of climate variability in Ethiopia include-

- Food insecurity arising from occurrences of droughts and floods;
- Outbreak of diseases such as malaria, dengue fever, water borne diseases
- Dysentery associated with floods and respiratory diseases associated with droughts;
- Land degradation due to heavy rainfall;
- Damage to communication, road and other infrastructure by floods ;

2.4.1 Impact of climate change in Ethiopian agriculture

Climate change will bring with it-increased frequency of two types of natural disasters that affect agriculture and rural households: droughts and floods. It will also alter rainfall patterns, thereby changing farming practices, household behavior, and welfare. (*Futoshi Y. & Agnes Q., 2009*)

Like many other developing countries, agriculture (with the largest number of livestock in Africa) is the single largest livelihood of an overwhelming majority in Ethiopia, 85% of the population (CSA2 2008). It also provides a lion's share of the economic activity, accounts for half of the GDP, 60% of the exports, and 80% of the national employment (CIA - World Fact book 2008). As agriculture is the backbone of the country, it is believed to continue being the determinant sector to bring sustainable economic development to the country (CSA2 2008)

During drought and delay in the onset of rain land becomes dry and difficult to plough, forage deficit leads to weakness and oxen mortality (engine of subsistent cultivation), and lack of precipitation hinders seed cultivation and germination of cultivated seeds. Even weeks delay in the onset of rain was found to have significant difference on the harvest and has deprivation of households' livelihood. Drought and delay in the onset of rain led to poor grass regeneration/forage deficit, water shortage and heat stress on livestock, and consequently increased the mortality of the livestock, vulnerability to diseases and physical deterioration due to long distance travel for water and pastures.(Abate,2008)

Agriculture is one of the sectors most vulnerable to climate change impact. The impact is even stronger in Africa, where agriculture is truly important for the daily subsistence, and where adaptive capacity is low. Abate, 2009*)*

2.4.2 Ethiopian farmer's vulnerability to climate change

Ethiopian farmers are exposed to both gradual climate change (mainly temperature and precipitation) and extreme climate change (mainly drought and flood). (Temesgen et.al, 2008)

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. Vulnerability assessment based on

existing information and rapid assessments carried out under NAPA has indicated that the most vulnerable sectors to climate variability and change are agriculture, water and human health. In terms of livelihood approach, smallholder rain-fed farmers and pastoralists are found to be the most vulnerable. The arid, semiarid and the dry sub-humid parts of the country are affected most by drought. (Abate, 2009)

Therefore, reducing vulnerability involves reducing exposure through specific measures, or increasing adaptive capacity through activities that are closely aligned with development priorities.

2.4.3 Local adaptation and copping strategies in Ethiopia

Ethiopian farmers have managed to learn how to control weeds and insects, select crop varieties, classify vegetation types, and cope with climatic and environmental changes. They have developed various strategies to cope with climatic changes. They conserve water resources and use it avoid moisture related crisis during dry seasons. They use drought-resistant crops to address problems related to climate variability and drought in particular. Farmers are well aware of the fact that trees and rain are interconnected. Trees protect soil erosion, influence climate, and provide shade for humans and animals (Kelbessa, 2001).

Traditional and contemporary coping mechanisms to climate variability and extreme in Ethiopia as NAPA (2007) includes;

- changes in cropping and planting practices,
- reduction of consumption levels,
- collection of wild foods,
- use of inter-household transfers and loans,
- increased petty commodity production,
- temporary and permanent migration in search of employment,
- grain storage,
- sale of assets such as livestock and agricultural tools,

- mortgaging of land,
- credit from merchants and money lenders
- Use of early warning system, food appeal/aid, etc.

2.5. Conceptual framework

Vulnerability to climate change and variability is a function of the exposure of the natural system to the change or variability of temperature and precipitation, the sensitivity of the biophysical system to changes and the socioeconomic ability to adapt and cope with the change. Hence, to study the extent of vulnerability of the local people of *Ebinat woreda*, integrated conceptual framework having both biophysical and socioeconomic vulnerability is constructed as below.

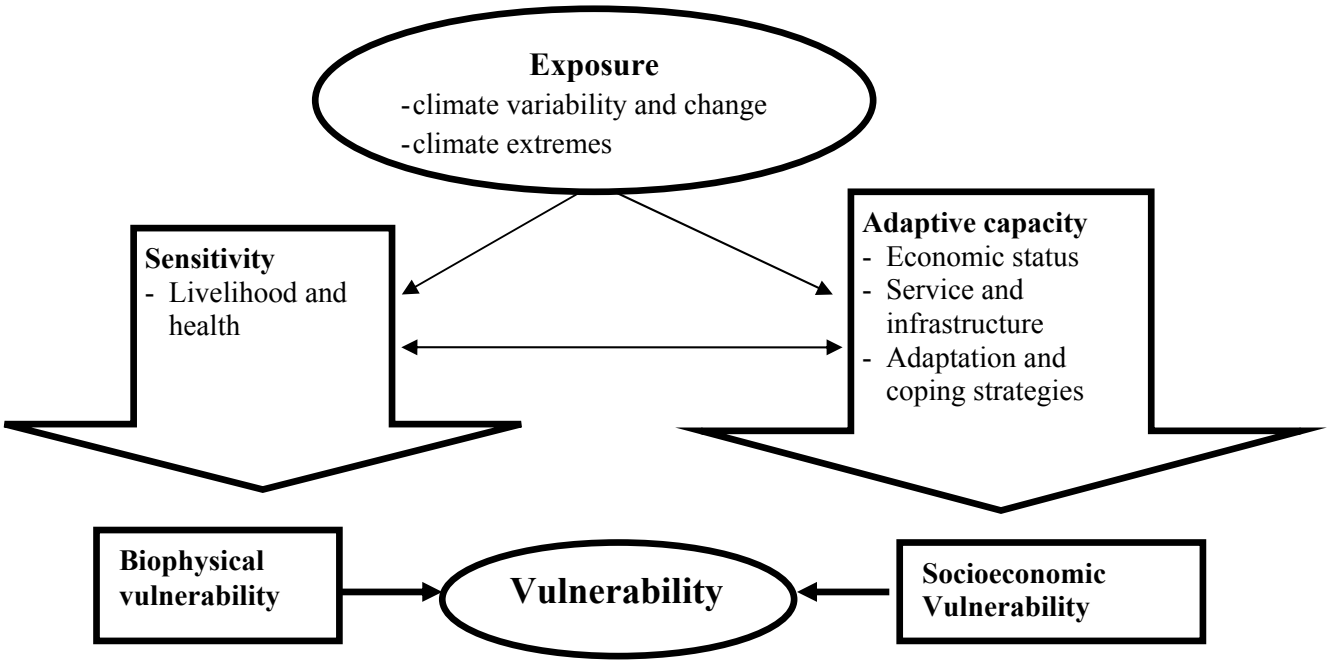


Figure 2.1 Conceptual framework to vulnerability assessment (adopted from Temesgen et.al, 2008 and modified)

As figure 2.1 vulnerability of people to climate change and variability is determined by the exposure to the area, their system's sensitivity to be affected with the impact of the change and their adaptive capacity, the potential of their methods to adapt or cope with the change. This

factors are interrelated. Exposure of the area to the change in perception and temperature cause climatic extremes like flood and drought. This exposure influences both the biophysical system and adaptive capacity. This means that the higher the exposure (frequent change and extremes) highly affect the livelihood (income and yield) and health of the households, sensitivity. Also the higher the exposure reduces the adaptive capacity. Sensitivity and an adaptive capacity are also linked. If exposure is constant, the higher the adaptive capacity results lower sensitivity and vice versa. Then, high sensitivity is biophysical vulnerability, low adaptive capacity, which is low economic status, poor service and infrastructure and effective adaptation and coping strategies, leads to socioeconomic vulnerability and the combination of biophysical, and socio economic vulnerability can show the areas total vulnerability.

CHAPTER THREE

3. METHODOLOGY AND STUDY AREA DISCRIPTION

3.1. Methodology

3.1.1 Study design

This study is designed as descriptive survey that assesses the vulnerability and coping mechanisms of the local people in Ebnat *Woreda* to climate change. In the study, both qualitative and quantitative approaches were employed to collect, analyze and interpret the data.

In the quantitative aspect, household survey was used to collect relevant data from the primary vulnerable bodies. For this purpose, the questionnaire focused on household social Characteristics, income, livelihood system, physical resources perception, risks and coping strategies. Most of the questions were structured and pre-coded and some open-ended questions were included.

Qualitative method was applied to be familiar with the past conditions of the area, present coping mechanisms and to understand people's perceptions. In this case, interview, observation and focus group discussion were employed.

3.1.2 Data sources and instruments

In order to answer the questions of this study and to provide comprehensive information on vulnerability to climate change, data were collected from different sources by employing both qualitative and quantitative data.

Primary sources - The primary sources were the principal vulnerable bodies, local community, and development agents working in the area. Thus, to understand the situation at household level different information collected from selected sample households by using

questionnaire. In addition, to understand the social and physical situations of the area, focus group discussion and discussion with key informants were employed by using checklists. To u understand the overall situation of the area observation was applied.

Secondary sources - To get concrete information and to support the data obtained from primary sources secondary data was collected. The data sources were Office of Agriculture, Safety net, Organization for Rehabilitation and Development of Amhara, Red Cross Ethiopia and South Gondar Zone Information and Communication office. Interviewing the officials in those bureaus and reviewing written documents were methods used to collect data from these sources.

3.1.3 Sampling

Both probability and non-probability sampling techniques were used based on the nature of the tools for primary data collection. In order to select and determine the sample *Kebele*s from the woreda, agro ecological zone was used as the criteria (i.e. purposive sampling). Therefore, from the three climatic zones *Kolla, Woynadega and Dega* the two extremes *Dega* and *Kolla* were selected. Dega was chosen due to relativly high population pressure and it is characterized by high rainfall and erosion. And the *kolla* areas are highly food insecure, exposed to frequent drought and famine. And both *kolla* and *Dega* have *Woynadega* agro ecological classification as microclimate. Hence, woynadega is addressed by defolt in both.

Then, one sample *Kebele* was randomly selected from each agro-ecological zone. Hence, *Worgaja* and Eyadawula were chosen from *Kolla* and *Dega* respectively. In sample *Kebele*s, because their division is not based on climate, there is again slight difference in climatic zone. Hence, 80% of *Worgaja Kebele* is *Kolla* and the remaining 20% is *Weynadega* and *Dega*. While 70% of Eyadawula is *Dega*, and the other 30% is *Weynadega* and *Kolla*. Therefore, to show the difference between the extreme zones selecting villages that can represent *Kolla* and *Dega* was made. Then, from the two *Kebele*s two villages (*Gote*) were selected as a sample, one village (*Gote*) from each *Kebele*. These are namely Aboye from *Worgaja* and Wulha from Eyadawula.

Table 3.1 Distribution of sample households.

Sample Kebeles	**Agro ecology**	**Gote (Village)**	**No. of HHs**	**Sample HHs**			
				M	**F**	**Total**	
Worgaja	*Kolla*	*Aboye*	72	49	15	64	**115**
Eyadawula	*Dega*	*Wulha*	57	38	13	51	

Sample household Selection

Sample households for household survey were selected by using simple random sampling technique. There were 72 households in *Aboye gote* and 57 households in *Wulha*. It is triad to encompass all of the households in the village. Only 64 households from *Aboye* and 51 from *Wulha* were available at during the survey. Hence, about 90% of the household heads participated in the survey. Totally, 115 sample households were selected to fill the questionnaire.

Development Agents facilitate the process of filling the questioner as enumerators.

Sample selection for focus group discussion and interview

Participants in community group discussions selected using purposive sampling based on age and living for a long time in the area. Thus, it is held with a few knowledgeable elderly individuals of the communities. In both villages, one focus group discussion prepared and 8 persons participated in each. The participants were 3 female and five male in both villages.

key-informant interviewees were agriculture and rural development office officials, development agents and other experts, officials of supporting institutions and some persons who lived in that area before 25-30 years.

3.1.4 Methods of data analysis and interpretation

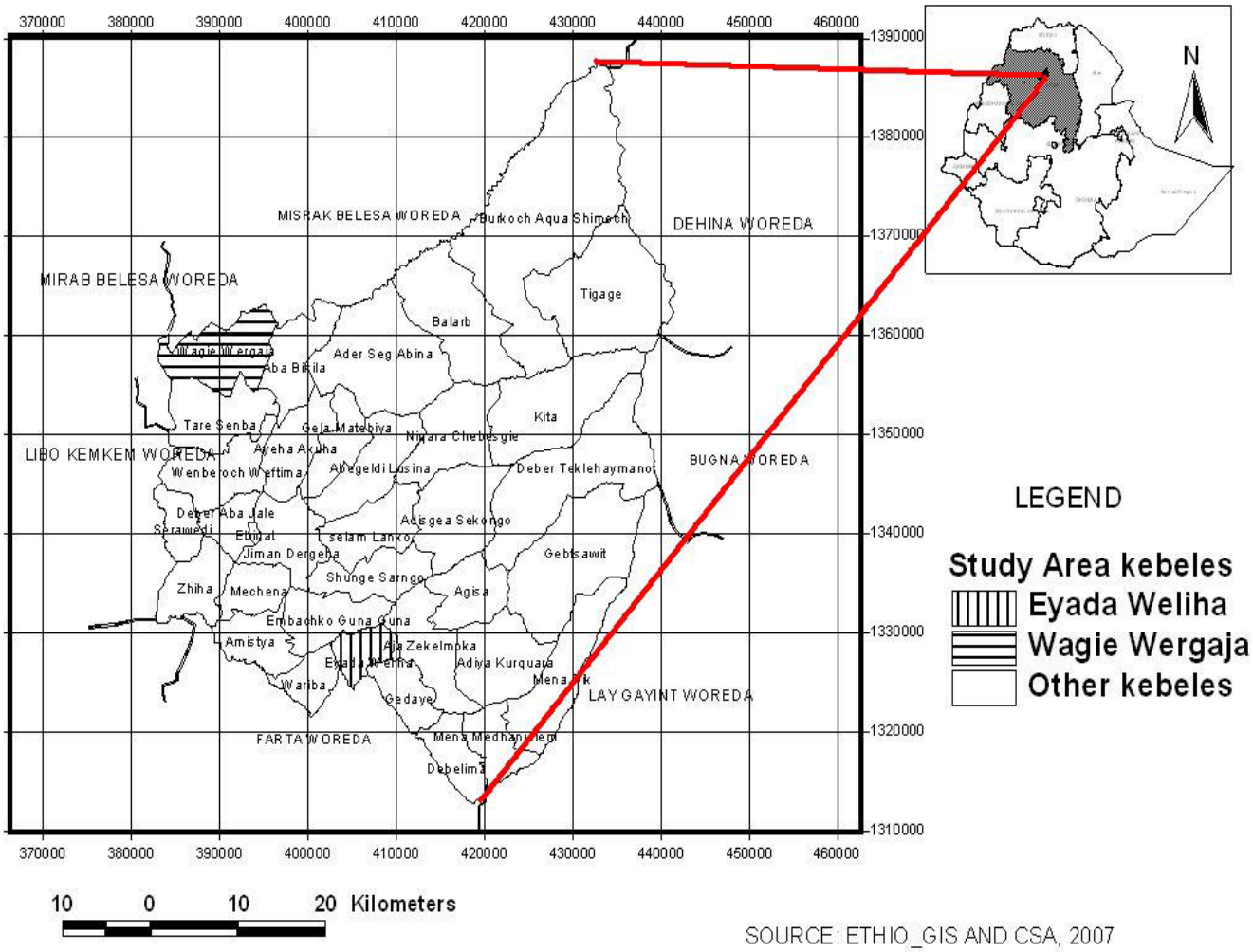
In order to answer the leading questions of this study, the collected data should be analyzed and interpret appropriately. To this end, data obtained from various sources were analyzed using qualitative and quantitative data analysis techniques. The qualitative information gathered using direct observation, focus group discussion, open-ended questions, and interview were analyzed and interpretated using qualitative techniques, whereas the quantitative data generated by questionnaire and meteorological data were analyzed using descriptive statistics such as frequency average, mode and by using graphs.

3.2. STUDY AREA DESCRIPTION

3.2.1 Location

Ebinat is located at a distance of 122 km from *Bahirdar*, the present capital of *Amhara* region and 109km away from the zonal capital *Debre Tabor*. *Ebinat* is one of the ten *woreda*s under south *Gonder* zone.

Figure 3.1 Map of Ebinat *Woreda*



It is bordered by north *Gonder* zone *Belesa Woreda* on the north, *Farta Woreda* on the south, north *Wollo Bugna woreda* and *Waghimra* zone *Dahina woreda* on the east *Lai Gaint woreda* and with *Libo Kemkem woreda* on the west. The *Woreda* covers a total land area of 2494.27sq. km.

3.2.2 Landscape and Agro-Ecology

Topographically, 45% of the *Woreda* is mountainous, 35% hilly, 15% plain and 5% is valley. Its altitude range is 1800-2150m above sea level. Similar to many place in the country Ebnat has, three agro-ecological zones with different degree of converge. Those are 50% kola, 35% *Weynadega* and 15% *Dega*.

Moreover, the average annual rainfall at present time is 500- 1300mm and the average minimum and maximum temperature is 23^0 and 30^0c respectively. (South Gondar zone information and communication office)

3.2.3 Land use pattern

Table 3.2 Description of land coverage

Description	**Area in** sq. km	**% from total area**
Total Area	249,427.0	
Total cultivable	169,784.1	68%
Grazing area	37,846.0	15%
Area Covered by forest	11,224.4	5%
Bush cover	5,509.8	2%
Water bodies	4,714.0	2%
Covered with housing & other infrastructures	20,348.8	8%

Source: *Ebnat Woreda report*

Based on the description on table 4.1, from the total area of the *Woreda* 68% is cultivable, 15% used for grazing, 5% forest covered,2% bush covered, 2% covered by water bodies and the remaining 8% is used to housing and infrastructure.

3.2.4 Demography and Structure

Ebinat woreda is structured with 37 *Kebele*s. Two of them are urban and the remaining 35 are rural. About 93% of the local people lived in rural areas. In the *Woreda*, there are about 25 governmental and 5 non-governmental bureaus which serve the community. The total population of the *Woreda* is 242,787 (Central Statistics Agency 2007) and of these 139,240 are male and 123,547 are female in the year 2007.

3.2.5 Infrastructure

There are two all season roads constructed in to two directions, from Addis Zemen-Ebnat-Belesa with 84 Km. There are also seasonal roads in 18 *Kebele*s that join different *Kebele*s and they are constructed by the participation of the community.

In terms of education there are two kindergartens, 35 elementary schools (Grade1-4), 45 full cycle elementary schools (Grade 1-8) distributed in the whole *Woreda*. In addition, there are two secondary school having grade 9 and grade 9-10 each, in sub *Kebele*s. Once more, in the capital of the *Woreda* there is one high school with preparatory and one other preparatory.

Amhara credit and saving association is the dominantly used credit and saving center in the *Woreda*.

Health wise there are 43 extension centers, 10 health centers, and 12 veterinary centers. There are 13 small markets around the offices of some *Kebele*s. The major market is at the *Woreda* town, Ebinat.

CHAPTER FOUR

4. RESULTS AND DISCUSSION

This chapter deals with the presentation of results of the collected data is and discussion. The result is divided into five sections. The first part describes the general demographic characteristics of the sample households. Then, climate change in the *woreda* generally observed by *woreda*s gradual trend of precipitation, the perception of the local people and observed climatic extremes. After that, the impacts of climate change on livelihood and health of the local people are discussed in relation to of biophysical vulnerability. Then, the adaptive capacity of the local people and their methods to cope with climate change is viewed with the eyes of socio-economic vulnerability. Finally, the major stressors that create *differential vulnerability* (Bohle *et al.* 1994) are discussed based on the result of the collected data.

4.1. General characteristics of the respondent households

In this part, the general profile of the respondent households is presented. This includes age, sex, marital status, educational status and number of dependants under each household.

Table 4.1 Age and sex composition of the sample households

Variables		Sample Keble				Total	
		Worgaja		*Eyadawula*			
		Freq.	%	Freq.	%	Freq.	%
Sex	Female	15	29.41	13	25	28	24.3
	Male	49	70.59	38	75	87	75.7
	Total	64	100%	51	100%	115	100%
Age	<30 (Young)	15	23.4	8	15.7	23	20
	30 – 45 (Adult)	38	59.4	30	58.8	68	59.1
	45 – 60 (Mature)	7	10.9	12	23.5	19	16.5
	> 60 (Old)	4	6.3	1	2	5	5.2
	Total	64	100%	51	100%	115	100%

(Survey, 2010)

As shown in the table 4.1 out of 115 sample households 64 of them from *Worgaja Keble*, which is Kola the remaining 51 of them, are from *Eyadawula,* which is *Dega*. From the total sample households 24.3% are females and 75.7% are male. Then as the sex composition of the samples from *Worgaja*, 29.41% were female and 70.59% male. In addition, from *Eyadawula Kebele* 25% female & 75% male-headed households were sampled. Accordingly, around ¾ of the sample household are male headed and only ¼ of the households are female headed. This shows that most of the households in the *Woreda* are male headed.

The age of the household heads is categorized in four stages; young, adult, mature and old aged. Based on this from the total households 20% are young, 59.1% are adult, 16.15% are mature and 4.3% are old aged. Hence, the majority of the sample households are in the category of adult that is 30-45 years old and this indicates that they are economically active and they know the area well. Secondly, the young generation holds 20% that is also active and new generation. The third category that has 16.15% of the households is in the age 45-60, which is a group of matured persons. Then only 4.3% of the households are above 60. This shows that most of the old aged persons are either dependent or live in problem.

Family structure

Among all respondents 60.9% are married, 16.5% widowed, 15.7% divorced, 5.2% single, and 1.7% are separated. When this is interpreted at *Kebele* level in *Worgaja* 64.1% are married, 17.2% widowed, 4.6% are single, 12.5 divorced and 1.6% separated. In case of Eyadawula *Kebele* 56.9% are married, 19.6% divorced, 15.6% widowed, 5.9% single and 2% are separated. This shows half of the respondents in both *Kebele*s are married, the number of widowed and divorced nearly the same but divorce is greater in Eyadawula and widowed is greater in *Worgaja*. The proportion of never married or single and separated is very few in both *Kebele*s.

Most of the females that headed houses are either widowed or divorced. In such a cases, they become responsible for all works inside and outside the house. They are taking care of children, fetching water, collecting firewood and cooking food. Therefore, impacts of climate change create additional burden on women and aggravates their vulnerability because of their low

adaptive capacity. This idea is also supported by the study on *impact of climate change on the livelihood and vulnerability of the people in west Arsi zone* by Abate (2009).

The number of permanent household members is one of the determinant factors in the livelihood of the household. According to the data, more than half of the sample households that are 56.5% have 4-8 family members and 25.2% have greater than 8. The small proportion of respondents, 18.3% have less than 4 members. This indicates that most of the households have large family size. As number of household members increases, the scarcely available food will be shared among many individual which would otherwise have been used for few individuals and satisfy their needs.

Table 4.2 Marital status and number of dependents of the respondents

Variables		Sample Keble				Total	
		Worgaja		*Eyadawula*			
		Freq.	%	Freq.	%	Freq.	%
Marital Status	Single	3	4.6	3	5.9	6	5.2
	Married	41	64.1	29	56.9	70	60.9
	Widowed	11	17.2	8	15.6	19	16.5
	Separated	1	1.6	1	2	2	1.7
	Divorced	8	12.5	10	19.6	18	15.7
	Total	64	100%	51	100%	115	100
Household Size	<4 (small)	10	15.6	11	21.6	21	18.3
	4-8 (medium)	41	64.1	24	47	65	56.5
	>8 (large)	13	20.3	16	31.4	29	25.2
	Total	64	100%	51	100%	115	100%

(Survey, 2010)

Educational status

As shown on table 4.3, from the total number of respondents 43.5% illiterate, 30.4% can read and write, 20% of them are categorized in grade 1-4, 5.2% are categorized in grade 5-8 and 0.9 %of them are above grade 8. Eyadawula *Kebele* has relatively better literacy rate. This shows that most of the HH of the Woreda are illiterate or able to read or write, only 1/5 of the total got an opportunity to learn elementary schools and very few of them can get to junior and high school.

Table 4.3 Educational status

Variables		Sample Keble				Total	
		Worgaja		*Eyadawula*			
		Freq.	%	Freq.	%	Freq.	%
Educational Status	Illiterate	35	54.7	15	29.4	50	43.5
	Read & Write	18	28.1	17	33.3	35	30.4
	Grade 1 - 4	10	15.6	13	25.5	23	20
	Grade 5 – 8	1	1.6	5	9.8	6	5.2
	Grade 9 – 12	0	0	1	2	1	0.9
	Total	64	100%	51	100%	115	100%

(Survey, 2010)

From this, it can be concluded that there is high illiteracy rate among local people of the "*Woreda*" especially among the adult and above aged people. Illiteracy has its own influence on adaptability specially, to accept new adaptation mechanisms.

4.2. Climate change in Ebinat woreda

As indicated in different literatures supported by evidences world climate is changing. In addition to this, different researchers proved that Ethiopian climate is changing. Still the rate of change differs within localities and it is difficult to conclude the change is equal in the whole Ethiopia. Therefore, in the section the climate change of the *woreda* will briefly assessed by perceived changes by the local people combined with metrological evidences.

4.2.1 Climate change as perceived by the local people

If climate change is happening, it has direct or indirect impact on life. The magnitude of its impact is high on the people that engaged on climate sensitive sectors like agriculture. Thus, those people can be familiar with the change in their day-to-day activities. In addition to this *It is important to have an insight of local peoples view on temperature and rainfall trends of change to dig out locally available climate change and variability adaptation options.(*Marye,2010)

Therefore, by having this understanding, the respondents were asked there feeling about the situation of rainfall, temperature and related issues.

According to survey, all most all of the respondents and the focus group from both *kebeles* discussion participants indicated that there is a change in duration of rainfall from the past two to three decades on wards. In addition, the respondents showed that the temperature is increasing. They mentioned some evidences as for the problems related with the change. Some of the occurrences related with climate change are stated in their order of severity in the table below.

Table 4.4 problems related with climate change

Indicators	***Worgaja***		***Eyadawula***	
	Freq.	%	**Freq.**	%
Shortage of rain	64	100	51	100
Increasing temperature	57	89	48	94.1
Flood	49	81.3	33	64.7
Epidemic disease	49	76.6	20	39.2
Drying of springs	41	64.1	20	39.2

(Survey, 2010)

As the above table indicates, shortage of rain is the major problem related with climate change that all respondents agreed. In addition, 89% of people from *Worgaja* and 94.1% from Eyadawula said there is temperature change and again 81.25%of *Worgaja* and 96% of Eyadawula respondents indicated that there is flood. Epidemic disease and drying of springs are also the other problems. Higher number of respondents from *Dega Woreda* perceived increasing temperature. In addition, epidemic disease and drying of springs is higher in kola *Woreda*.

Change in rainfall is one of the major indicators of climate change. In least developed countries rainfall and temperature, changes are the affect the life of farmers because of agriculture dependent livelihood. Therefore, living in rural areas, mostly farmers can explain the change in rainfall and temperature clearly. Accordingly, the entire households of *Ebinat woreda* agreed that

there is shortage of rain and appearing gradually. In addition, they perceived that the temperature increasing from time to time and became a cause to epidemic disease and drying of springs and drought. As mentioned on FGD the duration of rain is decreasing but the intensity is higher especially in kola areas. This results flood in some areas. Generally, this all imply that the society perceive the climate is changing.

4.2.2 Local climate pattern

The metrological station in the *woreda* is forth level, showing only rainfall pattern. Therefore, the data obtained from National Metrological Agency shows only the monthly distribution of rainfall of the years 1970-2005. Still, data from 1985 to 1996 is missing so only the available data is used to show the gradual trend. The change in temperature cannot be assessed because of lack of data.

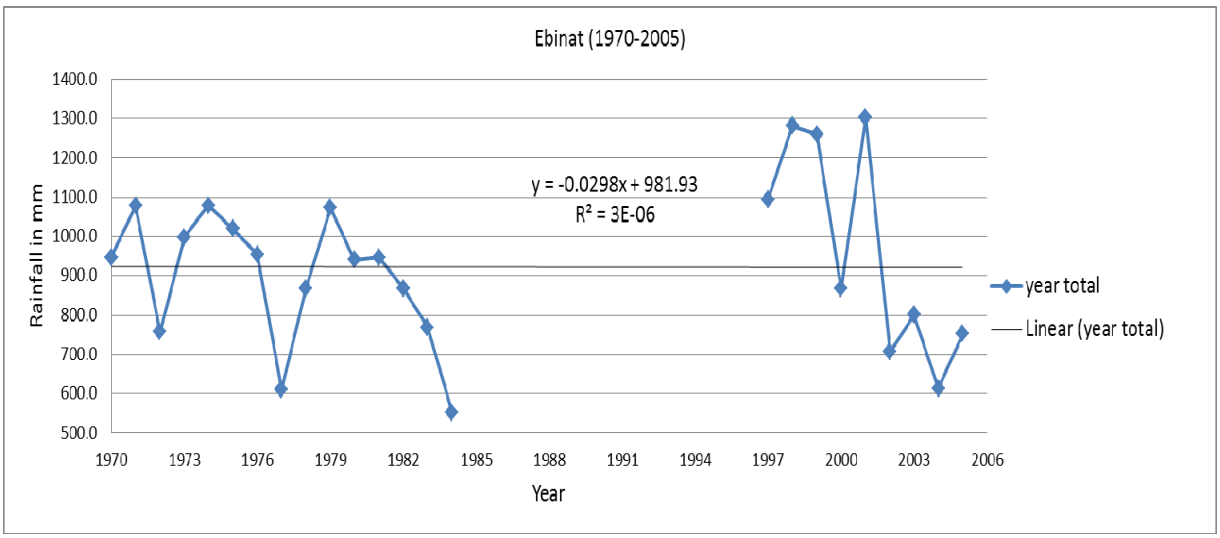
In addition, because of the location the metrological station is at the *woreda* capital, which is agro ecologically *Dega* the representative ness data especially to the *kolla* areas partial.

Annual rainfall trends

The average annual rainfall of *Ebinat woreda* ranges between the year 1970 and 2006 ranges from 550 to 1300mm. The mean annual rainfall of those years is about 920mm.

As shown on the figure 4.1 the rainfall shows high variability and erraticness over the past years. It is characterized by late onset and early cassation of *Meher* season, from July to September. This shortage of duration of rain is also indicated as major problem to crop production by the household heads. Analysis of linear trend of annual rainfall indicates slightly decreasing trend with approximately 0.03mm per year 0.3mm per decade within this years. The driest year was 1984, which is the minimum of all records and the wettest year was2001. Annual amounts were below the average in the years 1972, 1977, 1978, 1982, 1983, 1984, 2000, 2002, 2003, 2004, 2005. In the difference between these consecutive years are one or two years in most cases. This shows that the inter-annual rainfall is erratic.

Figure 4.1 Annual rainfall trend and variability of *Ebinat woreda*



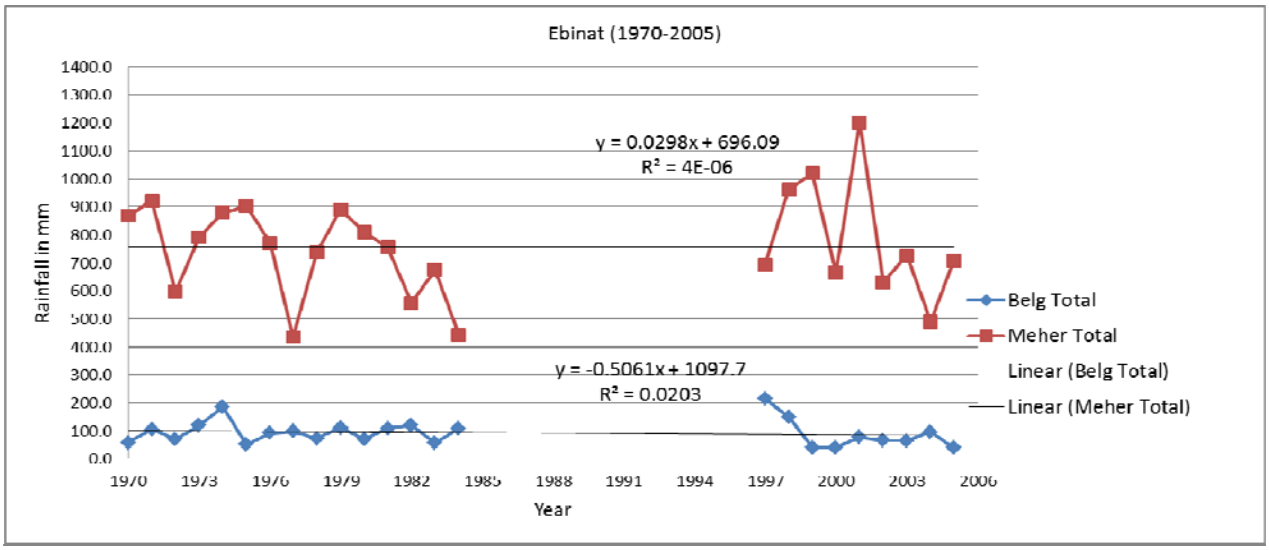
(*NMSA, 2010)*

These slight reduction amount and the high variability of rainfall brings difficult to predict the situation. This affect specially farmers whose life is depend on rain-feed agriculture. Therefore, the sum up of the perception of the people and the metrological data shows, the rainfall is slightly decreasing and highly variable.

Seasonal rainfall trend

There are two rainy seasons in most parts of Ethiopia. These are known as the small rainy season, *Belg (* February to May) and Main rainy season *Meher* (June to September). As shown on figure 4.2 the amount of *belg* rain is very low in the past there decades. In addition it showes a decreasing trend by 0.5 mm per year and 5 mm per decade in the years 1970 to 2006. In the same years, the *meher* rain also showed a slightly decreasing trend by 0.02mm per year or 0.2mm per decade. There for *Meher* is the main rainy season that the production all people depended in *Ebnat woreda.*However, as shown in the figure, the year-to-year variability of rainfall is becoming unpredictable.

Figure 4.2 seasonal rainfall trends



(NMSA, 2010)

4.2.3 Climate caused extremes

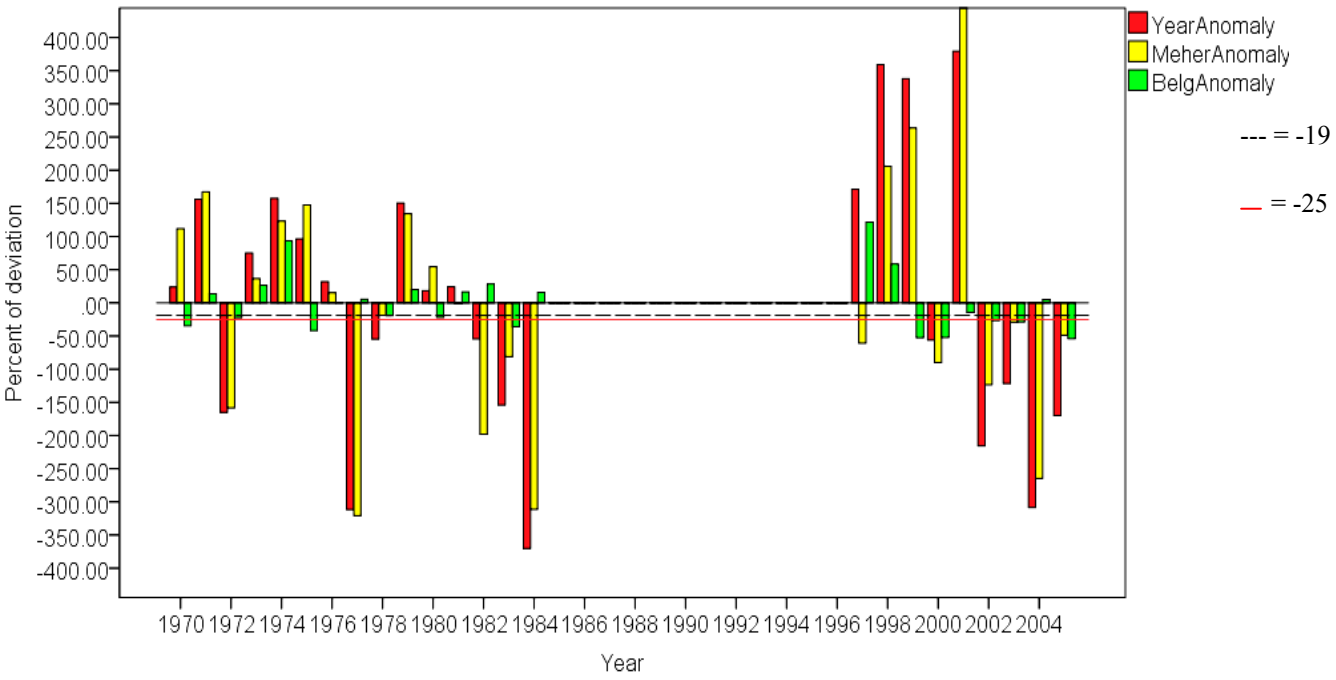
Climate change brings different problems that directly or indirectly affect the local people. These are food shortage, drought, and disease, decreasing productivity of the land, erosion and flood.

Drought

Drought is repeatedly appearing problem in *Ebinat woreda*. As elders from the area indicated the first severe drought occurred in 1950s. As the information from office of agriculture, after the drought appeared in most parts of Ethiopia from 1984-1986, the area become highly susceptible and unable to adapt such type of changes. *The year 1984/5, is the time where the harshest famine occurred in almost all parts of Ethiopia. The condition in the case of Northern Ethiopia was very much serious. As part of Northern Ethiopia, the people of Ebinat suffered much. Because of this, many have died due to hunger others who were capable fled from their locality (ORDA).* At that time many people died, some of them migrated, many cattle died and a highest lose took place in the area. Particularly since 1984 drought has repeatedly appeared in every 2-3 years and affects the life of the people. In the addition to this, 96% of the selected households confirmed that drought is serious problem.

Metrological drought years can be other evidences to show the years that drought occurred. According to the definition of National Meteorological Service Agency of Ethiopia (1996) defines drought by using rainfall anomaly (the percentage deviation of annual and seasonal rainfall from the mean). Based on this, drought occur over a region if the negative anomaly from the mean seasonal rainfall 19% or more. The result is also classified as, 19%-21% less drought, 21%-25 moderate ,and more than 25% sever.

Figure 4.3 Seasonal and yearly anomaly of rainfall



(NMSA, 2010)

The main crop production season in Ethiopia are *Meher* (June to September) and *Belg* (February to May). In different areas, the amount of rainfall received by this season is valid. As the data from NMSA indicates, the main season of harvest is *Meher.* While the *belg* rain cannot be used for crop production because it is very little in amount and. The participants in the FGD also support this idea. As their response they did not use the *Belg* rain to harvest before but the Mehar rain was begin early at around May and goes late.

As shown on figure 4.2 frequent drought appeared in the area. There are 12 severe drought occurred in *Meher* and 11 in *Belg*, in the periods 1970-1984 and 1996-2004. The year anomaly indicates the there are 11 severe drought occurred during this period. The total number of years with rainfall data are 31, therefore on average severe drought occurred in *Ebinat woreda* with every 2.8~3 years. Therefore, the data from the *woreda* office of agriculture and respondents is supported by the metrological drought frequently.

Deforestation is one of the factors that aggravate temperature change, rainfall fluctuation and drought. According the statistical records obtained from the *Woreda* office of agriculture, the general trend of the proportion of forest (vis-à-vis the total area of the *Woreda*) has been declining from 8% (maximum) in 1998 to as low as 3.25 % in both 2007 & 2008. Different factors were attributed to the decline of forest cover. These include population growth which triggered land clearance in search of agricultural land, land degradation in the form of soil erosion in arable, grazing as well as forest areas leaving many parts of the *Woreda* with big gullies. The 2008 report of ORDA shows that it can be said that it is just left with mainly bush, shrubs, and patches of sparsely arranged indigenous trees in few pocket areas. Farmlands have became bare this situation is facilitating the removal of the precious top soil from farmlands and other areas through erosion. Furthermore, from the response of the interviewees and FGD, deforestation and climate change are highly seen in the area.

A civil war between the *Derg* Regime and the opponents was conducted for many years in the area. This is one of the responsible factors for the environmental degradation.(interview)

4.2.4 Other problems related with climate change

As the response of the HHS food shortage is the most severe problem on their life system and 97%of respondents of *Worgaja* and 97%from *Eyadawula* agreed on it. The severity of this problem leads them to lift their hands to the donors. All of the respondent households are supported by safety net program.

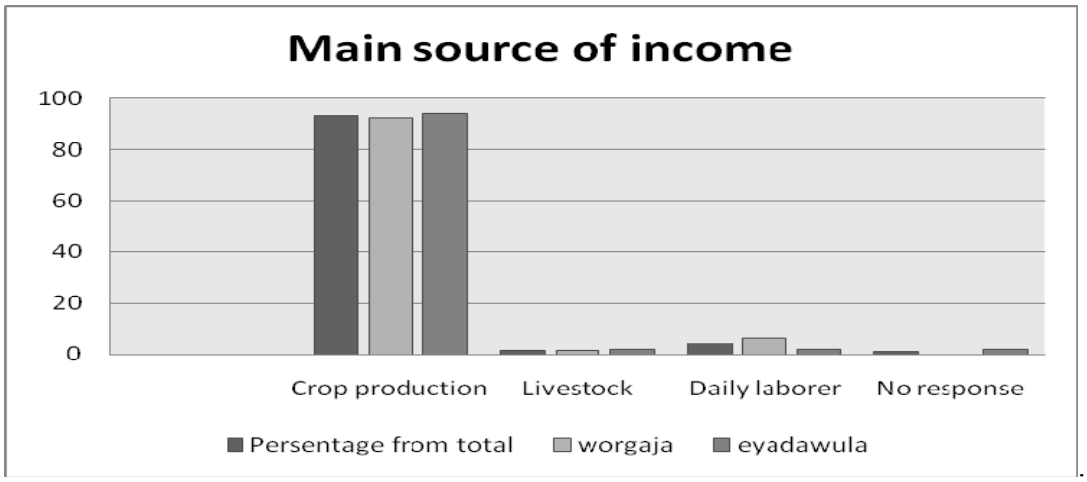
Another problem is decreasing productivity of land and erosion, the land is eroded because of high deforestation and flood so that productivity is declining. As observed even if some of the household's posses wider land, they cannot produce as much as expected because the land is highly degraded and loses its fertility. Disease is also the other problem that indirectly related with climate change and the next severe problem in this *woreda*. As discussed at the FGD in both *Kebeles* malaria and other diseases are occurring and increasing from year to year.

4.3. Impact of climate change on livelihood and health

4.3.1 Impact on livelihood of the local people

The term *Livelihood* in this study is to mean the *source of revenue*. Like in most of rural areas of Ethiopia, the source of income for most of the people in *Ebinat* is agriculture, mainly crop production. Around 93% of the local people are engaged in crop production as their main source of income. Daily laborer is around 4.3% of the total and animal husbandry 1.7%. Crop production is dominantly practiced in this area. Hence, environmental problems highly harm the livelihood.

Figure 4.4 Main source of income of the people in *Ebinat woreda*



(Survey, 2010)

Impact of climate change on agriculture

As indicated in previous sections the area is characterized by erratic rainfall and frequent drought. These shows that climate change is affecting crop production. To understand the extent of its impact the respondents mention the factors affecting crop production. During drought and delay in the onset of rain land becomes dry and difficult to plough, forage deficit leads to weakness and oxen mortality (engine of subsistent cultivation), and lack of precipitation hinders seed cultivation and germination of cultivated seeds. (Abate, 2009)

As indicated on figure 4.3 the main source of income for the local people is crop production. Therefore, the main factors that affect crop production in the *woreda* are assessed. These factors are classified in to three as Physical, economic and technological factors influencing crop cultivation.

Table 4.5 Factors affecting crop production by their order of severity

Factors		***Worgaja***		**Eyadawula**	
		Freq.	**%**	**Freq.**	**%**
Physical	1. Rain storage	64	100	51	100
	2. pest infection/crop	52	81	23	45
	3. Intense rain	29	45	24	47
Economic	4. Shortage of form land	28	43.75	21	41.1
	5. Luck of oxen	10	15.6	0	0
	6. luck agricultural imputes	7	10.9	4	7.8
Technology	7. Rudimentary farming method	2	3.15	0	0

(Survey, 2010)

Physical factors

As shown in table 4.5 most of the factors that influence crop production are physical factors. These include rain shortage, pest infection and heavy or intense rain. All the respondents in both *Kebeles* agreed that shortage of rain is the most severe problem that affects crop production.

Then, in *Worgaja,* pest infection is the next severe problem. However, this is not as much a problem in the *Dega kebele.*

This implies that shortening of rainy season and intense rain, which are the result of the changing climate are the major problems in the *woreda*s crop cultivation. The beginning and end of the summer is changing from year to year. As FGD before two and three decades, rainfall begins at around April and may ends at end of October and beginning of November. Now this situation is changed and the rainfall begins in July and ends in the half of September. Thus, the households support this idea. All of them indicate that since the past two decades the situation is worsened from time to time.

This situation is affecting crop production which most of the livelihoods of the people depends on. As the office of agriculture of the *Woreda* indicates, before three decades the area was known for its *teff* and honey production. In addition, barley, wheat, beans, peas, and sorghum were dominantly produced. However, at this time, because of the fluctuation of rainfall the farmers have been forced to change crop type. Hence, the types of crops produced at this time are early maturing *teff* (*Bubugn*), millet, and other early maturing crops (FGD). The amount of yield per household is also significantly decreasing from 50-60 quintals to 6-10 quintals during the past three decades. (Office of agriculture) Therefore, now days the average production of all type of crops per house hold is 4-6 quintals with six members of household averagely. While DPCC standard for per capita production is 180kg per person per year.

As ORDA state the situations in the *woreda*, on its report, rain fall pattern is disturbed and became very scares and erratic, the fertility of the soil especially those of the cultivated land has reached to the point where it cannot become productive.Due to these cases, shortage of food crops has occurred. As the result of the survey indicates, 96% of the people in *Worgaja* and 91%of peoples from *Eyadawula* are affected by shortage of food. As the information from Red Cross Ethiopia indicated, the area is chronically food insecure area. In addition, it is one of the areas supported by safety net program in Ethiopia.

On the other hand, intense rain is affecting the production in both *kebeles*. As indicated on (Abate 2009) the phonological stage of plant, soil type topography. The soil type in some areas of woragaja is sandy (office of agriculture) and so it is easily degraded because have low water logging capacity. In addition, most of the soil in *Eyadawula* is verity soil with having high water logging capacity. When there is heavy rain, the land may not prepare to cultivation. Therefore, intense rain affects this area highly.

The result of the study on climate change impact on livelihood, vulnerability and coping mechanism in west *Arsi* zone indicates the heavy rain affects land preparation, seed germination, and crop growth stunt and causes inundation of cultivated seed and land degradation. It also sticks when wet and cracks wet dry. Moreover, it is difficult for plough. Therefore, this impacts area affected the crop production of the *woreda* .

Pest infection is the other major problem in the *woreda* particularly in kola *kebeles*. The disturbance made on the ecosystem has forced the non-pest insects to become crop pests and transformed in to devastating agents of crop loss. The combined effect of these factors have resulted a sever crop yield reduction. Consequently, this has induced shortage of food crop and income and hence they became destitute. (ORDA, 2008)

Economical and technological factors

The other factors that influence crop production in the *woreda* were shortage of farmland, luck of oxen, luck of agricultural inputs and rudimentary farming method. Most of these are related to economical status of the local people. Therefore, households that face the problems such as shortage of oxen, farmland and inability to buy agricultural inputs are highly vulnerable to shortage of food crops. Technologically, the method that the farmers used influences the amount of the yield. These means as the method modified the yield increased and vice versa.

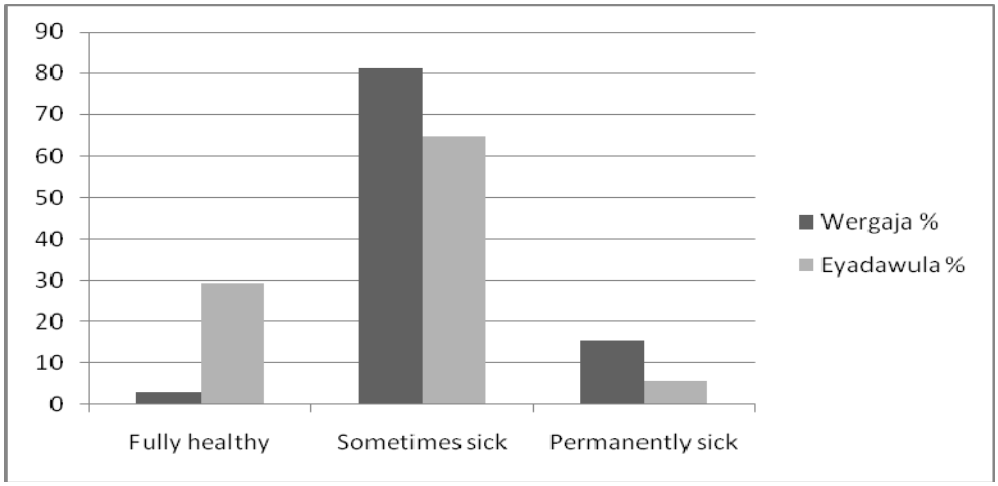
Generally, these all factors directly and indirectly aggravate the people's vulnerability to the impacts of climate change and variability.

4.3.2 Impact of climate change on health

Health status

Climate change has direct or indirect impact on health. In recent years, Climate change resulted in an increase in the frequency of occurrence of epidemic diseases like malaria. To have detail information, the respondent's health status is assessed as below.

Figure 4.5 Health status of HHs



(Survey, 2010)

As shown in Figure 4.4 only 3.1% of the respondent from *Worgaja* are fully healthy 81.3% sometimes sick and 15.6 % of them are permanently sick. In Eyadawula 29.4% of the total respondents are healthy 64.7% of them sometimes become sick and 5.9% permanently sick. Comparatively, most of the peoples from the *Kolla Kebele*, *Worgaja* are sometimes and permanently sick. Whereas, the percentage of fully healthy peoples are higher in Eyadawula. In the table below, the causes of repeatedly appeared diseases in the *Woreda* are stated.

As described in the table 4.6 95.3% of the people from *Worgaja* and 84.3% from Eyadawula ranked lack of nutrition as the major cause of disease in the area. Then in *Worgaja* environmental problems, sanitation problems and lack of proper medication are respectively ranked by having 62.5%, 54.7% and 37.5% agreement.

In addition, in Eyadawula lack of proper medication is the second cause for disease appeared in the *Woreda*. In addition, in Eyadawula lack of proper medication is the second cause for disease

appeared in the *Woreda* (41.2%), and then the environmental problems are ranked thirdly. (39.2%) and sanitation problems are the last reasons but not the least heavy 31.2%.

Table 4.6 Causes for repeatedly appeared disease in order of severity

No	**Causes**	***Worgaja***		**Eyadawula**	
		Freq.	**%**	**Freq.**	**%**
1	Lack of nutrition	61	95.3	43	84.3
2	Environmental problems (epidemic)	40	62.5	20	39.2
3	Sanitation problems (including water pollution)	35	54.7	21	31.2
4	Lack of proper medication	24	37.5	16	41.2

(Survey, 2010)

As the area is highly food in secured area the people are susceptible to nutritional problems that leads to disease. Most of the respondents in both *Kebele*s stated lack of nutritional as major factor. (Interview)

Diseases related with the nature, such as increasing temperature are mostly happened in the *Woreda* especially in *Kolla Kebele*s. This cause is directly resulting with the impact of climate change. From the information from the *Woreda*, in *Worgaja* malaria and flue are repeatedly happing as epidemic disease. Therefore, from this all in formations we can conclude that *Kolla Kebele* is highly exposed to such diseases and the exposure decreases with decreasing temperature. In addition, the respondents from *Dega woreda* indicates that malaria now a day it is becoming a problem.

The other reason is problem related with sanitation including water pollution. Pure water supply is not available in the area. Therefore, disease related with polluted water often happens in the area.

Lastly, problems related with lack of proper medication happened especially in Eyadawula. This can be related with the distance and availability of health center. As explained in the above

sections most of the respondents from Eyadawula stated that it takes 3-4 hours to get health center. In addition to the distance, there is a problem of road and transportation services. In this case, the people in Eyadawula are highly vulnerable to problems related with health even if the rate of the appearance of disease is lesser. Some people incline in going to areas having holly water than medication (FGD). Additionally, this lack of medication is related with the capacity to afford medicine. As observed, most of the farmers in the *Woreda* cannot afford medicines and choose to ignore the prescribed medicines due to lack of money and awareness.

4.4. Socio-economic features of the households and vulnerability

Since the impacts of climate change are affecting the environmental system and the livelihood of the local people, the area is biophysically vulnerable. In other words, the *woreda* is negatively sensitive to climate change impacts. Then, in this part, the socio-economic status of the local people is assessed to show the adaptive capacity of the society.

The adaptive capacity in this study includes economic conditions of the households, the situations of major infrastructures and the mechanisms that the local people used to adapt or cope with the changing climate.

4.4.1 Economic conditions of the local people

Income

Because of cultural problems getting information about income and number of children is difficult in Ethiopia. In order to this, to assess the economic status of the respondents, different related questions such as assets, land holding, livestock are asked.

The average monthly income of the households when calculated from the annual income is classified in to four based on the response from the HHs. These are very poor with less than 50birr per month, poor (50-100birr) per month, average (101-200birr) per month and relatively better (201-300 birr) per month.

Table 4.7 Average monthly income

Status	**Eyadawula**		***Worgaja***		**Total**	
	Freq.	**%**	**Freq.**	**%**	**Freq.**	**%**
<50 (Very poor)	13	25.5	10	15.6	23	20
50-100 (Poor)	22	43.1	44	68.75	66	57.39
100-200 (Average)	15	29.4	8	12.5	23	20
201-300 (Relatively better income)	1	2.0	6	9.37	3	2.6
Total	51	100	64	100	115	100

(Survey, 2010)

Based on this classification 20% the total households, 25.5% from *Eyadawula* and 15.6% from *Worgaja* get very low income and are extremely poor. The highest number of the respondents that is 57.39% of the total, 68.75% of *Worgaja* and 43.1% of *Eyadawula* are categorized as poor. Only 20% of total people, 29.4% of *Eyadawula* and 12.5% of *Worgaja* categorized as average income households. The households categorized in relatively better income are very few or insignificant compared to others that is only 2.6%.

Most of the people are in the category of poor and very poor. This indicates that they are highly needy and easily harmed by natural and anthropogenic problems. Above half of the households of the *Kolla Kebele* are poor and their percentage is higher than the *Dega*. The people from *Dega* have relatively higher average income or better income than *Kolla*. In general, as the information from the FGD the proportion of wealthy among the population has declined significantly, while the share of poor and very poor households has been increasing during the last three decades.

Assets

The assets can indicate the wealth of the household of the respondents. One of the major assets in this level is house. Therefore, the respondents estimate the cost of their house in birr as shown below:-

Table 4.8 Estimated cost of house per HH

Birr	***Worgaja***		**Eyadawula**	
	Freq	%	Freq	%
≤1000(low)	52	81.3	32	62.7
1001-3000 (moderate)	12	18.7	8	15.7
3001-5000 (high)	0	0	9	17.7
>5000 (very high)	0	0	2	3.9
Total	64	100	51	100

(Survey, 2010)

As shown on the table 4.6 from the respondents in *Worgaja Kebele* the highest percentage, 81.3% estimated their living and other house less than 1000 birr. Then 18.7% of houses are in the category of 1001-3000. In this *Kebele*, the minimum estimated cost is 100 while the maximum is 3000. Most of them estimated 900 birr. In *Eyadawula* 62.7% of the house of the HHs are estimated less than 1000 birr then 15.7% are 1001-3000 birr, 17.7 are 3001-5000 birr and 3.9% are estimated 2000-3000 birr , and above 5000 respectively. The minimum cost estimated in this *Kebele* is 300 birr and maximum 8000 birr. However, most of the estimators are 700 birr.

Depending on this information most of the house per household is estimated at less than 1000 birr, which is the least, categorize very cheap. Specially, in *Worgaja* the very highest number of the house are in this category and the minimum cost is 100 birr, which is extremely low. Whereas, in *Eyadawula* the minimum cost is relatively better 300 birr. This indicates that most of the house are very poor in quality and made from cheep materials. From this, it can be concluded that most of the people in the *Woreda* are very poor.

When the cost is compared with the two *Kebele*s, again the maximum cost is per household is 8000 birr in the *Dega*, *Kebele* whereas in *Kolla* it is 3000 birr. This range may show that there is a difference with in the *Kebele*s. Additionally, in *Worgaja* the maximum cost is categorized in average cost house. While, 21.6% of the houses in *Eyadawula* are estimated above moderate cost house which is relatively high, high and very high. From this, one can conclude that the houses in the *Dega Kebele* are better than the *Kolla*. Which means the people in the *Dega* have better assets and wealth than the *Kolla*.

Table 4.9 land holding of households

Items		*Worgaja*		*Eyadawula*	
		Freq.	%	**Freq.**	%
Do you have land?	Yes	50	78.1	43	84.3
	No	14	21.9	8	15.7
	Total	64	100	51	100
Number of plots per house hold	One plot	1	2	0	0
	Two plot	2	4	13	26.53
	Three plot	6	12	14	28.57
	Four plot	27	54	17	34.69
	Five plot	4	8	4	8.16
	Six plot	10	20	1	2.0
	Total	50	100	43	100

(Survey 2010)

Land holding and fertility

As shown in table 4.7 78.1% of respondents from *Worgaja* and 84.3% of respondents from *Eyadawula* have their own land of different size. However, 21.9% of respondents in *Worgaja* and 15.7% in *Eyadawula* are land less. The proportion of the land size in *Worgaja* is higher than *Eyadawula*. Most of people in *Kolla* have four and above plots rather than *Dega*, the high percentage is between two to four plots of land.

In addition, according to the rural socio economic survey report by BOFED (2004), the average land holding of a household in the *Woreda* is estimated to be 1.35 hectares. However, assuming that an average size of a household being 4.51 persons, the per capita landholding for arable land become only 0.30 ha.

According to the data obtained from the *Woreda* office of agriculture, the proportion of people with possession of less than 0.5 ha, between 0.51 & 1 ha, between 1.1 ha & 2.ha, and above 2.0 ha is respectively 12%, 43%, 30% and 14%.

Despite the fact that almost all of the farmers have their own farmland, most of it is not productive. When they answered for the question how many plots of land is productive, 57% of the land was not productive, and 36% moderately productive and 7% is productive. The document from office of agriculture of the *Woreda* states that land degradation in the form of soil erosion & gully formation is a major concern for declining productivity of arable land in the *Woreda*. In such conditions, land fragmentation may have appositive effect for the households. Hence, as the fragmentation increases the productivity may be better. However, this becomes true only if there is difference in fertility of the fragmented plots.

Livestock

Most of the households used livestock as the source of income in, addition to crop cultivation. In the Kola *Kebele Worgaja* 75% of the people have livestock and in *Dega Eyadawula* 90.2% have livestock. People who live in *Dega Kebele* more used livestock and its products as shown on table 4.10.

The types of the livestock found in the *Woreda* are Oxen, Cow, Sheep, Goat, Hen and Honey Bee. The proportion of these animals in both *Kebele*s in *Worgaja* from the entire farmers that have livestock 54.2% have Oxen, 65% Cow, 25% Sheep, 94% Goat 98% Hen and 4.2% Honey Bee. Most of the farmers have Hen and Goat.

Table 4.10 Description of the livestock

Item		Sample *Kebele*									
		Worgaja					*Eyadawula*				
		Freq.	**%**	**Min/ HH**	**Max/ HH**	**Mode**	**Freq.**	**%**	**Min/ HH**	**Max/ HH**	**Mode**
Do you have Livestock?	Yes	48	75	0	0	0	46	90.2	0	0	0
	No	16	25	0	0	0	5	9.8	0	0	0
	Total	64	100	0	0	0	51	100	0	0	0
Type of Livestock	Oxen	26	54.2	1	2	1	29	63	1	4	1
	Cow	31	65	1	2	1	40	87	1	4	2
	Sheep	12	25	1	5	3	26	56.5	1	4	4
	Goat	45	94	1	6	3	41	89	1	5	3
	Hen	47	98	1	6	4	46	100	1	6	4
	Honey Bee	2	4.2	1(hive)	1(hive)	0	1	2.2	0	2 (hive)	0

(Survey, 2010)

Despite most of them are engaged in crop cultivation and their farming system is traditional by using Oxen, above 48% of the households, have no their own Oxen. In addition to that, the Goat production is higher and increasing in the area that may relate with the desertification and one of the adaptations mechanisms.

As the information from FGD indicates before 25 and 30 years, the *woreda* was known for production of Honey but now because of deforestation and expanding population the production reached almost at zero level. In addition to this most of the farmers were highly engaged in Sheep raring than Goat, but now because of the increasing temperature and desertification they changed it in to Goat. In *Eyadawula*, which is the *Dega woreda* the number of livestock is greater than *Worgaja*. Which is 63% have Oxen, 87% Cow, 56.5% Sheep, 89.1% Goat 100% Hen and 2.2% Honey Bee. The percentage of Cow, Ox, Sheep and Hen is greater than the Kola *Kebele* but the *Worgaja* has greater Percentage of Goat and Bee. There is a difference among households in the number of animals. To this end the minimum, maximum and the frequent number or mode is shown on table 5.6. Regarding to this in *Worgaja Kebele* the maximum number of Oxen and Cow per person is two and the minimum is one, and most of them have only one Ox and one Cow. The minimum number of Goat and Sheep in one household is one

and maximum number of Sheep and Goat in most of the households is three Sheep and Goat in this *Kebele*. The livestock with the largest number and can easily be produced is Hen. Minimum and maximum number of Hen in one household is one and six respectively, and in most of the households, there are four Hens. Lastly, the Honey Bee, which is counted with, hives maximum two per household.

In *Eyadawula*, the maximum number of Oxen, Cow and Sheep per household is 4 and the minimum is one. In most households, there are one Ox, two Cows and four Sheep. The maximum number of Goat is five and mostly three Goats are found per household. The average number of Hens per household is four and maximum six, and in both cases the minimum is one.

In general, the number of livestock available in each household is very few compared to other potential areas in the *woreda* and it cannot give much support on the livelihood but it creates little difference between the households. There is better number of livestock in the *Dega* Woreda than the *Kolla*. Therefore, people in *Dega* are more capable than the *Kolla* to cope with different problems.

Income from Livestock

Since livestock is one of the additional income sources for most of the house holds its supportive capacity should be assessed. To this end, the data obtained from survey categorized in to five on table 4.8 From the households that have live stock in *Worgaja* 40% of them earned less than 150 birr, 42% between 151-250, 10.4% from 251-350 & 8.3% of them earn 351-450 birr per year, during the year 2002. Then, in *Eyadawula*, 33% of the total households who have live stock earned less than 150 birr, 37% earned between 151-250, 17.4% earned from 251-350 birr, 11% of them earned between 351 and 450 birr and 2.2 earned above 450 birr per year.

In both *Kebele*s, the highest percentage of income earned by households is less than 250 birr. When this is compared with the numbers households members. In most households, the income from livestock is not as much supportive.

Table 4.11 last year income from livestock per household

Item		*Wogaja*		*Eyadawula*	
		Freq.	**%**	**Freq.**	**%**
Your Last Year Income From Livestock	≤150	19	40	15	33
	151-250	20	42	17	38
	251-350	5	10.4	8	17.4
	351-450	4	8.3	5	11
	>450	0	0	1	2.2
	Total	48	100	46	100

(Survey, 2010)

When the income is compared within the two *Kebele*s, the income in the *Dega Kebele*, which is *Eyadawula*, is better than the *Kolla Kebele*. As the development agents indicates that even if there is better number of goats and hen in kola area, the hens are highly susceptible to disease because of high temperature.

4.4.2 Infrastructure

Poor Infrastructure is one of the factors that make the local people more susceptible to climate change. Infrastructure at this level focused on road, health service, pure water supply, market, information…Hence, from the data collected & observation in both *Kebele*s the level of Infrastructure is interpreted as below.

Road and market

Worgaja Keble is located at 25 km from the capital of the woreda, Ebinat. As the data obtained from both the households & development agents of the *Woreda*, there is a road that joins the *Kebele* with the surrounding *Kebele*s and with other *Woreda*s. In addition, it is located at the road from Ebinat to Belesa. This road is all weather roads & food transportation is accessible. So, they travel both on foot and by bus. The distance from the market takes 1-2 hours.

Worgaja Keble is located at 43 km from the *Woreda* town, Ebinat. Moreover, as the DAs explain there is no structured road to join the Keble with other *Kebele*s and with the capital of the *Woreda*. Besides this, the distance from the nearest market takes 5 hours at an average. The transportation is mostly on foot or by using draft animals.

However, in *Eyadawula* Keble there is no road. This means there is a difficulty in marketing their products unable to sell their products easily and unable to get goods and services as they want. In addition to that, it creates communication gap or lack of information about timely happenings. This includes metrological information, situation of markets etc… Moreover, most of the respondents reported that they cannot find sufficient food crops in the market and they cannot sell their products with reasonable price.

Most of the female headed households explained that they have a problem to go the market because of the distance and the uncomfortably of the road. So, that they choose to stay there to sell their products with cheap price and buy consumer products expensively. With such challenges, the local people especially female-headed households are more vulnerable to the problems related with climate change or unable to adapt with the changes.

Education and Health Services

Education can play a great role on the development of a country. Therefore, access to education can be one of the determinants of the vulnerability. This is also associated with access to get up to date information.

In *Worgaja*, there are two schools one elementary (grade1-4) and one junior secondary (1-8) schools. While in *Eyadawula*, there is one elementary (1-4) and junior secondary (1-6) school.

Health wise, in *Worgaja* there is one health extension, one health center and one animal's treatment center. It takes one hour to reach to health center for people from the villages which are very far.

Most of the respondents from *Eyadawula* said that the nearest health center looks three up to four hours on foot. Most of the people used holly water to be cured from the diseases. This is mostly because of the religious belief. On the other hand, some of them respond out that it is because of the long distance to get better medical care.

Water Supply

As the information from the sample households indicated that the local community used rivers, springs and hand pump to get water.

In *Worgaja* Keble, there are two rivers, 23 springs and 11 hand pumps. Most of the population used spring water to drink. In *Eyadawula Kebele*, there is 1 river, 9-hand pump and 17 springs.(office of agriculture) The water sources in number is greater in *Worgaja* and in both *Kebele*s the people use spring water to drink but most of springs are unprotected and exposed to pollution. In addition to this, it is decreasing in number from time to time because of drought. The amount of water in the rivers is also very little especially in winter time they almost dry. In both *Kebele*s, only the hand pump gives better service. These, all shows that the water resource sector is vulnerable to effects of climate change and in long time the area become highly susceptible to shortage of water.

Figure 4.6 Drying rivers

Information and communication

Most of the local people in both woredas used meetings as the source of information. Some of them used Radio and gathering information from other places like social meetings, coffee ceremony etc…

Energy source

All of the respondents in use firewood and dried animal dug as energy source for cooking and kerosene for lights. This shows two things spontaneously, firstly, as most of the rural areas in the country power supply are at poor stage. Therefore, especially females who engaged in preparing food are highly exposed to disease cause by smoke. The second things as firewood are the main source of energy it is highly related with deforestation. As indicated at FGD before some decades the area was covered with forest was high but now days the proportion of forest highly decreasing due to increasing population. The energy source of the local people has an effect on the changing climate.

4.4.3 Food insecurity as indicator of vulnerability of the households

Food insecurity can be an indicator of vulnerability of the area. If the income can't sufficiently feed household for the whole year, then the household is food insecure. That means its adaptive capacity is very low. In this case, the household become vulnerable to any risk such as climate variability and drought. As indicated on table 4.12, 93.8% of the respondents from *Worgaja* and 88% from *Eyadawula* stated that their income is not enough to sustain their family all year round. Only the rest 6.2% from *Worgaja* and 11.8% and *Eyadawula* can sustain them with their income the whole year. From this, one can understand that in almost all households, it is very difficult to pass the whole year by their own production. There is very little difference within the *kebeles*. The respondents from *Eyadawula* live relatively better life than *Worgaja*. As the information from both FGD and interview; peoples that have additional income source; other than agriculture can live better life than different than those fully dependant on agricultural practice.

Table 4.12 vulnerability to food insecurity

	Item		*Worgaja*		*Eyadawula*	
			Freq.	%	**Freq.**	%
1	Is your income enough to sustain your family all the year round?	Yes	4	6.2	6	11.8
		No	60	93.8	45	88.2
		Total	64	100	51	100
2	How was your income last year?	Best	0	0	0	0
		As usual	12	18.8	20	39.2
		Exceptionally low	52	81.2	31	60.8
		Total	64	100	51	100
3	For how many months you feed your family from your own products.	≤5(highly vulnerable)	11	17.2	9	17.8
		5-8 vulnerable	49	76.6	29	56.9
		9-12 (Relatively less vulnerable)	3	4.7	10	19.6
		>12(not vulnerable)	0	0	0	0
		No response	1	1.6	3	5.9
		Total	64	100	51	100

(Survey, 2010)

The other related question was for how many months they sufficiently feed their family from their own production. The answers are analyzed by grouping the whole year in to for groups. 11.2 % of the respondents from *Worgaja* and 17.6% from *Eyadawula* can feed their family from their production for four or less months in the whole year. Then 76.6% and 56 % from *Worgaja* and *Eyadawula* can sufficiently feed their family for 5-8 months. These are also poor because they need support to sustain. The next is the group of people who can feed their family from 9-12 months per year. Those are 4.9% from *Worgaja* and 19.6% from *Eyadawula*. In both *Kebele*s, nobody can feed his/her family for more than a year.

In the next category, that the majority of the households are categorized includes poor people that can feed their family for 5-8 months. This is relatively better than the very poor people, but still they cannot feed their family for more than 8 months in a year. This shows that they also lift their hands to donors for support.The percentage of peoples in this category is greater in *Worgaja* than *Eyadawula*. This means the people in *Worgaja* are highly vulnerable to food insecurity than

in *Eyadawula*. In addition, the percentage of people categorized as relatively better income group is higher in *Eyadawula*, which is around 20%, and in *Worgaja* only around 5%. The reason for high vulnerability of the people in *Worgaja* than in *Eyadawula* as development agents and focus group participants indicate is the high fluctuation of rain and fertility of soil the *Kolla Woreda* than the *Dega*.

As a result, the *Woreda* is highly vulnerable to food insecurity and the people live very poor standard life. As to recent evidence of income in the former year for 81% of *Worgaja* respondents and 60.8% of Eyadawula respondents was exceptionally low. In addition, around 15% percent of people in both *kebeles* are very poor that holds approximately 1/5 of the total number. From this, one can conclude that there are many poor peoples in the *Woreda*. The amounts the yield is very less and most be of them have large family. Therefore, the nature of the area, the land size and family size made them more vulnerable. (Interview and FGD).

In such cases ,as the rainfall variability is high, if one *meher* season failed almost all of the households are exposed to risks like famine. That can show the increasing vulnerability to the risk.

4.4.4 Copping and Adaptation Mechanisms

Since, climate change is a real phenomenon and affecting the entire world, people are working to minimize the influence by adapting and coping. However, the capacity differs from country to country, from region to region and even from *woreda* to *woreda*. This is because of the nature of the area and development. So far, in *Ebinat* as one of the exposed areas for climate change, there are different local and institutional adaptive and coping mechanisms.

Local Adaptation and Copping Strategies

Adaptation strategies are methods that the local people used to adjust themselves with the existing change. In order to this, the local people on the *Woreda* made different changes and adjustments in different sectors. These are changing crop type, changing livestock type, working additional works other than agriculture, using irrigation and planting trees.

Changing crop livestock type - Above 95% of the respondents are permanently living in the area and the remaining 5% live in the area for above 15 years. Therefore, they know well about the past and the present changes in the area. Before the past three decades, the area was productive in cereal crops and pulses but now because of fluctuation of rain, the crop types are changed from late maturing to early maturing. In addition to this the households who have livestock indicated that they are changing the type from Sheep and cattle to Goat and Hen. This is because of the expansion of desertification.

Using additional source of income-The other method that most of the local people used to adapt is working additional works other than crop cultivation and livestock raring. This includes shopping, daily laboring, selling *Tella* and *Caticalla*, weaving, carpeting, pottery etc

Above 80% of female headed households are engaged in selling *Tella* and *Caticalla*, in *Worgaja kebele* and 60% in *Eyadawula kebele*. In most of the male-headed households the HHH and the young sons, (if there is) work labor works such as making terrace. In addition to this, the young females of the households fetch water and doing labor works as maidservants for governmental officials and other persons who can pay for them. Shopping is another way to get additional income that very few proportions of the respondents use other works that some of the households inherited from their family like weaving, carpeting and poetry are supportive activities for increasing the capacity of the household.

Irrigation- The other and the supportive adaptive mechanism that employed in the whole country is irrigation but in this *woreda*, it is not as much effective. Only 10% of the total population from *Worgaja* and in 6% from *Eyadawula* used irrigation. The reason for not using irrigation of above 85% is luck of water or land nearer to rivers, lack of capital to use modern irrigation method and lack of awareness about the use and methods of irrigation.

According to the households that are using irrigation the reason that push them to begin to use irrigation are to adapt with the fluctuation of rain to cultivate twice a year and to produce high yield.In most cases the reasons that make the local people to work additional work is decreasing

income from agriculture and it is not enough to sustain. A few percentage of them are used this jobs as a main source of income because they have no land.

However, not this all mechanisms are enough to the local people to sustain and adapt with the changing climate. Therefore, they used additional coping mechanisms that can give immediate response for their current needs.

Coping Mechanisms

The major coping mechanism that the local people where using for decades is food aid. This aid is from governmental and nongovernmental organizations. Because the area is repeatedly damaged by drought, it is supported by different governmental and nongovernmental organizations at different times. During the wide occurrence of drought throughout the country, There were different organizations such as World Vision, ORDA (organization for Rehabilitation and Relief Organization), ERRS (Ethiopian Relief and Rehabilitation Commission). From this, some of them phased-out and left as the drought decreased. However, some of them are still working in the area, like Safety net program, and Red Cross organizations are supporting the local people. Almost all of the *Kebele*s are included under safety net program. These, organizations give support to the local people in the form of food for work. As shown in the table 4.13, 96.9% of the people in *Worgaja* used aid from organizations as the major coping mechanism. In the same way, 82.8% from *Worgaja* and 76.5% from *Eyadawula* used aid from relatives as the second choice.

As shown in the table 4.13, 96.9% of the people in *Worgaja* used aid from organizations as the major coping mechanism. In the same way, 82.8% from *Worgaja* and 76.5% from *Eyadawula* used aid from relatives as the second choice.

The other mechanism, which 81.5% from kola and 66.7% from *Dega* used, is borrowing money or grain. In extreme cases, some of the households choose to migrate seasonally to other places and selling their fixed assets. However, these mechanisms cannot bring sustainable change

because they focus on immediate response. As most of the households, indicate that, their life is highly subsistent.

Table 4.13 Coping mechanisms

Mechanisms	***Worgaja***		**Eyadawula**	
	Freq.	**%**	**Freq.**	**%**
1. aid from organizations	62	96.9	46	90.2
2. aid from relatives	53	82.8	39	76.5
3. borrow money or grain	52	81.5	34	66.7
4. seasonal migration	15	23.4	8	15.7
5. selling fixed assets	4	6.2	2	3.9

(Survey, 2010)

Generally, most of the times in the woreda have low level of income, cheep assets limited number of livestock and mostly infertile fragmented land. These all result high sensitively of the live hood of the local people to risks and hazards. in addition the infrastructure, especially in the *kebles* found very far from capital of the woreda and the main road are affected by different problems related with lack of infrastructure such as, lack of a proper medication , information, difficult to sell their food crops etc…

The other indictor that show the low level of adaptive capacity is the coping and adaptation strategy that the local people used. In this case, the local people have their strategies to response to change like other people. However, the response of the people is not as mush strong and it cannot save them from being vulnerable. The rate of vulnerability differs within different in the community. From this all, the assignment socio economic vulnerability results the people are highly vulnerability to those impacts induced by climate change.

4.5 Who is the most vulnerable?

It is concluded that the *Woreda* is vulnerable to the impacts of climate change. But still there is a difference on the capacity to adaptive those impacts among the households. Therefore, some socio economic indicators are selected to expose who the most vulnerable is. In this study wealth (income, physical assets, and livestock), family size and sex are chosen to assess the rate of vulnerability. In order to this, the poor people, with low income, low cost of assets, no oxen, no land & livestock, and large family size are chosen as most vulnerable group.

Those, indicators are divided in to two groups based on their weight or their contribution to the local people vulnerability. These are high-level indicators and medium level indicators of vulnerability. This is based on the content of the situation of the *Woreda*. Thus, monthly income , family size, availability of land availability of oxen are high level indicators of vulnerability and house hold head (female, old),cost of houses, livestock, additional source of income and infrastructure are medium level indicators of vulnerability.

Table 4.14 Most vulnerable groups

vulnerable group	large family size	land less	Very poor	no ox	female headed house	Old HHH	low cost of assets	no livestock	no additional source of income
Kolla	20.3	21.9	15.6	45.8	29.4	6.3	81.3	25	28.1
Dega	29	15.7	15.5	37	25	5	62.7	9.8	37.2
Average	25.2	18.8	20	52.2	24.3	5.2	73	17.4	32.2

(Survey, 2010)

As shown in the table 4.14 on average 25.2% of the respondent from both *Kebele*s have large family size, 18.8% are land less, 20% are very poor & 52.2% of them have o ox. These are the highly vulnerable groups to climate shocks. In addition 24.3% are female headed, 5.2% have old aged house hold headed, 73% of them have cheep houses,17.4% have no live stock, 32.2% are defend on only crop production. Therefore, this all are highly vulnerable to climate change.

Poor

As all participants of FGD are suggested and as it is clear for everyone, economically poor people are the first vulnerable bodies. The average monthly income, physical assets and availability of additional income source determine the wealth of the household in this study. Hence, 15.6% of respondents from kola and 25.5% from *Dega* earn less than 50 birr per month. Then the estimated cost of residential and other houses of 82.3% respondents from kola and 62.7% from *Dega* less than 1000 birr. In addition, 25% respondents from kola xx 37.2% from *Dega* have no additional source of income. Therefore, most of this is categorized as poor.

Poor people's have very low capabilities to respond to the impact of climate change or have low adaptive capacity. Specially, those who do not have additional source of income any livestock with large family size are the most vulnerable ones. These are because they cannot afford the consuming costs with only crop production in the fluctuating rainfall.

Large family size

Large family size independently is not average for vulnerability but it is directly related with the income of the household. As table 5.3 77.4% of the total population is categorized as poor. Therefore, vulnerability of the local people can be directly proportional to the family size. Among the total respondents, 25.2% are characterized by extended families. Therefore, this is highly vulnerable groups in the *Woreda*.

Availability of land and ox

As crop production is the major source of income, availability of land and ox are the backbone of the household's life. However, unfortunately, 8.8% of the respondents are land less and 53.3% of them have no their own ox to plough. This may be due to population increase and lack of income or subsistent living style of the local people. Therefore, this people are grouped as the most vulnerable HHs in the *woreda*s.

Female and old

Traditionally women are dependent on income generated by men and they do not engage in plugging and other activities that need strength. However, in case of death of the husband and divorce the women takes all responsibility of taking care of household. Specially, if she is land less & have many dependants, the situation become difficult and she face socio-economic pains of the situations. Therefore, in most cases female needed households are more vulnerable than male headed households.

The same is happened in the house with old aged household head. If the household head become very old & if there is no elder to support, the household will vulnerable to lack of labor.

Poor infrastructure

These situations are aggravated by poor infrastructure such as road, health service, pure water supply, energy, education etc. If the infrastructure of the area is very poor vulnerability is increased. Therefore, because of the distance from the capital of the *Woreda Eyadawula* has relatively very poor infrastructure. Thus, this area is vulnerable in terms of infrastructure.

CHAPTER FIVE

5. SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

This part deals with brief summary of the data analysis and interpretation in order to make the data manageable.

From the whole respondents ¾ males and ¼ were females. Most of them were at economically active age i.e. 30-45. Above half are married with medium family size. There is high illiteracy rate especially among the adults.

Erratic rainfall is a major environmental problem in the area and then temperature change, frequent drought, flood, epidemic disease and drying of springs are pointed out as climate related problems. Rainfall shows slightly decreasing tread. These affects crop production, which 93% of the population engaged in. Shortage of rain, pest infection, intended rain, shortage farmland stated as the impact of climate change related with crop production. Lack of nutrition, environmental problems (epidemic diseases) and lack of proper medications are the major reasons are for disease happened in the *Woreda*. The occurrence of Malaria is increasing over time.

Economically 20% of the entire population is extremely poor and most of the others are in poor category. The income in Eyadawula (*Dega*) is better than the *Worgaja* (*Kolla*).Assets in terms of house quality is better in Eyadawula. Average land holding per households is 1.35 hectares. However, most of the land is infertile. Income from livestock is not as much sufficient but it's relatively better in Eyadawula. Infrastructures are relatively better in *Worgaja* than *Eyadawula*.

Adaptation mechanisms in those areas are doing additional works, irrigation, and livestock rearing, changing crop type etc…Borrowing many or grains, seasonal migration, receiving aid, selling fixed assets are the major coping strategies in this area.

The area is highly food insecure. Most of them cannot sustain the whole years with their own production. Poor, large family, landless, HHs without ox and female and old headed households are the most vulnerable groups in the population.

As a result, in the area the most dominant source of income (crop production) is highly sensitive sector. In addition, there is high deforestation rate, which cause increasing temperature and deceasing rain fall. Then, this leads to frequent drought, flood & epidemics. The rate of degradation in the area is increased. Therefore, the combine effect of these factors makes the Woreda vulnerable to the impacts of climate change. The rate if vulnerability is high due to the climate sensitive sector, exposure to change the temperature and change in rainfall, frequent drought that leads to food insecurity and low adaptive capacity

Generally, dependent livelihood on climate sensitive sector, rainfall fluctuation, increasing temperature, deforestation, drought and epidemic disease shows the area is exposed and sensitive. On the other hand, low adaptive capacity characterized with low income, high illiteracy rate, large family size, lack of sufficient information, poor infrastructure, small land size infertile land are exacerbating the societal vulnerability. Food insecurity is major indicator that shows the susceptibility of the area.

5.2 Conclusion

The result of the study shows that the amount and duration of rainfall in Ebinat Woreda is declining and the variability is increasing. These are affecting the livelihood of the local people which is highly dependent on rain-fed agriculture. In addition, climatic extremes particularly frequent drought becomes the major problem in the area in the recent decades. The repeatedly happed drought reduces the adaptive capacity of the local people and leads them to lift their hands to donors. Because of these, the society gradually develops the spirit of receiving aid rather than struggling to adapt with the change.

On the other hand, adaptive capacity of the local people is very low in terms of wealth, infrastructure, and adaptation mechanisms. The current adaptation mechanisms that the local people used are also not sufficient and still it cannot support the local people to sustain their life without external aids. This all show shows that vulnerability of the local people to the adverse impacts is worsening both socio economically and biophysically.

The vulnerability is exaggerated in *Kolla Kebeles* where the biophysical influences are high in addition of socioeconomic factors. Other variables like poorness, landlessness or having infertile land, large family size, lack of ox and the like increased the vulnerability of households among the society.

The different governmental and non-governmental organizations has played significant role in reducing the vulnerability of the local people. However, the mechanisms they used are mostly emergency aid than preventive adaptive measures.

5.3 Recommendations

Based on the results some measures should be taken to enhance the adaptive capacity of the local people. Moreover, the coping and adaptation strategies need additional work. To this end, some possible ideas are recommended in this section.

Environmental rehabilitations - Rehabilitating the environment by using different mechanisms like afforestation, protecting water sources, protecting the soil from erosion. Also changing the land use in degraded areas.

Awareness creation - Creating and expanding awareness to the local people and policy makers about the causes and impacts of climate change by providing reliable and up to-to-date information, to decrease the rate of deforestation and erosion and to take appropriate adaptive measures.

Focusing on adaptation strategies - focusing on preventive adaptation strategies can bring sustainable development in the area. Therefore, the policy makers should focus on modifying and supporting the indigenous adaptation practices and studying to adopt effective strategies. In this case, irrigation should livestock production have given much attention because they are effective and already using methods by some farmers.

Diversifying resources- diversified resource base is used to minimize the risk due to harvest failure. This can be through growing varieties many different crops and, livestock. Change in crop varieties and species is also the other method already used and need to be improved

Diversifying income sources – to cope with the changing climate the sources of income should be diversified other than depending on crop production. This is used to minimize exposure to climate variability and change shocks. So the society should be encouraged to take part in off-farm activities such as petty-trading, engaged with handcraft are important

Building up the capacity of the community- building the capacity is necessary in such areas whose adaptive capacity is very low. Specially, it is significant for those categorized as most vulnerable by different activities such as:

- providing effective level of fertilizer with reasonable price
- promoting sustainable cropping practices
- training effective livestock production ways
- facilitating credit associations,
- creating employment opportunities and the like
- supporting and modifying current adaptation and coping strategies
- Improving road transport, market and storage & distribution infrastructure, extension services

Finally, further studies should be conducted which specifically address the adaptation mechanisms to better guide policy options that lead to sustainability.

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APPENDIX I

Questionnaires for house hold survey

Date of questionnaire filled_____

Dear respondents, I am Rediet Tsegaye and I am a student in Addis Ababa university geography and environmental studies department. The main objective of this questionnaire is to get first hand information on the extent of **vulnerability** to climate change and variability and the local coping strategies in your Wereda, for thesis as a partial fulfillment of MA in climate change and human adaptation.

The information from respondents will keep confidential and will not affect any body in any way. So you are kindly requested to give your honest opinion.

Thank you in advance!

Socio economic and demographic aspects of local households

1. Sex of the household head
   1. Male 2. Female
2. Age of the household head in years_____
3. Marital status
   1. Married 2. Single 3. Widowed 4. Divorced 5. separated
4. Number of children (if you have)
   Male_____ female_____
5. Number of permanent household members including the household head
   Male_____ Female_____

6. Educational status of the household

   1. Illiterate 2. Read/write 3.grade _____

7. What as highest level of education among your family members?

   _____

8. How much money you earn per month (approximately)? _____

Livelihoods of the household

9. What is the main source of income for the household? (Multiple answers could be given)

   1. Crop production 2. Cattle rearing 3. Weaving 4. Carpeting 5. Daily laborer

   6. Other (specify)_____

10. If crop production, what are the main factors that adversely affect it? (Multiple answers could be given)

    1. Rain shortage 2.Too much rain 3.pestinfestion (crop disease) 4.Shortag of farm land 5. Luck of agricultural inputs 6.lack of labor 7.Rudimentary farming method 8.Shortage or lack of oxen 9.other (specify)_____

11. Is your income enough to sustain your family all the year round? (Enumerators please make sure that not only for food consumption)

    1. Enough 2.more than enough 3.not enough

12. If not enough, what do you do to supplement it and sustain your family?

    1. Borrow money or grain 2.move to other places (migrate) 3. Sell fixed assets 4. Sell livestock 5. Other (specify)_____

13. How do you see your income last year (2002 E.C)

    1. Best 2.As usual for most of the year 3. Exceptionally low

14. Do you have land of your own? 1. Yes 2. No

15. If yes how big? Put it in hectare _____

16. Do you own livestock? 1.Yes 2.No

17. If yes how many of the following do you have?

Type	Oxen	Cow	Sheep	Goats	Hen	Honey Bee
No.						

18. How much you earn the sales of such products in the year 2002?

_____

19. In how many plots your land is fragmented? _____

20. How many of them are fertile?

Very fertile	
Moderately fertile	
Less fertile	

21. If infertile or poor, what do you think the reason is?

1. Erosion 2. Intensive cultivation 3.soil type 4.other (specify)_____

Perception and vulnerability

22. Are you vulnerable to such problems like economic shocks, health, price fluctuations….?

1. Yes 2.No

23. If yes, which one of the following affects your life? (Please put in order of severity)

1. Drought 3.price fluctuations for agricultural products
2. Food inadequacy 4.disese 5. Flood
6. Shortage of water supply 7. Other (specify)_____

24. Which of the following environmental problems are very common? (please put in order of severity)

1. Soil erosion 2.deforestation 3. Climate variability
4.land degradation 5. Water pollution 6. Other (specify)_____

25. Have you heard about the issue of climate change? 1. Yes 2. No

26. What problem have you observed due to changing climate? (Multiple answers are possible)

1. Fluctuation of rainfall 2 Increased temperature. 3. more flooding

4.disease incidence such as malaria 5.deforestation 6.drying up of water streams 7.other (specify)_____

27. Did you notice any variability in Rainfall pattern onset and cessation in your area since EPRDF come to power? 1.Yes 2.No

28. If yes what happened to it more commonly?

1. Comes early and goes late 2. comes late and goes late 3.comes late and goes early

29. In such conditions, for how many months do you feed your family from your own produce? (without receiving any external aid) _____

30. Which of the following the bulk of your income goes?

1. Food 2. Clothing 3.schooling 4. Medicine

5. Social obligation 6. Loan repayment 7. other (specify)_____

31. What is your (household head) health status?

1. Fully healthy 2. Have prominent sickness

3. Sometimes/occasionally become sick

32. What are the causes of disease in your family mostly? (please put in order of severity)

1. Nutritional problems 2. Sanitation 3.inadqute medication 4. Environmental problems 5. other (specify)_____

33. Where do you go when you or someone in your family is sick?

1.to clinic or health centre 2.Hospital 3.Tsebel

4.no where 5.other (specify)_____

34. How far is the nearest modern health center? (it is possible to put in hour to walk)_____

35. Do they household get sufficient water in the whole years? 1.Yes 2.No

36. From where do the household get water? (Multiple answers are possible)

1. River 2. Protected spring 3.unprotected spring

4. Hand dug well 5 Pipeline 6. Pond 7. Dams 8. Open walls 9. Other (specify) _____

37. How far is the nearest market from your village? (it is possible to put in hour to walk)_____

38. Are food crops available in the market you go to all the year?

1. Yes 2. No

39. Is the market large to sell your crop production?

1. Yes 2. No

40. What is the means of transportation you use? _____

41. Did u face shortage of food?

1. Yes 2. No

42. What means you used to overcome the shortage of food?_____

43. What did you use for power supply?

1. Fire Wood 2. Animal Waste 3. Kerosene 4. Electric Power

44. Which of the following Medias you use to get information?

1. Radio 2. Television 3. News paper 4.Other (specify)_____

45. Estimate your residential and other houses value in birr_____

Adaptive and Copping strategies

46. Do you think it is possible to avert or adapt to the impacts of climate change by action in your locality? 1. Yes 2. No

47. What local actins do you think possible in your capacity

1. Afforestation

2. Doing additional non-farm activities

3. Agricultural practiced such as terracing

4. Irrigation

5. Using renewable energy source 6. Other (specify)_____

48. Do you use irrigation? 1. Yes 2. No

49. If yes, when did you start using irrigation?_____

50. If no, what is the reason?

1. Shortage of water 2.cultural practices 3.financial problem 4.luck of awareness 5.oter(specify)_____

51. Why did you start using irrigation?

1. To cultivate two times a year
2. To overcome shortage of rain water
3. Because of other developmental organization forced you to do it.
4. Because it the culture inherited from my parents

52. Do you have non-farm or of farm income sources?

1. Yes 2.No

53. If yes mention_____

54. When did you start this work?_____

55. Why you are doing this work?

1. To get a better income by doing par time.
2. Because the income yield from agriculture is few.
3. Because it is a trained inherited from family
4. To pay a credit
5. Because no farm land or shortage of farm land
6. Other (specify)_____

56. For how many time you have been here?_____

57. Did u make a change to the crop type that you cultivate before?

1. Yes 2. No

58. If yes what did you cultivate before?_____ Now?_____

59. Why did u change the type of crop that you cultivate?
    1. Because of the change in rain water
    2. Because the changed crop price is good in market
    3. Governmental or other developmental organizations forced to do it
    4. Because of increased temperature
    5. Other (specify)_____

60. How do you try to cope with some of your problems related to your vulnerability?
    1. Through aid
    2. Through social works (like equb, senbte…)
    3. Through seasonal movement to other places
    4. Remittance from relatives
    5. Through loan
    6. Other (specify) _____

61. In your household either anyone other than the HHH that help the family by his own income?
    1. Yes 2. No

62. If yes how many are they in number?_____

63. What type of works they do?_____

Institutional issues

64. In times of crises like drought and food shortage who helps you best? (Please put in order)
    1. Relatives/friends 3.NGOs 2. The government
    4. Traditional associations 5. Cooperatives 6.other (specify)_____

65. Are you the member of credit unions? 1. Yes 2. No

66. If yes, what benefit you get from it? _____

67. Do you think government services are adequate in minimizing your vulnerability and diversifying your livelihood? Yes/no(please explain your answer)

_____

_____

_____

_____

68. What type of aid does the government or other institutions gives to you? 1. Suppluing agricultural in puts 2.giving money 3. Food aid 4.facilitating additional job opportunity 5.showing different adaptation mechanisms 6. Other(specify)_____

69. For how long, did these institutions give aid? 1. Less than five years 3.**10-15** years 2.**5 -10** ten years 4.above **15** years

Thank you very much!

APPENDIX II

Cheek list for focus group discussion

1. How was the vegetation cover in past years?
2. Is there change in to and rainfall pattern? Why do you think this might be?
3. Have you heard of climate change? What do you know?
4. Do you think climate change is something affecting or is going to affect you, personally or as a community? What are the impacts on the environment, farming system, health, economy…?
5. Do you think anything to tackle climate change? Who should have the main responsibility to do this?
6. What is the role of traditional institutions in coping the problem?
7. Does it differently affect various resource groups' poor, medium, reach? How?
8. How is the existing natural capital (in terms of land, forest, water erosion protection, wild resource etc?
9. Have there been climatic extremes (drought and flooding) in the past 20 years? how many times? Which type of climatic shock is your main concern?
10. What are the major constraints you have that hinders your coping mechanisms?

APPENDIX III

Cheek list for key informant interview

1. Name _____
2. Position/profession _____
3. Is there any form of climate change in the kebeles? If yes, please can you explain?
4. What is the impact of climate change and variability on the livelihood of the people there?
5. Who is more vulnerable to the impacts? Why?
6. What are the local coping mechanisms used to reduce the impacts?
7. What is the institutions effort to reduce future impacts?
8. What are the main challenges and how do you think they can be improved