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**Pastoralists and Agro-Pastoralists Vulnerability to Climate change
and Adaptation Response: The Case of Aysaita Woreda, Afar
Regional State, Northern Ethiopia**

BY

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This is to certify that the thesis prepared by Hassen Ali entitled the *Pastoralists and Agro-Pastoralists Vulnerability to Climate change and Adaptation Response Aysaita Woreda, Afar region, northern Ethiopia* and submitted in partial fulfillment of the Requirement for the Degree of Master of Art in Geography and Environmental Studies compiles with regulation of the university.

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Abstract

This study was conducted in Aysaita woreda, Afar Regional State of Ethiopia with the objective assessing pastoralists and agro pastoralists vulnerability to climate change and adaptation response in Aysaita woreda. The study was conducted in two rural kebeles of Galifage and Barga kebele. purposive sampling was used to select the study area and stratified sampling were also used by categorizing agro ecology and wealth status group. After strata simple random sampling was used to select 153 respondents in the study areas. In addition, 1 FGD in each kebele were made which have 7 members in the group comprising the elderly people men and women, rich people men and women, medium people men and women, poor men and women, model farmers and adult. The data were collected from primary data were selected from interview, FGD, observation, while secondary data were selected from project report and information at woreda level The key informant interview with resourceful 50 farmers and 4 development agent persons were conducted. The key informant interview included experienced people and community elders, including men and women also included woreda experts and kebele leaders. Suitable word and descriptive statistics were employed to analyze the data. The result shows according to participant in the study area most of pastoral and agro pastoralist community perceived as temperature increased and decreased rainfall in their locality. The pastoralist in the study area is vulnerable and the cause of vulnerability in the study area like; drought, flood, shortage of water, governmental intervention. And this has led pastoralist to adverse impacts on the study area like: human and livestock loss, prosopis juliflora, deforestation, environmental degradation and famine, migration were the major impact in the study areas. Different local adaptation and coping mechanism like; mobility, fodder management, diversifying livestock and crops, selling of fuel wood and charcoal, change meal size, sharing risk, polygamy marriage, Handicrafts activities were used. hinders to do not make them their coping mechanism thus; limited access, lack of agricultural input support from GOs and NGOs, limited access and poverty are the major hinder in the study area. Based on the findings the following recommendations are forwarded: developing farmers' awareness on how to managed their natural resources, introduce agricultural technologies & inputs, facilitating access to credit services, diversifying source of income, set backing of prosopis juliflora expansion, empowering women, controlling of Awash river.

Key word: Climate Change, Vulnerability, Impact, Adaptation, Coping strategies.

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Acronyms

ARDO	Agricultural Rural Development Office
CSA	Central Statistical Agency of Ethiopia
CCPP	Contagious Caprine Pleuropneumonia
DA	Development Agent
DRMFSS	Disaster Risk Management and Food Security Sector
EPA	Environmental protection Authority
EPRDF	Ethiopian People Revolutionary Democratic Front
FAO	Food and Agricultural Organization
FGD	Focal Group Discussion
GHG	Green House Gas
HH	Household
IPCC	Intergovernmental Panel on Climate Change
KII	key Informant Interview
M.a.s.l	Meter above sea level
MoARD	Ministry of Agriculture and Rural Development
MoFED	Ministry of Finance and Economic Development
NAPA	Adaptation program of Action of Ethiopia
NGO	Non-Governmental Organization
NMA	National Metrological Agency
SSA	Sub-Sahara Africa
UNCED	United Nations Conference on Environment and Development
UNFCCC	United Nations Framework Convention on Climate Change
UNDP	Unite nation development program
USAID	United States Agency for International Development
WMO	World Metrological Organization

CHAPTER ONE

1. INTRODUCTION

1.1. Background

There has been a growing consensus that, climate change is one of the major environmental threats facing the world today. Climate change refers to a permanent shift in the state of climate mechanism manifested by changes in the mean and/or the variability of its properties persisting for an extended period of time, usually decades or longer. It happened whether due to natural variability or as a result of human activity (IPCC, 2007). The majority common sign of climate change and variability are changes and variability in temperature and precipitation in addition to occurrences of extreme climatic events especially drought, flooding sea level rise and storms (hurricanes, tornado, typhoons etc.). Empirical studies have confirmed that, climate change poses direct negative impacts on agriculture, livelihood assets, water resources, nutrition and health status of people (Henson, 2006; IPCC, 2007; Boko et al., 2007).

The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report of 2007 gives realistic evidence that climate change is ongoing and it is event now; that it will become bad and that the poorest in developing countries and most vulnerable people will be the worst affected. In many parts of the world, vulnerability and adaptation practice to climate change is a subject that is receiving significant attention. The reason for such attention include rising crop yield to meet the need of the increasing human population for food, ecological problems, biomass energy, fibers and timber, and scarcity of forest products (Montagnini,2001).

The horns of African countries are the most vulnerable people to climate change, because of the low adaptive capacity of the African population. This low adaptive capacity is owing to the extreme poverty situation of various Africans, recurrent natural disasters such as floods, droughts, and agriculture, which are critically dependent on rainfall. The main impacts of climate change are on food security and agriculture, the water resource, human health, natural resource management and biodiversity (Huq, et al., 2003). It has become common facts that the poor people are likely to be strike hardest by climate change, and their potential to answer to climate

change is lowest in the developing countries and along with the poorest people in those countries (Olmos, 2001).

Ethiopia is commonly to be vulnerable to climate change because of its low adaptive capacity, the geographic coverage and difficulty, the low income capacity, and dependence on climate sensitive to economic sectors predominantly agriculture and pastoralist. The livelihoods of millions of people in the country are seriously dependent on climate. The impact of climate change in Ethiopia is highly manifested because of agriculture is likely to play a key role in ensuring food security and the country's economy's (Aklilu & Dereje, 2010).

The climate situation of the pastoral lands in Ethiopia is characterized by restricted absolute rainfall which falls unpredictably and within short rainy seasons, and which is often of slight availability for the human use. The high temperatures in rainy seasons make certain that much of the rainfall is lost in evaporation, and exhaustive rainfall results in floods. Arid and semi-arid areas that provide as the source basis for the livestock production system recognized as pastoral production system in Ethiopia are facing enormous threat (Kassahun et al., 2008). The Afar Pastoral societies live in arid and semi-arid environments where the climate change is believed to increase the likelihood of increase in the occurrence and intensity of droughts and floods. The level and nature of their experience is often believed to be different from those communities living in diverse agricultural systems, which frequently remain the central focus and policy priority areas of national governments. The Pastoralist communities are generally expected to be amongst the most affected groups, and therefore will need access to resources and services that help them cope with coming catastrophic shocks, protect their livelihood assets and increase their resilience (Birch and Grahn, 2015).

Thus, Aysaita woreda are highly vulnerable to the effects of climate change, as well as the impacts happened in the woreda. understanding farmers' responses to climatic change is crucial, as this will help in designing appropriate coping and adaptation strategies to climate change. Therefore, the researcher was interested to assess pastoralists and agro-pastoralists vulnerability to climate change and adaptation response Aysaita woreda, Afar Regional State, Northern Ethiopia.

1.2. Statement of the problem

The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report of 2007 gives convincing evidence that climate change is increasingly recognized as a serious challenge to environmental health, human well-being and future development (IPCC, 2007). It is one of the most challenges of humanity, affecting both current and future generations. African countries are one of the most vulnerable continents to climate change which is manifested in the short term by climate variability. A condition forced by the interaction of multiple stresses in the form of weather uncertainties or unpredictable seasons, the constant climatic abnormalities which is resulting drought and floods, extensive environmental degradation and prominent food insecurity occurring at different levels, and low adaptive capacity to the impacts of these climatic related events (Boko et al., 2007).

In Ethiopia also the change with climate elements are being increasingly fact as a serious issue to be addressed in order to conquer the equitable and sustainable development. The country experiences major climate variability and frequent extremes, both of them are estimated to increase as climate change becomes more evident. In the rural areas, high levels of poverty and heavy dependence on the natural resource-based livelihoods along with other factors yield high vulnerability to the impacts of climate change and it is faced with increasing uncertainty and the climate extremes. (Dazé, 2011).

Afar is one of the regions known by pastoralist and agro pastoralist in the country. The region is one of the surplus livestock producing areas of the country and characterized by arid and semi-arid climatic condition where it is highly inclined to vulnerability of climate change as compare to the other areas. The afar pastoralist and agro pastoralist society has used their indigenous knowledge to solve their problem of vulnerability to climate change for centuries by making Pastorals migrate from place to place to search feed and water for their animals to survive them from recurrent drought. On the other hand, some indicators justify that the potential of the region for the livestock production; occurrence of diversified inherent resources of animals adaptable to the harsh environmental condition, the high interest of people towards livestock production, the huge areas of rangelands and proximity of the area to export routes (Care Ethiopia, 2014).

According to disaster risk management and food security sector, (2014) report identified that Aysaita Woreda is mostly affected by flood and livestock diseases, drought, human diseases and crop diseases are also extra hazards that households face in the woreda. Water pollution, spread of *Prosopis juliflora*, deforestation and soil erosion are major environmental problems that are faced in Aysaita Woreda.

Flooding is in effect due to overflow of Awash River is indicated as the major hazard that households face every year mainly in the western part of the woreda. It mainly happens in August causing damage on crop and grazing land and the migration of household members. It also enhances the incidence of water borne disease. Malaria is the major health problems for households in Aysaita Woreda followed by Diarrhea. *Prosopis juliflora* has become the major problem in the woreda by invading grazing land and crop land which is difficult for households to remove it. It is reported that *Prosopis juliflora* is expanding to new areas due to flooding and animal feces (DRMFSS, 2014).

In addition, the Livestock productivity suffers from lack of water and fodder, leading to low prices for animals that are sold. This identify that impacts cause food shortages and reduced the household incomes (ANRS, 2010). On the other hand, The Livestock diseases are the main reasons for declining number of livestock. Livestock production and agricultural activities in the area depends on rain fed natural grazing land whose productivity is declining as a result of recurrent drought, land degradation, encroachment of agriculture, conflict, the scarcity of water and the invasion of weeds. The feed produced following the main rain season will last only two to three months and pastoralists are forced to migrate early (Joanne et al., 2005).

The Aysaita woreda pastoralists groups have experienced droughts and other shocks like flood since time immemorial. Recently, the severity of drought has increased its magnitude that it is now becoming difficult for the pastoralists to reconstitute sufficient herd size to help them. The failure of rainfall or delayed rains, chronic water shortages, livestock diseases and pests and herb infestation, human diseases like malaria and water borne diseases are the key vulnerabilities due to the climate change in Aysaita woreda.

Hence, the pastoralist communities have their own traditional adaptive strategies to overcome the above mentioned challenges. Through time the pastoralists have developed their own coping and adaptive strategies that can greatly contribute to managing the climate change.

Therefore, the main purpose of this study was to focus on the pastoralist's and agro pastoralist's vulnerability to climate change and adaptation response in Aysaita woreda.

1.3. Objectives of the Study

1.3.1. General objectives

The general objective of the study is to assess pastoralist's and agro pastoralist's vulnerability to climate change and adaptation response in Aysaita woreda.

1.3.2. Specific objectives

- To analyze the vulnerability of the community to climate change
- To evaluate the impact of climate change on the community
- To assess the adaptation strategies of the community
- To document the challenges in adaptation to climate change

1.4. Research Questions

1. What makes the pastoral and agro pastoral household community in Aysaita Woreda more vulnerable to climate change in the study area?
2. What are the impacts of climate change on pastoral and agro pastoral households in the Aysaita Woreda?
3. What kinds of adaptation strategies have been employed to cope up with climate change in both pastoral and agro pastoral households Aysaita Woreda?
4. What Challenges are identified to hinder with adaptation mechanisms?

1.5. Significance of the Study

As it is evidently clarified in numerous literatures, the vulnerability and adaptation to climate change in pastoral and agro pastoral areas of Afar region has been given little attention. As a result, there is a severe impact from frequently recurring drought and flood on pastoral and agro

pastoral areas. Hence, the result which will be generated by this study will have a paramount importance in improving efforts geared towards reducing the vulnerability and enhancing their adaptation mechanisms to climate change impacts. The finding will serve as an input for various governmental and non-governmental development organizations working on reducing vulnerability of pastoral and agro pastoral communities from the adverse impacts of climate change and fill gap. Furthermore, based on the findings it will be possible to devise interventions which adequately reach all vulnerable communities. Moreover, it can encourage further research and study by other researchers, development practitioners and local development actors.

1.6. Scope of the Study

The study focused on afar region of Aysaita woreda as the area is drought prone. Within Aysaita The study was conducted in a small geographical area particularly only in two kebeles namely Barga and Galifage from pastoral and agro pastoral areas considering the prevalence of the problem and its scope is limited to the assessment pastoralist and agro pastoralist vulnerability to climate change and adaptation response. The study could have been much more interesting had it been possible to include more kebeles from Aysaita woreda and beyond. However, for practical reasons such as budget and time constraints.

1.7. Limitations of the Study

Limitations that encountered the researcher while conducting this research are lack of time and financial limitations, unwillingness of some respondents to fill questionnaires and give responses to tell the right information, participation in FGD, lack of organized data from the Woredas Agro pastoral and rural development offices and lack of sufficient reviews literature written in the study area. The other limitation of the study is that there is a missing data from three four months in a year were the major limitation challenges faced during the study.

1.8 . Organization of the Thesis

This thesis is organized in to five chapters. Chapter one constituted the introduction, which focuses mainly on the background, statement of the problem, objectives, research questions, significance, and scope of the study and limitation of the study. Chapter two deals with reviews of different literatures related to vulnerability and adaptation strategies to climate. Chapter three contains description of the study area and research methodology. Chapter four contains disaggregated analysis of pastoral and agro-pastoral encompassing perception, vulnerability, impact and adaptation mechanisms. The final chapters' deals with recommendation and conclusion.

CHAPTER TWO

2. Literature Review

2.1 Theoretical framework

2.1.1 Climate Change and Variability

Climate change refers to a change in the state of the climate that can be recognized by the changes in the mean and/ or the variability of its properties, and that continues for an extended period of time, normally can takes decades or longer. It refers to any change in the climate over time, whether due to natural process or as a result of human process (IPCC, 2007). Climate change is one of the most persistent problems of our time. There has been a major rise in greenhouse gas(GHG) emissions, such as carbon dioxide, methane, nitrous oxide, etc., from the time when the industrial revolution. This increasing of emission has led to increase in the concentration of GHG in atmosphere and consequently a rise in radiative forcing. Over the 20th century, the increase in global average surface temperature has been of 0.6 ± 0.2 (IPCC, 2007). Changes in climate happen as a result of both internal inconsistencies within the climate system and external factors (both natural and anthropogenic) independent of the climate system. The effect of external factors on climate can be largely compared to using the concepts of radiative forcing activities. The positive radiative forcing, such as that produced by rising concentrations of GHG or black carbon, inclines to warm the surface. Whereas negative radiative forcing, which can be raise from an increasing in some types of aerosols (e.g., surplus) inclines to cool the surface (IPCC, 2007).

The Natural factors such as changes in solar output or volatile volcanic activity can also cause radiative forcing. The IPCC TAR projected that global mean temperature will rise between 1.4 and 5.8°C over the period 1990 to 2100. For the same set of scenarios, global mean sea level increase was projected to rise by 0.09 to 0.88 meters between 1990 and 2100. Precipitation is also projected to during 21st century, but there are regional differences. Available observational proof indicated that current regional changes in climate, mostly raise in temperature, have already affected a different set of physical and biological system in many parts of the world (IPCC, 2001).

Climate variability: according to (IPCC, 2001) reports the differences in the mean state and other statistics (such as standard deviations, the incidence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. On the other hand, Variability may be happened due to natural internal processes within the climate system (internal variability), or to differences in natural or anthropogenic external forcing (external variability) (IPCC, 2001).

2.1.2 Vulnerability to Climate Change

Vulnerability to climate change refers to the amount of harm that would result from a particular dangerous event of climate on society over exact place and time. As a result, IPCC, (2001) report defines climate vulnerability as it is the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, as well as climate variability and extremes. Although, it depends not only on a system's sensitivity but it's also on adaptive capacity (IPCC, 2001). Fussel (2007) and Fussel and Klein (2006) argued that the IPCC (2001) definition, which is conceptualizes the vulnerability to climate as a function of adaptive capacity, sensitivity, and exposure, accommodates the integrated approach to vulnerability analysis. The African continents are more vulnerable to effects of climate change. As a result of global warming, the climate in Africa is estimated to become more erratic, and extreme weather events are likely to be more recurrent and harsh, with increasing risk to health and life. Arid and semi-arid regions are the major areas to be vulnerable especially in Western and eastern part of the continent. This includes increasing risk of drought and flooding in new areas and stream due to sea-level increase in the continent's coastal areas (Mironer, 2009). Vulnerability has three elements: Exposure, Sensitivity and Adaptive capacity. According to IPCC (2001), exposure is defined as the, "degree of climate stress upon an exact unit of analysis; it may be represented as either long-term changes in climate conditions, or by changes in climate variability, as well as the extent and frequency of extreme events". While *Sensitivity is* defined as, the degree to which a system is affected, either harmfully or usefully, by climate-related stimuli Olmens (2001).

2.1.3 Adaptation to Climate change

Adaptation refers to the adjustments in natural or human systems in reaction to actual or expected climatic stimuli or their effects, which moderates damage or exploits beneficial opportunities.

(IPCC, 2007). Adaptation to climate change has various typologies and the most common classification are between autonomous versus planned adaptation.

Autonomous versus planned adaptation

Adaptation answers can be considered by the level of ownership of the adaptation measure or strategy. The individual level or autonomous also adaptations are considered to be those that take place in the response to climatic stimuli (after indicator of initial impact), that is, as a matter of course and without the directed interference of any public agency (Smit and Pilifosova, 2001). Autonomous adaptations are broadly interpreted to be creativities by private performers rather than by the governments, typically caused by market or welfare changes persuaded by actual or anticipated climate change (Leary, 1999).

Whereas Policy-driven or planned adaptation is often taken as being the result of a thoughtful policy decision on the part of a public agency, based on an awareness that environments are about to change or have changed, and that action is said to be essential to minimize losses or benefit from opportunities (Pittock and Jones, 2000). Thus, autonomous and policy-driven adaptation largely agrees to private and public adaptation, respectively (Smit and Pilifosova, 2001). Private adaptations are those assumed only for the exclusive benefit of the individual decision maker. The acceptance of various measures will be determined purely by self-interest and underlying welfare- maximizing objectives (including profit maximization, output maximization, and forward) (Mendelsohn, 2006). Although the public adaptations are those accept by the government. In Public adaptation the owner and organizer of adaptation interferences is government not the individual (Kurukulasuriya and Rosenthal, 2003).

As understood in the previous section, autonomous adaptation answers will be assessed by individual farmers in the terms of costs and benefits. It is expected that farmers will adapt “proficiently”, and that markets alone can encourage efficient adaptation in dealt agricultural goods (Mendelsohn, 2006). However, in situations where market failures exist, such as the lack of information on climate change or land tenure insecurity, climate change will further decrease the capacity of individual farmers to manage risk effectively. Moreover, the answers at the individual level incline to be costly to poor producers and often create excessive burdens. As a result, suitable balance between public sector efforts and incentives, such as capacity building,

creation of risk insurance and private investment, needs to be hit so that the burden can shift away from poor producers.

2.2 Conceptual Framework of The study

This study is intended to assess the vulnerability and adaptation strategies to climate change in pastoral and agro pastoral household. Hence the conceptual frame work to guide this research is associated with the IPCC definition of vulnerability (2001) and the integrated assessment approached discussed above. According to IPCC (2001), vulnerability the degree to which a system is susceptible, or unable to cope with adverse effects of climate change, including climate variability and extremes, and vulnerability is the function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity. This is as depicted in the diagram below:

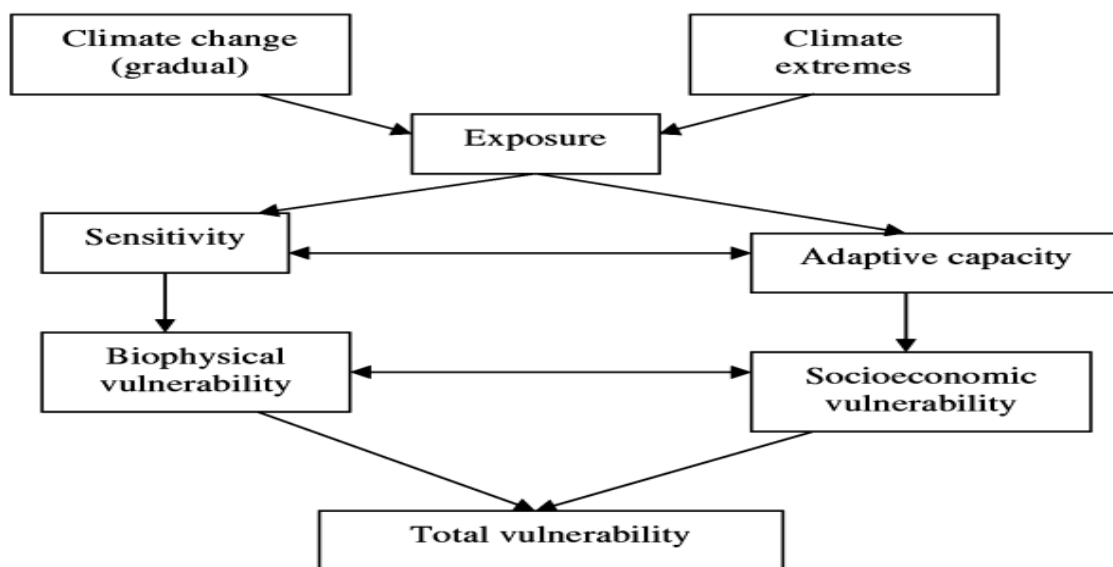


Figure 1 Conceptual frame work of vulnerability

Source Adopted from Deressa et, al. (2008)

The components of the diagram clearly show the association of the various variable of study that are related to the vulnerability and adaptation situations of pastorals in the study area. In this study, climate change and variability are the major concepts addressed and it was hypothesized that, pastorals in the study area faces climate change which is designated by gradual changes in

temperature and precipitation trends. Hence, analysis of temperature and rainfall trends over the last 30 years is crucial. In addition to the climate change, there is variability and occurrences of extreme weather events and this is represented in this study by the analysis of drought occurrence, flood and temporal variability of some weather elements.

Prevalence of climate change and variability in the study area leads to exposure of pastoralists to impacts of climate change. For a given pastoralist to be vulnerable to climate change, he/she has to be exposed to either climate change in the first place. However, the level of pastoralist vulnerability to climate change is not the function of exposure only, rather is depending on the level of the pastoralists sensitivity and adaptive capacity. The more sensitive a pastoralist is, the more vulnerable to climate change and vice versa. In this study, sensitivity refers to the nature of the physical environment in which pastoralists live and function. Hence, biophysical variables of the study area are assessed to come up with findings that indicate the level of pastoralists sensitivity. Contrary to sensitivity, adaptive capacity is more of socio-economic aspect of the pastoralists in the study area and the higher the adaptive capacity of pastoralists, the lower their vulnerability to climate change and variability. Adaptive capacity in this study represents access of pastoralists to basic services and the level of pastoralist's ownership of key assets. The higher the access and the wealthier the pastoralist in terms of assets, the lower its vulnerability and vice versa. However, access to basic services and infrastructures as well as possession of assets alone doesn't guarantee low vulnerability, such element should be directed in to coordinated adaptation strategies so as to withstand shocks and hazards. Hence, the total vulnerability of a given pastoralist in this study is the function of exposure (-ve), sensitivity (-ve) and adaptive capacity (+ve).

2.3 Review of Related Literatures

2.3.1 Global overview of climate change

The Global warming is defined in the terms of a regular raise in the average temperature of the earth's atmosphere and it's on the oceans, shifting the earth climate situation. The scientist from intergovernmental panel were established on climate change associated to global warming is that the average temperature of the earth has increase between 0.4 and 0.8°C over the past 100 past years ago. in addition to that, the increased carbon dioxide and other greenhouse gases are out by the burning of fossil fuels, land clean-up, agriculture and other human process are believed to be the primary sources of the global warming that has happened over the past 50 years (IPCC, 2007).

According to the IPCC fourth assessment report, warming of the climate system is unequivocal, as is now evident from observations of increases in the global average air and ocean temperatures, extensive melting of snow and ice, and rising the global average sea level due to the melting of the polar ice caps, an increasing in event and severity of storms and other severe weather events. (IPCC, 2007). In the other hand, the IPCC fourth assessment report to the global average temperature has risen by 0.74°C and the global sea level has increase by 17cm during the 20th century, primarily due to melting snow and ice from the mountains and the Polar Regions (IPCC (2007). The World Meteorological Organization (WMO) (2003) and IPCC (2007) states that the concentration of carbon dioxide has increased from 280 parts per million (ppm) in the pre-industrial times (1750s) to 370 ppm at the present this has lead the global climate change in to dangerous conditions and it is expected that, with the present tendency, the concentration will range between 540 and 970 ppm and also the global temperature could be increase between 1.4 and 5.4°C in the year 2100.

2.3.2 Over view of climate change in Ethiopia

The Ethiopian countries are highly vulnerable to climate change. This is due to very high dependence on rain fed agriculture, which is very sensitive to climate change, lack of water resources, the low health service management, the high population growth rate, the low economic development level, the low adaptive capacity, deficient road infrastructure in drought prone areas, weak institutions and lack of awareness (NMSA, 2007).

The Vulnerability assessment based on accessible information and rapid assessments approved under National Adaptation program of Action of Ethiopia (NAPA) has indicated that the main vulnerable sectors to climate change are agriculture, water resources and human health. Agriculture is the major key sector in the Ethiopian economy (Temesgen, 2007). Though, the productivity and competitiveness of this region is increasingly forced by temporal and spatial variability of climate change (NCCF, 2009). In addition to that, both droughts and floods are already common in Ethiopia. Climate change is expected to have adverse environmental, social and economic impacts in Ethiopia (NMSA, 2007).

Ethiopia has been affected by climate change and extremes for long time periods. Such effects are Drought, food shortage and famines are the major part of Ethiopia's history which is caused by

climatic and non-climatic related disasters. In addition to that, as the country is residing in very vulnerable part of the world for climate changes, which is wisely small events during the growing season, likely a lot or small amount of rain at the wrong times, this can bring disasters to the livelihood community (Alebachew et al., 2011). Also, The Climate Trend Analysis of Ethiopia which is built by US Geological Survey, USAID and the Famine Early Warning Systems raise out that there is a main reduction in rainfall and increases in temperature over the period from mid-1970s to 2000s in various areas of the country (Keffyalew, 2011).

In addition to disparities in different parts of the country, the Ethiopian climate is also categorized by a history of climate extremes, such as drought and flood, and increasing and decreasing trends in temperature and precipitation, respectively. The history of climate extremes, especially drought, is not a new phenomenon in all over parts of Ethiopia. Although there was a long record of drought, Lautze et al., (2003), NMS, (2007) in their studies show that the occurrence of drought has increased over the past few decades, mainly in the lowlands (Lautze et al., 2003; NMS, 2007).

Some of Studies also indicate that mean temperature and precipitation have been changing over time. According to NMSA (2001), the average annual minimum temperature over the country has been growing by about 0.25oC in every 10 years, whereas the average annual maximum temperature has been increasing by about 0.1oC in every decade. The average annual rainfall of the country also showed a very high level of variability over the past years even if the trend continued more or less constant (NMS, 2007). Droughts in Ethiopia can shrink household farm production by up to 90 % of a normal year output (World Bank, 2003).

2.3.3 Pastoralist and Climate change

Dry lands can be defined as arid, semiarid or dry sub humid areas; their characteristic feature of dry lands is low but highly mutable rain fall high temperature (EPA, 2010). Pastoralist is the key living strategy practices in driest lands. The dry lands establish nearly half of the total land area of sub-Saharan countries and about 40% of the world's land surface and 54% of the productive land area of the earth. Owing to this adapting dry lands and pastoralist to the impact of climate change and other hazards is very vital.

In the case of Ethiopia also, (CSA, 2008) has identify that 12% of the country's total population

are pastoralists (CSA, 2008), For the same set of scenarios, (MoARD, 2008) is said to be herding their livestock in the dry lands (arid and semi-arid lowlands) that found about 63% of the country's land mass (MoARD, 2008). These areas are disposed to rainfall variability, extreme drought and flash floods. The people in the pastoral lowlands are mainly pastoralist and agro pastoralist who have direct daily dependence on climate sensitive livelihoods and natural resources (pasture and water) and they are among the most resource deprived and geographically marginalized (PFE, 2010). According to Prolinnova (2011), the simple relationship that used to exist between the social and natural environment in the pastoral areas has become difficult due to the enhanced demands (arising from high population growth) and reduced supplies (depletion of the natural resource bases and lack of access to critical resources (Prolinnova, 2011). As the increase of environmental hazards was taking place increasingly in the past, pastoralists had tolerable time to adapt to the new conditions. However, the step of those changes has increased momentum and the adaptation mechanisms of the past have become less effective, insufficient and even obsolete (EPA, 2010).

In the pastoral areas of Ethiopia, climate change adds a new and largely ambiguous dimension to the development problem by compounding the risks of natural hazards and confusing existing social and economic differences. Although it will add to the load of those who are already poor and vulnerable by affecting their livelihood pattern and strategies and causing food, feed, water and social insecurity (Prolinnova, 2011). Pastoralists have high degree of exposure to climate change due to their location in vast arid and semi-arid areas all over the World, Africa and Ethiopia. Compared to highland areas, these areas are characterized by marked rainfall variability, fast return rate of drought cycles, and associated uncertainties in the spatial and temporal distribution of water resources and grazing for animals feeding (Conway and Schipper, 2010).

Pastoralists are also highly sensitive to such exposure of climate change due to their location in inaccessible, remote and underdeveloped areas. These areas are frequently and highly conflict disposed to food insecure, underdeveloped basic service provision with low levels of health and education indicators than national-level figures (IPCC, 2007, Deressa et al., 2010). Furthermore, growing population growth, unresolved land tenure issues, poor market access, invasion of large scale state and private investment and all forms of the main political and socio-economic

relegation make pastoralists more sensitive to the impacts of climate change. That also implies low adaptive capacity to climate change impacts (Yohannes and Mebrahtu, 2008).

For many years, pastoralists and agro pastoralists have developed management systems based on strategic mobility, which are well-adapted to problematic environments (Hesse and MacGregor, 2006). Mobility is a common feature of pastoralist's adaptation to changes in climate and lack of resources. In addition to mobility, pastoralists have been adapting to climate change thought strategies such as keeping their livestock that can tolerate seasonal feed shortage and long intervals between drinking; keeping large herds in the hope that some animals with survive a period of feed shortage; change into cropping, engaging in non-pastoral activities like trade, renting their livestock to market trade etc. (Hesse and MacGregor, 2006; Coppock et al, 2009; Niamir-Fuller, 1999). While studies about the decision regarding sedentary agricultural farmer's adaptation to climate change are abundant, studies on pastoralist's adaptation to climate change and variability are very limited. This is also very much clear when it comes to local level analysis, which is totally absent (Deres et al., 2008).

According to Amaha (2006), the dry-lands of Ethiopia are conquered by rangeland based on the livestock production systems known as the pastoralist and agro-pastoralist partly involved in timeserving cropping and livestock production. It is the livestock based economy which is characterized by exterior shock, such as drought, moreover decreasing of production (milk and meat), and in terms of buy and sell, seriously affect livestock both in terms of harmfulness and death rate. Repetition of drought at shorter time will thus have the multiple effect of eroding the livestock resources of the pastoral community and eventually, frustrating the food security and livelihood problems of the communities, making them more vulnerable and dependent on relief aid (Beruk, 2003). These systems are representing a major sector of the national agriculture in the country. Similarly, to other countries in the horn of Africa, agro-pastoralism in Ethiopia has been scattering into purely pastorals rangelands as the people have increasingly adapted to farming over the last few hundred years, particularly the last 100 years (Holt, 1989).

2.3.4 Pastoral Livelihood System

In addition to the definition given above, Swift and Umar, N (1991). Have explained pastoral production systems as those “in which at least 50% of the gross incomes from households (i.e.

the value of market production and the projected value of existence production consumed by households) it comes from pastoralist or its from related activities, or else, anywhere more than 15% of household's food energy ingesting involves the milk or dairy products they produce. According to Morton (2010), Pastoralists are people who depend on livestock or the sale of livestock products for most of their income and consumption, whose livestock is mainly grazed on communally-managed or open-access pastures, and who show at least some propensity, as households or individuals, to move seasonally with their livestock (Morton 2010). Pastoralist is also can be defined by a high dependence on livestock as income for economic and social welfare and the different types of strategic mobility is to get access water and pasture resources in areas of high rainfall variability.

The Pastoralist system has three major supports: (1) the pastoral family and other wider social institutions, (2) natural resources supporting the system and (3) the herd. Those characteristics are the typical elements of the pastoralist system. Pastoralist has two principal differences: the first one is Agro pastoralist and second one is nomadism. The term agro pastoralist refers to the co- existence of agricultural and pastoral activities side by side at different scales. Agro pastoralists are sedentary farmers who produce crops and raise livestock. Livestock are used for draught, savings and milk production (Alemayehu, 2004). Agro pastoralists can be described as the established pastoralists who cultivate enough areas to get feed to their families from their own crop production. Agro pastoralists grasp land rights and use their own or rented labor to cultivate land and grow clips. While livestock is still valued assets the agro pastoralist, agro pastoralists' peoples are naturally smaller than those found in other pastoral systems.

The term pastorals (nomadism) refer to people pursuing on rearing animals mainly of camel, small ruminants and cattle. They use natural grazing through extensive mobility in search of animal feed and water. (Tsegaye et al., 2013).

2.3.5 Impact of Climate Change on Pastoralist Community

Due to the delicate nature of the environment they live, the sensitiveness of their livelihood to changes in climate and poor infrastructure pastorals has been highly affected by the impacts of climate change. According to Chantalle and Dejene (2011), the impact of climate change on

pastoralist can be summarized as impact on the physical in environment, livestock herd, food security, social welfare and livestock market.

Impacts on the Environment

A study by Angassa and Oba (2007) in the range lands of southern Ethiopia concluded that, the events of drought and rainfall variability seriously affects the grazing land of the pastoral communities found there. Climate change is also a major factor for the increased level of deforestation and decline of woody species as in range lands where pastorals and agro pastorals rear their herd as in southern Ethiopia (Angassa and Oba, 2007). Even though the interferences by development organizations, loss of biodiversity has become the major impact of climate change in pastoral areas and according to the study conducted by Bassi and Boku (2007) in the Borena pastoralists of Ethiopia; this is the more improved by the disregard of customary natural resource management strategies by pastoralists. Climate change is also mentioned to cause degradation of soil resources and drying up of wetlands and water points that are very key to the livelihood of pastorals.

Impact on livestock herd

In the study of Bassi and Boku (2007) conducted a study using participatory epidemiology to control the relative occurrence of livestock diseases and their impacts on livelihoods as a result of changes in climate and weather. The study shows that goats and sheep were perceived to be the most abundant livestock species whereas goats and camels donated the most to the livelihoods of pastoralists. This is due to the common prevalence of disease related to climate change. Gelagay et, al. (2007) also mentioned that, some of the disease becoming cut in pastoral areas due to climate change; which was acceptable by their finding on a study conducted in Borena Pastoralist of Ethiopia revealing a diseases called contagious caprine pleuropneumonia (CCPP) becoming a very important goat disease than ever. Additionally, climate change has annoying sever restrictions and impairments to the usual seasonal mobility options of herd in search of forage and water which in turn affects the livestock quality and induce conflict (Butt, 2010).

In addition to this, Oba (2001) in his study on Kenyan pastoralists confirmed that, climate change more importantly drought causes change of livestock heard composition and structure in a way that negatively affect the owners. Similar findings on the impact of climate change on

livestock were obtained by Perry et, al. 2011, Rufael, 2008; and Bossche and Coetzer 2008.

Impact on livestock Market

The nature of most pastoral community is related with increasing the number of herds rather than its quality. The number of herds is associated with the wealth tutus and dignity of a given pastoral and therefore they incline to increase the number while they sell them in a limited extent. In addition to this, their remote location from markets and urban center has hindered them from actively participating in livestock markets. However, studies indicated that changes in climate has recently forced them to be includes in livestock markets (Aklilu and Catley, 2011). Aklilu and Catley (2011) and Behinke (2006) also argued that, livestock trade method and markets have moved in one hand and the approaches of mid-altitude farmers towards the ownership and use of camels and other pastoral livestock has increased the contribution of pastorals in marketing.

Differing to this, climate change has a negative impact on the quality of pastorals herds provided to market. Due to the prevalence of disease and alteration of the composition and structure of livestock, the herd supped to market by pastorals are increasingly becoming condensed and poor quality which ultimately reduce their income compared to sedentary farmers (Cagnolati et, al.2006, and Negassa , 2008).

Impact on food security and welfare

The rising of vulnerability to food insecurity that pastoralists and agro pastoralist face stalk from the failure to put the shelter of pastoral livelihoods at the middle of emergency preparedness, planning and response mechanisms. The Scarce and poorly intended state-led investments in development initiatives, increasing climatic variability and public policy constraints combine to impoverish pastoralists (Humanitarian Policy Group, 2009). Due to climate change and variability, the east African pastoral communities like many others, become highly food insecure and in a need of urgent food aid to the community. Poverty is highly linked with wellbeing and food securities which are both serious by climate change induced incidences. Findings of Blackwell (2010), Block (2008), Boku (2008) and Deresa et, al (2008) are all in conformity with the above conclusions regarding the impact of climate change on the welfare and food security of pastorals.

2.3.6 Pastoralist's perception to Climate change

Perception is the process of accomplishing awareness or understanding of sensory information. According to Maddison, (2007). Mention that Farmers are more likely to perceive climate change when they have more farming experience (Maddison,2007). Farmers learn and accept new innovations in many ways. Based on their perception what they in their locality and observations from neighbors, success stories and practices, farmers have a tendency to update and try to adapt to the adverse effects of weather changes. Nevertheless, this depends on the resources of availability in their hands and opportunities in retrieving extension serves, credits as well as inputs. They perceive there is an increase in temperature and decrease in precipitation but their perception about climate change not evidenced from weather monitoring stations (Maddison, 2006).

Local community's perception about their environment is serious because their perception basically determines the socioeconomic activities in their locality. Effectively mitigating and adapting to climate change need changes in the behavior of billions of human being, who each day make individual choices that communally have huge impact on the earth's climate. Though, very little is known about international local community opinion regarding climate change. For example, in Ethiopia empirical studies made so far about local community awareness of climate change are very limited (Adane, 2009).

In most parts of Ethiopia, people have perceived decreasing in rainfall and increased frequency of temperature and drought but it did not confirm from weather station. This lack of equivalence could be due to the fact that farmers assess rainfall in relative to the needs of particular crops at particular times; small changes in quality, onset, and ending of rain over days or even hours can make a big difference with farmers, whereas meteorological data is more likely to measure totals and larger events. Maddison (2006) also argued that this lack of congruence between farmers' perception and meteorological records could emanate from the analysis of short term climate data and/or due to averaging of record from wider areas.

The Most farmers reported that they have perceived rise in the duration of the cold season, no change in the duration of the hot season and a reduction in the rainy season's duration. Furthermore, various findings (e.g. Acquah, 2011 and Ogalleh et al. 2012) indicated that most of

the farmers in Sub-Saharan Africa are aware of the impact of climate change and variability, especially changes in temperature and precipitation. In similar studies conducted in the Ethiopian highlands (Deressa et al. 2008; Yesuf et al. 2008), farmers reported that temperature has significantly increased over the years. Generally, the agro-pastoralists have experienced increased temperature and decreased precipitation, and this awareness has been established by predictions about an overall increase in temperature between 0.7 and 3.5°C in Africa by 2050 (IPCC 2007).

2.3.7 Adaptation Measures to climate change and variability: A pastoral context

A number of researches were conducted on the type and effectiveness of adaptation strategies used by pastorals across various pastoral communities. A study conducted by Yohannes et, al. (2011) indicated that pastoralists in Ethiopia and Niger have applied various adaptation strategies among which cut-and-carry feeding system, settlement around water points, changing heard composition, diversification of livelihood sources, fodder conversion, use of vehicles and buying hay the most important ones. Similar to this, in their study on the vulnerability and adaptation strategies of Afar pastorals Amanuel et, al (2004), has discovered that Afar pastorals around Gewane and Amibara used mobility, livelihood diversification, fodder management and herd management as some adaptation strategies to the climate change and variability observed in the area. According to Blaikie *et al.* (1994) in his study defined coping strategies “as the method in which people perform within accessible resources and range of expectations in the given context to attain different ends”. Coping strategies are an important part of planning for adaptation. Climate change is leading communities to incidence climatic extremes more recurrently, as well as new climate environment. Coping strategies to climate change are the vital response of a society to the happened hazards. As compared to the adaptation strategies, coping strategies are the strategies which are not well planned. The local knowledge of the community can help to provide capable, suitable and time-tested ways of advising and enabling adaptation to climate change in communities who are in the sense of effects on climate changes (UNFCCC, 2006). Some of pastoralist and agro pastoralist coping mechanism that have been used written below;

Pastoralist Mobility

In Ethiopia mobility is a major coping strategy for pastoralists to cope up with drought and risks induced by dry incantations (Tesfay and Tafere, 2004; Holmann et al., 2005). Pastoralists usually move seasonally to search water and pasture shortages during the dry season. In other hand, the time, direction, duration, and frequency of visit vary from one pastoral place to another place in order to get different fodder and water but this all activities have the important feature in order to avoid heavy grazing pressure persuaded by repeated and longer period of time grazing and water shortage (Tesfay and Tafere, 2004).

Livelihood diversification

According to Leary et al. (2007) financial diversification and off-farm engagement in Ethiopia have threatened GDP, it reduced human wellbeing losses and lowered income variability. Although Income diversification has long been seen as a risk reducing strategy in the face of increasing climatic and financial risks in developing countries (Bryan et al., 2009; Deressa et al., 2009). Farmers in east Africa have been use both on-farm and off-farm income diversifications activities (Wanyama et al., 2010). Whereas, the on-farm income diversification contains planting varieties of crops and raring different animals, while off-farm income generation livelihood activities contain casual labor, petty trading, and also selling of natural resources (mainly wood and charcoal) (Eriksen et al., 2005).

2.3.7.1 Importance of indigenous knowledge to climate change adaptation

The use of Indigenous knowledge is also the social assets of the poor people; their main benefit is that to invest in the struggle for survival, to produce food, to provide shelter for their livelihood or to achieve control of their own lives. Even though, today many indigenous knowledge systems are at danger of becoming destroyed because of quickly the change of natural environments and fast pacing economic, political, and cultural changes on a global scale Practices is also become disappear, as they become unsuitable for new challenges or because they adapt too slowly (Nyong et al., 2007). However, many indigenous practices disappear only because of the interruption of foreign technologies or the development concepts that promise short-term gains or solutions to problems without being capable of supporting them. The tragedy of the imminent loss of indigenous knowledge is most obvious to those who have developed it

and make a living through it. But the plan for others can be harmful as well, when skills, technologies, artifacts', problem solving strategies and expertise are lost.

2.3.7.2 Barriers to Adaptation practice

Institutional support related factors

The Role of Government: -The role of government in the natural resource management particularly in less developed nations is enormous. The Government has a major role to play in natural resource in order to protect the environment from natural disaster. Although it should be helping as a mechanism and facilitator in the process of enlisting people participation.

According to Singh (1992), there are some key roles of government institution to be engaged in natural resource issues. First, it is protecting the interest of future generations. The responsibility of long term planning and management of natural resources should be contained and discharged by the government, which was a longer planning perspective than individual. Second, it provides funds, because there is difficult to stop free condition there is no incentive for private investors to provide fund for such investment of uncertain. However, the government does some activities in the natural resource in order protect from climate change, the government should give priority for their people interest.

Non-Governmental Organization: -As any development program the involvement of NGOs may a valuable role in keeping natural resource management to protect from those hazards that can come and change the world climate change as well as to keep their people from the vulnerability. This is because most of the people mainly the illiterate society have less knowledge about the negative impact of miss-utilization of natural resource and somewhat they look for the short-term benefit and to survive from the problem that's happen. This has led them easily to be vulnerable and change the world climate. So the NGOs are more close to the local people so that they can participates the community in resource management. NGOs in most African countries are active in advocating and increasing public consciousness on environmental problems and call for actions and changing the existing institutions, laws and attitudes (Terefe, 2003).

Socio-economic factors: - Improved human well-being is essential objective of sustainable development and is closely linked to environmental goods and services. Human well-being is multidimensional and requires in order to access to live a good life in good health such as profits, food, clean water and energy personal security through the absence of conflict, to cope with the environmental disasters which can easily make them to be more vulnerable to climate change, and good governance; good social relation which include all people and promote justice and impartiality; and the chance to make choices. This implies a condition in which people are not just physically well, but have choices and live in inequity, is an indication of how successful or unsuccessful development policies have been. In turn, the well-being of people affects their aptitude too efficiently and sustainability manages resources (UNEP, 2008).

2.3.8 Ethiopian Policy context

Throughout its history, Ethiopia has given a little or no attention to its pastoralist who are estimated to be more than 15 million by now (Mohamed, 2015). The first national document to incorporate the issue of pastoralism and pastoralists was the 1995 F.D.R.E constitution. Apart from the legal recognition of pastoralism at constitutional level, instructional measures such as establishment of a department in the ministry of federal affairs that coordinate development issues in pastoral areas of the country. Moreover, Pastoralist Affairs Standing committee was also set in the parliament to oversee the overall development activities in the country. In regions where pastoralism is the major economic system, regional offices were also established.

The special pastoral programmer under PASDEP aims to three pillars: (1) Improve pastoral livelihoods and asset base: improved service delivery (marketing, animal & human health, education, water) & range management (2) Address livestock movement within and across boundaries and (3) Protect pastoral lands (PASDEP, 2006).

The major focus of GTP devoted to pastoral area development include: (1) A strategic focus on livestock resources development, (2) Primary emphasis on water resources development accompanied by (3) improvement of pasture land and the development of irrigation schemes, (4) Settlement programmers and (5) Selection and distribution of local breeds, animal health services, natural resource management and the establishment of livestock marketing (GTP,2010).

At policy level there is an emphasis away from mobility and “traditional livestock production methods” and towards settlement. The Ethiopian Investment Policy regards the “current output per domestic breed of livestock to as low” and seeks investment opportunities “in the areas of modern commercial livestock breeding, production and processing of meat, milk and eggs.” While the PASDEP recognizes pastoralism as a livelihood with economic (livestock) and cultural values, and marginalized by past policy and vulnerable to drought and conflict, it is not clear that the drive towards the “modernization” of the sector recognizes the inherent logic of the “traditional” system in the context of highly variable and unpredictable environment.

Today, pastoralists are still being evicted from their land by larger interest groups (e.g. irrigation schemes, commercial farms etc.). Not only are the economic benefits of pastoralism poorly quantified and consistently underestimated by governments, such enterprises match the government vision of “modernization”, and also make it easier for governments to capture greater returns. One of the indicators of the attention certain to the pastoral system as the different government policies, In Ethiopia the government was developed the pastoral policy in year 2002. This pastoral policy according to Ministry of Federal Affairs, (2002) described as the Phased intended Sedenterizations along the banks of the key rivers as the main direction of changing the pastoral societies into agro-pastoral systems, from mobility to sedentary life, from a spread population to small pastoral towns and urbanization; complementing sedenterizations by micro- and the small-scale enterprises development in the urban centers and off-farm activities implement in the rural areas. The Activity included development based on irrigation and focused on livestock production, complemented by fixed and mobile education and health services as well as rural roads, water supply and rural energy, rural telephone services etc. (MoFA, 2002).

CHAPTER THREE

3. MATERIALS AND METHODS

3.1 Description of the Study Area

3.1.1 Location

The Afar National Regional State is one of the nine administrative regions of Ethiopia located in the north-eastern part of the country. The region is divided into five zones. Geographically, the region is located between 8°49' -- 14°30' north latitude and 39°34' -- 42°28' east longitude. The region shares both national boundaries (with four national regional states i.e. in the northwest Tigray Region, in south west Amhara region, in south Oromiya and in southeast Somalia region) and has Two International boundaries in east Djibouti and northeast Eritrea (ANRS BoFED. 2006).

The study was conducted in Aysaita Woreda of zone one (Awsirasu) of the Afar Regional State. Aysaita is a town in northeastern Ethiopia, and before 2007 was the capital of the Afar Region of Ethiopia. Administratively it is found in Zone One of the regional administration. Aysaita Woreda is bordered on the south by Afambo, on the west by Dubti, then on the north by Awash river which separate it from Elidar, on the east by Djibouti. As a zonal capital, the town has an administrative linkage with all the Woreda of its zone. With regard, to linkages outside the region, it has strong transport and economic interaction particularly with Dessie town of the Amhara Region. The town is geographically located has a latitude/longitude of 11°34'N/41°26'E and an elevation of 300 meter (980 ft.). Aysaita is 655 kms far from the capital city of Ethiopia, Addis Ababa and 65kms far from the capital city of Afar, Samara. (ATM, 2011).

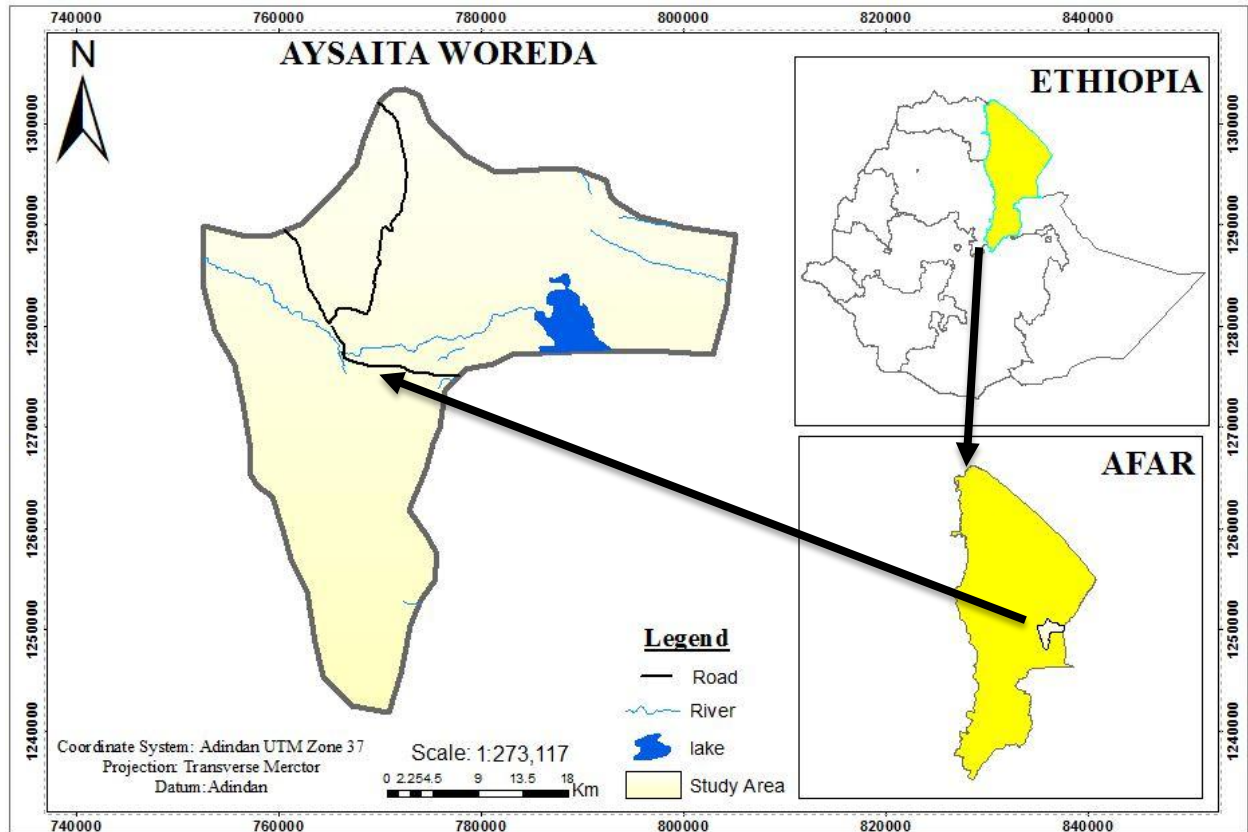


Figure 2 - Map of the Aysaita Woreda

Source: Ethio GIS map, 2007

3.1.2. Population

Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), this Woreda has a total population of 50,803, of whom 27,284 are men and 23,519 women; with an area of 1,678.28 square kilometers, Aysaita has a population density of 30.27. While 16,052 or 31.60% are urban inhabitants, a further 9,358 or 18.42% are pastoralists. A total of 11,096 households were counted in this Woreda, which results in an average of 4.6 persons to a household, and 11,404 housing units. 95.12% of the population said they were Muslim, and 4.61% were Orthodox Christians (CSA, 2007).

3.1.3. Climate

Aysaita town is one of the towns in Ethiopia located within the rift valley system. Its location connected with low altitude, makes it to have warm temperature. The temperature very much

varies among seasons, and the months of December and January are comparatively cold months while June, July and September are the hottest ones. Bereha is the dominant agro climatic zone covering 99.33% of the region (ANRS, 2010). The average temperature of the area is about 31.1°C, (WPADB).in this case, the Awash River plays a key role to make the region of agro pastoralist.

Rainfall is bi-modal throughout the region with the average annual rainfall is recorded to be between 250 and 350 mm. The region receives three rainy seasons. The seasonality of Afar region is by large determined by the timing, availability, and performance of the rainfall. The main rain, Karma accounts for most of annual rainfall occurring from mid-June to mid-September. This is followed by rainy showers in mid-December called dada and a short rainy season during March-April called *sugum* (Getachaw, 2004). The region is climatically categorized as arid and semi-arid agro-ecological areas, where livestock production is the main occupation of the community.

3.1.3. Topography

Topographically, Aysaita and its surrounding area consist of basically flat landscape with some hills and small mountains that range in altitude from 350 to 473 m.a.s.l.

3.1.4. Land use and land cover

Based on Aysaita woreda 2016 report, in this woreda who held an average of 1.78 hectares of land. Of the 5.39 squares kilometers of private land surveyed, 71.59% was under cultivation, 1.22% pasture, 31.06% fallow, and 4.54% was devoted to other uses; the percentage in woodland was missing. For the land under cultivation in this woreda, 66.21% is planted in cereals like maize; none of the land was planted in fruit trees, 0.81 hectares in bananas and 0.41 in guavas. 9.95% of the farmers both raise crops and livestock, while 25.79% only grow crops and 64.26% only raise livestock. Land tenure in this woreda is distributed between 66.49% own their land, 14.09% rent, and the remaining 19.42% are held under other forms of tenure.

3.1.4. Basic infrastructure of the study area

Health center: According to Key informant interview held with kebele administrator, at barga kebele there is health center so, the local people protected from some suffering various disease such as malaria, pneumonia, diarrhea etc. Whereas, in pastoral kebele of Galifage community

do not have any kinds of health center due to this the local people are vulnerable to incoming impacted and affected by various diseases.

Road: According to Key informant interview held with kebele administrator, there is a road in both pastoral and agro pastoral kebeles. 25 minutes for agro pastoralist while pastoralist it took 45 minutes to reach the nearest paved road. As the interviews with people stated that, in the area problem of transport service leads to the problem of health and market accessibility especially for the elder, women and poor community. Market accessibility is increasing farmer's adaptation mechanisms since they exchange their local and introduced adaptation mechanisms.

Education; as the elderly people said during the FGD at both pastoralist and agro pastoralist community were said there are one elementary school (1-8) in both pastoralist and Barga and Galifage kebeles. Even though, there is elementary school in their locality some of local community are not volunteer to send their children to school due to the distance of school far from their home stead. Student also get it is very long journey and difficult student to study due to lack of time. Student affected by impact of climate change, like hotness of the sun when they come back to home. In the study area most students are dropout from school especially female students because of one and the largest problem is the traditional thinking of the society regarding female should help her mother until she become ready for marriage. In sequence the most of female student school dropout leads to the female vulnerability to the impacts of climate change because, they have large home responsibilities or their parents use as adaptation mechanisms like fetching water, fire wood collect, field work etc. in addition they leads to under age marriage, increasing population pressure, then increasing their vulnerability because they have no their own land, this implies to divorced and female household head without any capital asset is difficult.

Market accessibility: According to Key informant interview held with kebele administrator, there is no market accessibility near to both pastoral and agro pastoral kebele. the local community of barga and Galifage kebeles use the urban market for their livestock and crop production market. This has led pastoralist production and livestock has to be vulnerable to climate change.

Veterinary service: According to Key informant interview held with kebele administrator, in agro pastoral community of barga have service of veterinary in their locality. Even though there is veterinary service in their locality do not get service due to lack of enough material. While in pastoralist kebele of Galifage completely do not have veterinary service in their locality. This has led both pastoralist and agro pastoralist kebele community of livestock are exposure to vulnerability to incoming impact.

Saving and credit institution: According to elderly people during the FGD said saving was practiced in the form of increased livestock number. Nowadays, with decreasing livestock number, there is no saving as such. No cash saving is practiced except the sum held at hand for immediate use. Traditionally, credit is given by one member of the community to another based on reciprocity. No interest is charged on the amount disbursed. The purpose is usually for consumption. In some instances, the credit is not paid back, consented by the lender.

The Role of Traditional Institutions

According to SAILSAPC 2011, Afar pastoral communities have indigenous institutions that govern the behavior of each individual member. The traditional institutions are organized to serve the social, economic, security and development needs of its members. The institution leaders have the responsibilities of decision-making and enforcement of resource use rules using traditional political authority. This authority is hereditary based on clan ties. Each clan has a clan leader (Kedo Aba), lineage (Dala Aba or sometimes called Dabala Aba), youth leaders (Fei'ma Aba) and elders' councils. The traditional leaders reinforce co-operation and social solidarity between clans through shared rituals, resource sharing and the practice of paternalistic cross-cousin marriage called Absuma SAILSAPC (2011).

In Afar, religion has high value and even dominates the enforcement of traditional rules and regulations. It is so important in that, without the consent of the religious leaders, it would be difficult to think of cultural changes in the Afar pastoral community. The “Kadis” and “Shekas” implement Islamic religious rules and regulations and teach the faith. The religious leaders have the authority in the cases of marriage and divorce decisions. Traditional leaders work in harmony with the government system at woreda level. They often play advisory roles. The traditional

leaders can play pivotal roles to bring about social changes through continued dialogue at different levels in a participatory manner. SAILSAPC (2011).

3.2 Research Design

The study was to assess rural people's vulnerability to climate change and adaptation responses in pastoral and agro pastoral communities. In order to assess the overall activities at one shot cross sectional research method was used, with purposive sampling techniques to select kebeles and stratified sampling techniques to select households.

3.3 Sample size and Sampling techniques

The study at hand was focused on zone 1 from Afar Region for reasons. Zone 1 is characterized by pastoral and agro pastoral way of life in the region while the other zones 2,3,4,5 are not both pastoral and agro pastoralist. From zone 1, the studies focused on Aysaita Woreda because Aysaita Woreda pastoral and agro pastoral are more vulnerable to climate change related to other zonal Woreda. On the other hand, both livestock and farming activity is high at Aysaita Woreda and livestock death and human death, drought, flood is increasingly rapid and it has attracted the researcher attention. From Aysaita Woreda the researcher was focused purposively selected only two kebeles namely Barga from agro pastoralists and Galifage from pastoralists kebeles. Because these kebeles are the most vulnerable to climate change and weak to adapt compared to other kebeles in Asayita woreda.

The total population of the two kebeles is 4562 and from this population 614 householders are living in these two kebeles. Out of which 492 are male households and 122 are female households. Whether Male-headed or female-headed households, 153 (25%) households are selected from 614 total households using simplified formula provided by (Yamane, 1967 cited in Mesfin, 2006). Stratified sampling also used to categorize households to make comparative analyses among different groups in the community. First, categorical division is based on their agro ecology of pastoralist and agro pastoralist, while the second extended category wealth group of the community is within wealth status category. After accomplishing the strata and having to the sampling frame, simple random sampling was implemented in each stratum to select respondents from pastoral and agro pastoral community. Again the researcher has been

proportionally selected 66 sample household from Pastoralist and 87 sample household from agro pastoralists using simple random sampling techniques. Among this, 48 are Male-headed and 18 female headed households from pastoralists; and 64 male headed and 23 are female-headed households from agro pastoralist kebeles were selected.

3.3.1. Wealth status of the respondents

After having FGD a conversation with the kebele elders (tribe leaders), DAs and kebele leaders, it was tried to classify the wealth rank as better off, medium and poor based on the community criteria's on both pastoral (Galifage) and agro pastoral (Barga) kebeles. According to community criteria, a pastoral household belongs to better off, if he/she would have 3 or more than 3 hectare of farming land, 5 or more than 5 camels, 10 or more than 10 cattle, and 20 or more than 20 goats and sheep. For a person to be medium he/she should have 1-3 hectare of farming land, 3-5 camels, 7-10 cattle, 13-20 sheep and goats. A person is considered as poor if he/she have with less than 1 hectare of farming land, owns less than 3 camels, less than 7 cattle, and less than 13 goats and sheep. For agro pastoral Kebele, those with 3 or more than 3 hectare of farming land, 2 or more than 2 camels, 6 or more than 6 cattle and more than 15 goats and sheep are taken as better off. Those with 1-3 hectare of farming land, 1 camel, 3-6 cattle and 5-15 goats and sheep are taken as medium wealth rank group. And poor wealth rank group are those with less than 1 hectare of farming land, no camel, less than 3 cattle and less than 5 goats and sheep.

Table 1: Distribution of Respondents by wealth indicators

Kebeles	Farm land in ha			Livestock ownership								
	>=3	1-3	<1	Camel			Cattle			Ruminant		
	>=3	1-3	<1	>=5	3-5	<3	>=10	7-10	<7	>=20	13-20	<13
Barga	4	6	11	3	5	10	8	7	10	3	8	12
Galifage	2	5	6	5	4	8	4	5	11	2	5	9
Total	6	11	15	11	9	18	12	12	19	7	13	20

Source: Computed field survey data 2017

3.3.2. Sample Size Determination/sample survey calculation

This study was used a simplified formula provided by (Yamane, 1967 cited in Mesfin, 2006) to determine the required sample size at 95% confidence level, degree of variability=0.5 and level of precision= 5% (0.05) calculated as follows:

$$n = \frac{N}{1 + N(e)^2}$$

$$n = 614 / 1 + 614 (0.05)^2$$

$$n = 153$$

Where, n = the required sample size= total households= expectation error, N =is the population size and e = is the level of precision

In addition to sampling households for questionnaire, the researcher selected some respondents for key informant interview and focused group discussion using purposive sampling technique as they should be old enough to witness the climate change over time.

Table 2: Population, No of HHs and sample size by samples kebeles

S No	Kebele Name	Population size	Total Household	Sample size			Average HH size	
				Male	Female	Total		
				No		% kebele HH		
1	Galifage	1956	266	48	18	66	24.8	7.35
2	Barga	2606	348	64	23	87	25	7.49
	Total	4562	614	112	41	153	24.9	24.92

Source: Aysaita Woreda Agricultural office, 2017

3.4. Sources of Data

In this study the investigator used both primary and secondary data sources in order to collect necessary information to this study.

Primary source: primary data was collected through survey questionnaire, Key Informant Interview (KII), Focus Group Discussion (FGD) and field observation.

Secondary source: To add supportive concepts and findings from the primary data, secondary data such as project reports, report and information at Woreda level, institutional and official documents, records on vulnerability and adaptation strategies status of the sample kebeles will be collected.

3.5. Tools of Data Collection

The methods of data collection depend on the nature, the objective, and the method of data analysis and the scope of the study. The availability of data, finance, time, personal and other facility also influence the selection of method to be used for the study.

To get reliable and accurate data from the selected sources, the researcher was used the following data collection tools:

3.5.1. Questionnaires

In this study, questionnaires were distributed to the selected 153 sample households to get data about vulnerability and adaptation to climate change in pastoral and agro pastoral households. The Household survey is commonly used approach in various enquiries. The survey consists of household's demographic information, socio-economic characteristics, access to resources, livelihood activities, local people perception about climate change, adaptation strategies, impacts of climate change, and extent of vulnerability. The survey was conducted on the selected 153 households. In order to conduct household survey, 4 enumerators were involved for data collection after taking necessary training. As enumerator, development workers of the respective kebeles were included. The main reason for the selection of the station developmental workers as enumerator is that they are familiar with the respondents of the respective kebeles and they are

easily understood the questionnaires. The survey data was collected by enumerators with a close supervision of the researcher for the entire data collection period.

3.5.2. Key informant Interviews (KII)

In this study, the researcher employed interview because of its flexibility and to make clear any time when there is ambiguity. Interviews were held with key informants from pastoral and agro pastoral who were randomly selected from with resourceful 50 farmers and 4 development agent persons were conducted. Key informant interviews include model farmer, elder, women, young, clan leader, Woreda natural resource expertise, developmental agent, and Kebele administrator. to gain enhance, explanation about the local perception, impact, causes of vulnerability, adaptation mechanisms, hinders of adaptation mechanisms.



Figure 3: Individual interview in the field

Source: FGD Researcher interview, 2017

3.5.3. Focus group discussion

Focus group discussion is essential to generate data on group dynamics and allows small group respondents to be guided by skilled moderator, to focus on the key issues of the research topic. To describe the previous and the present situation of the study area, to know the present perceptions and the future intention of the community view randomly select 1 FGD in both pastoralist and agro pastoralist kebeles were made which have 7 members in the group in all the

sample population comprising the elderly people men and women, rich people men and women, medium people men and women, poor men and women, model farmers and adult. Data collected through Focus Group Discussion include extent of vulnerability, perception of climate change, impacts of climate changes, adaptation strategies and hinder for adaptation strategies.



Figure 4: group discussion in the field

Source: FGD group discussion, 2017

3.5.4. Field observation

Observation was made with the support of checklist reflecting Crop production and livestock husbandry, Government and Non-government activities on environmental conservation, Major people economic activities in their environment, Grazing land (degradation), other livelihood bases, local innovation, settlement and rangelands. The observation helps better understanding for vulnerability and adaptation at household and community level and serves as triangulation. at different.

3.6. Methods of Data Analysis

Based on the nature of basic questions and data collected, both qualitative and quantitative methods of data analysis were used to interpret findings. The quantitative data obtained from the questionnaires have been analyzed using descriptive statistical tools such as percentage and frequencies. Errors related to inconsistency of data were checked and cleaned. The empirical analysis of the study was conducted using descriptive statistics: measures like percentages, tables, frequencies and figure.

CHAPTER FOUR

4. RESULTS AND DISCUSSION

This chapter presents the results of the study on demographic characteristics of respondents, community perception of climate change, vulnerability, impact and adaptation strategies to climate change in the Aysaita Woreda pastoral and agro pastoral areas.

4.1. Demographic Characteristics of the community

This part relates the demographic features of the community under study on some milestones such as sex, marital status, Educational status and others to vulnerability to climate change and adaptation strategies.

4.1.1. Distribution of Respondents by Sex

Sex is usually considered as a key variable in livelihood adaptation strategies and vulnerability in all pastoral and agro pastoral communities. In the two kebeles of Aysaita woreda, (75%) of Barga (agro pastoral) Kebele were male headed households whereas the rest (25%) were female headed households. For Galifage Kebele, (pastoral) (71%) of the households were male headed and the rest of (29%) were female headed.

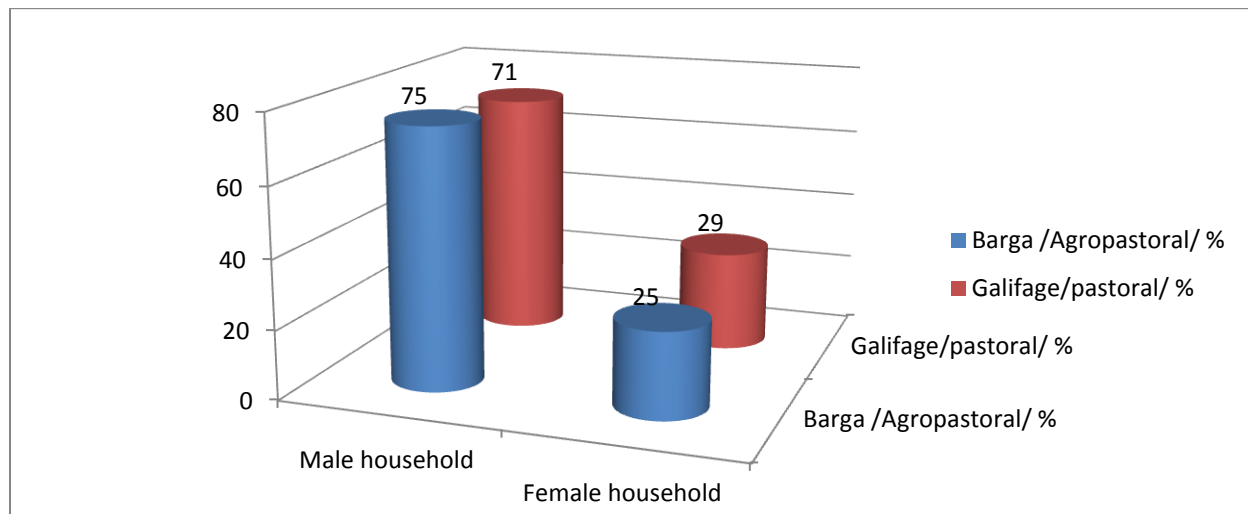


Figure 5. Distribution of the respondents by Sex

Source: Computed field survey data 2017

4.1.2. Distribution of respondents by their marital status

Most literatures hypothesized that Male Headed Households are most likely to cop up climate change impact as the result of the high possibility to information access and new technologies than female headed households (Asfaw and Admase, 2004).

Table 3: Distribution of respondents by their marital status

Kebele	Marital status	Wealth rank			TOTAL	
		Better off	Medium	Poor	N	%
Pastoral and Agro pastoral	Married	20	30	56	106	70
	Divorced	4	6	10	20	12.4
	Widowed	7	9	11	27	17.6
Total		31	45	77	153	100

Source: Computed field survey data 2017

As shown on the table households sample of respondent for both pastoralist and agro pastoralist kebele, 70% of the households were married (male headed), 12.4% were divorced and 17.6% were widowed. This implies majority of the respondents have better adaptation to climate change.

4.1.3. Age categories of the respondents

Age of household-head matters adaptation to climate variability. It is farming experience, Kebede (1990) years of experience in farming activity has a positive correlation in adapting the vulnerability and impact of climate change. According to Santrock (2011) age group categorization from 20-40 young, 41-60 adult and >60 are elders. In this regard the age distribution of the respondents ranged from 25-65 years.

Table 4: Distribution of sample household heads by Age Group

Kebele	Age(years)						Total	%
	25-40		41-60		>60			
Age groups	No	%	No	%	No	%		
Agro pastoral/ Barga	19	21.9	31	35.6	37	42.5	87	100
Pastoral/ Galifage	11	17	24	36.3	31	47	66	100

Source: Computed field survey data 2017

As shown in table 4, the Age of respondents seems a similar trend in both pastoral and agro pastoral Kebeles in terms of the proportion of the productive and unproductive age groups. For Barga Kebele, only 21.9% of the households are aged 25-40, which is the most productive age group. While 35.6% of the households are aged 41-60; and more increasingly, 42.5% of the households are aged greater than 60. This implies the proportion of households with a productive Age range is too low for such an agro pastoral community engaged in farming, and conversely, the proportion of the unproductive age group seems higher. Similarly, for Galifage Kebele, the proportion of the household with a productive age group 25-40 is 17%, and households aged 41-60 age are about 36.3% and those aged greater than 60 are about 47%, almost half of the households. This shows the majority of the sampled population are matured and more experienced in farming and assumed to have better knowledge and information on the change in climatic conditions. The trend increasing in both age and proportion could clearly be observed in the graph below, showing that most of the households are not in a productive age.

4.1.4. Educational status

Table 5: Distribution of sample household by their educational status

Kebele	Illiterate		read and write		grade 1-4		Total	
	No	%	No	%	No	%	N	%
	Agro pastoral/ Barga	61	70	17	20	9	10	87
Pastoral/ Galifage	53	80	8	12	5	8	66	100

Source: Computed field survey data 2017

From the Computed survey result shows in table 5, the level of education was very low as almost all of the respondents 70% Agro pastoral/ Barga and 80% Pastoral/ Galifage kebeles were illiterates. 20% Agro pastoral/ Barga and 12% Pastoral/ Galifage kebeles can read and write. 10% Agro pastoral/ Barga and 8% Pastoral/ Galifage kebeles were learned from grade 1-4.

Generally, educated household respondent from both pastoral and agro pastoral Kebeles are more advantageous than illiterate household because they got information from kebele extension worker and Medias. In addition, from conducted data the pastoralists are more vulnerable to climate change than agro pastoralist due to following of unsettled (nomads) livelihood system make them to do not get any information and help from government. Although the people in the study area are pastoralists (nomads), it was barely impossible to expand education service for those people who have no permanent settlement, which explains the high level of illiteracy. This has led pastoralist to affect the adaptation of new technologies and in turn decreased the facility to cope with climate change impact.

4.1.5. Livelihood activities of the respondents

As shown in table 6, it can be observed that the pastoral community has been employed fewer livelihood activities to generate income for their households as compared to the agro pastoralists. In other words, the agro pastoralist community had additional opportunities in crop productions, fruits, roots and vegetables production, hand craft, grass and forage productions and land renting. Whereas the principal livelihood activity of the pastoral community seems livestock and livestock products, but it still proportional number of pastoralist and agro pastoralist community are engaged in this activity. The principal livelihood activity of the Agro pastoralist community is crop production followed by livestock and their products.

Therefore, Agro pastoralist had more livelihood income compared to pastoralist. These verities of livelihood activities make agro pastoralist to have different coping mechanism in order to adapt from incoming impacts in their livelihood. This had led agro pastoralist to have less degree of being vulnerable. Whereas pastoralist household livelihood activities were only depending on livestock and livestock production. Due to decreasing availability of pasture land and livestock disease their livestock become loss and decreased the livestock production. As a result of this pastoralist have faced so many hazards when they loss their livestock and livestock production

because of incoming impact. This has led pastoralist to do not have verities of income. Therefore, pastoralists become more vulnerable than agro pastoralist.

Table 6: Livelihood activities of the sample household

Livelihood activities	Kebele		Total
	Pastoral / Galifage	Agro pastoral/ Barga	
Selling of crop productions	-	52	52
Selling of livestock and their products	46	44	90
Selling of fruits, roots and vegetables	-	32	32
Selling of fuel woods	23	21	44
Selling of grasses, forage	-	27	27
Selling of wooden poles	11	9	20
Land renting	-	18	18
Dibora	-	20	35
Others (contraband, livestock rent...)	19	12	31
Total	104	235	349

Source: Computed field survey data 2017

Note: - Total No of HHs are > the sample size due to multiple answers.

4.2. Climate Change as perceived by the community

The Aysaita Woreda Community perceived climate change in the area in terms of temperature and rainfall. As shown in figure 6, indicated that 95% and 93% pastoral and agro pastoral communities were perceived that as there is climate change in their locality. Whereas 5% and 7% of pastoral and agro pastoral communities were perceived that as there is no climate change in their locality. (See below figure6).

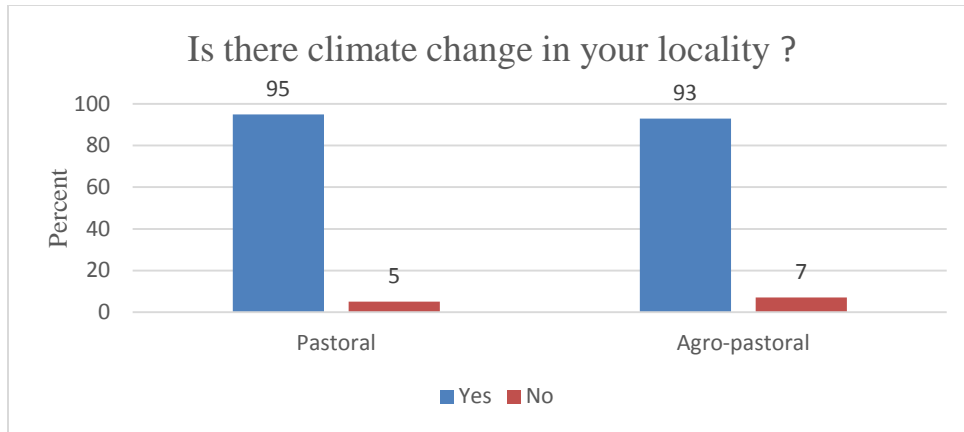


Figure 6. Climate change perception by agro ecology

Source: Computed field survey data 2017

4.2.1. Local people's Perception on causes of climate change

As shown in Table 7 indicated that a slight difference in the perception between pastoralists and agro pastoralists that curse/wrath of God is the cause of climate change. That is, 34.4% of the agro pastoralists and 39% of the pastoralists believed that wrath of God is the cause of climate change. In the same way, 23% of the agro pastoralists and 20% of the pastoralists perceived that the causes of climate change are the result of human actions. 17.2% of the agro pastoral and 17% of the pastoral households believe that climate change is the result of natural process, 25.4% from the agro pastoralist and 24%, pastoralist who believed that the cause of climate change is such an activity that is both man-made and natural.

This implies, the pastoralist and agro pastoralist are perceived the major cause of climate change is curse/worth God. Most of the peoples assume that they face climate change impacts as a punishment of God as they decreased worshipping of God. Because of this God has punished them by different impact that already have faced.

Table 7: Distribution of sample HHs by their perception on causes of climate change

Causes of climate change	Frequency of H.H Heads in Kebeles					
	Agro pastoral/Barga		Pastoral/ Galifage		Total Frequency	
	N	%	N	%	N	%
Curse/worth of God	30	34.4	26	39	56	36.60
Human action	20	23	13	20	33	21.57
Natural process	15	17.2	11	17	26	16.99
Human and natural process	22	25.4	16	24	38	24.84
Total	87	100	66	100	153	100.00

Source: Computed field survey data 2017

4.2.2. Temperature

The first change in climate, as perceived by the community, one indicator of change is *temperature*. The change in climate, particularly in temperature has brought with it a change in the livestock condition, health condition of the community people and the physical environment condition.

One of the respondent called Haysama Hussen from pastoral kebele of Galifage said “... hot days are exponentially increasing in temperature and we have learned that this manifests itself the livestock condition, our health condition and the way the physical environment changes...”.

Change in Livestock condition: The changes in the temperature have led the pastoralists to travel too early in the morning to escape a burning sun light. There is also a change for the size of fodder the livestock are getting. As the temperature increases, the animal feeds as declining.

One of the respondent called from pastoral kebele of Galifage said “... before twenty years, our livestock used to stand strong, not early in the morning without feeling sickness or tiresome as they march searching for their fodder, the air was

colder....and return early having enough fodder. However, currently, have to move very early in the morning to escape the hot sun travel, even they move separately because of the hot temperature among them, and return late without enough fodder, and fatigued....”

The health condition of the community is a general indicator of change in temperature. The people do not feel strong to move anywhere they want at any time, especially longer journeys are becoming unthinkable. Few people in our locality might have got sick, if any, before two decades but now many are sick.

One of the respondent called from agro pastoral kebele of Barga said “... Before two decades, we used to move anywhere any time since there was a favorable air... we used to travel long distances on foot... but now simply, we can't...”

The physical condition of the environment has drastically changed for the past twenty years. Scarce fodder, little water, decline of shades in the locality is becoming common.

One of the respondent called pastoral kebele of Galifage said one of the Participants said “...before twenty years there were specific places, with abundant water, fodder and shades, we used to move to. Currently, the temperature is high, the amount of rainfall is low, and the size of fodder we may find for our livestock is small and almost no shade for us. It is becoming harder and harder....”

As shown in table 8, the pastoralist describe the change of temperature based on their wealth rank, pastoral/Galifage kebele community from 13 number of respondent from better of 10 were said increased temperature, 3 were said no change, agro pastoral/Barga community from 18 number of respondent from better of 16 were said increased temperature, 2 were said no change, pastoral/Galifage kebele community from 19 number of respondent medium 17 were said increased temperature, 2 were said no change, agro pastoral/barga kebele community from 26 number of respondent medium 25 were said increased temperature, 1 were said no change, pastoral/Galifage kebele community from 34 number of respondent poor 32 were said increased

temperature, 2 were said no change, agro pastoral/Barga kebele community from 43 number of respondent poor 41 were said increased temperature, 2 were said no change.

Generally, the pastoralist and agro pastoralist perceived temperature is increasing in their locality, and this has led both pastoralist and agro pastoralist are affected in their health status, livestock health, environmental condition, crop and livestock products by increasing of temperature. (see Table 8).

Table 8: Local people's perceptions on Temperature

Kebele	Wealth rank	N	Increase	decreased	No Change
	Better off	13	10	-	3
Pastoral	Medium	19	17	-	2
	Poor	34	32	-	2
Total		66	59	-	7
Agro pastoral	Better off	18	16	-	2
	Medium	26	25	-	1
	poor	43	41	-	3
Total		87	81	-	6

Source: Computed field survey data 2017

4.2.2.1. Mean Annual maximum temperature

It is found that mean annual maximum temperature of Aysaita Woreda varies between 36⁰C and 45⁰C. The lowest mean annual maximum temperature was recorded around the year 1994 and the highest is recorded in 2011. Mean annual maximum temperature of the study area was observed from 1994 to 2014.

This implies, the mean annual maximum temperature identified that an increase of 0.82⁰C in these 20 years, whereas the average annual maximum temperature over the country has been increasing by about 0.41⁰ C every decades. Similar to metrological data in the study area, the local community perceived as temperature increase in both pastoral and agro pastoral community.

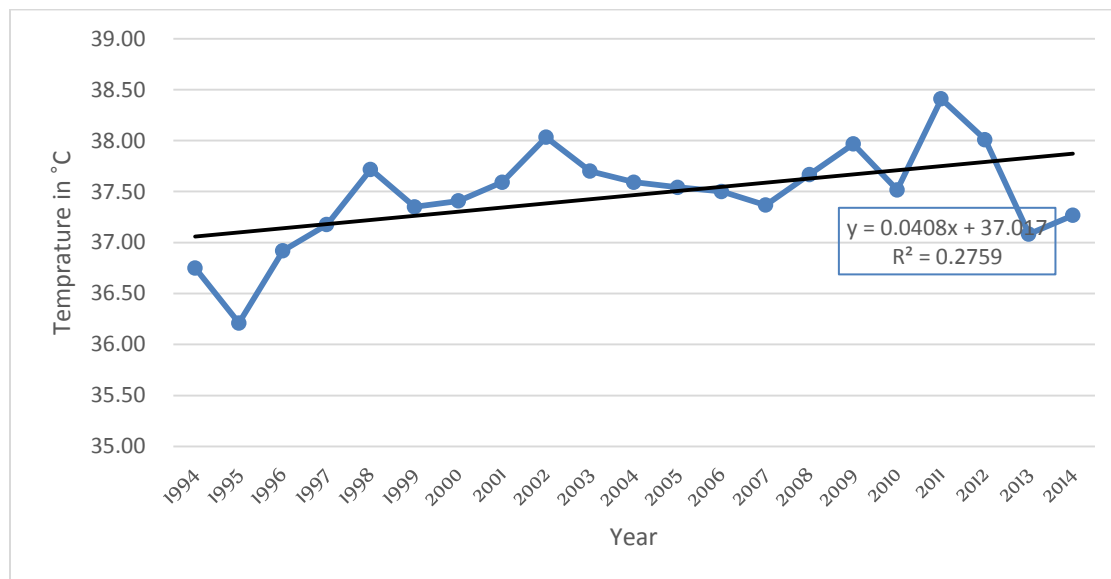


Figure 7. Trend in Mean Annual Maximum Temperature

Source: NMSA 2017

4.2.2.2. Mean Annual minimum temperature

It is also found that the mean annual minimum temperature of the Aysaita Woreda varies between 23.25⁰C and 25.25⁰C during the last 20 years, the lowest recorded being in the year 1994 and the highest in 2011. The figure below shows that the trend is not systematic in that it increases in some years and decreases in some others. The mean annual minimum temperature were increased by 0.62⁰C in the past two decades with an increment of 0.31⁰C in every decades. This indicates as there is irregularity of temperature in mean annual minimum temperature.

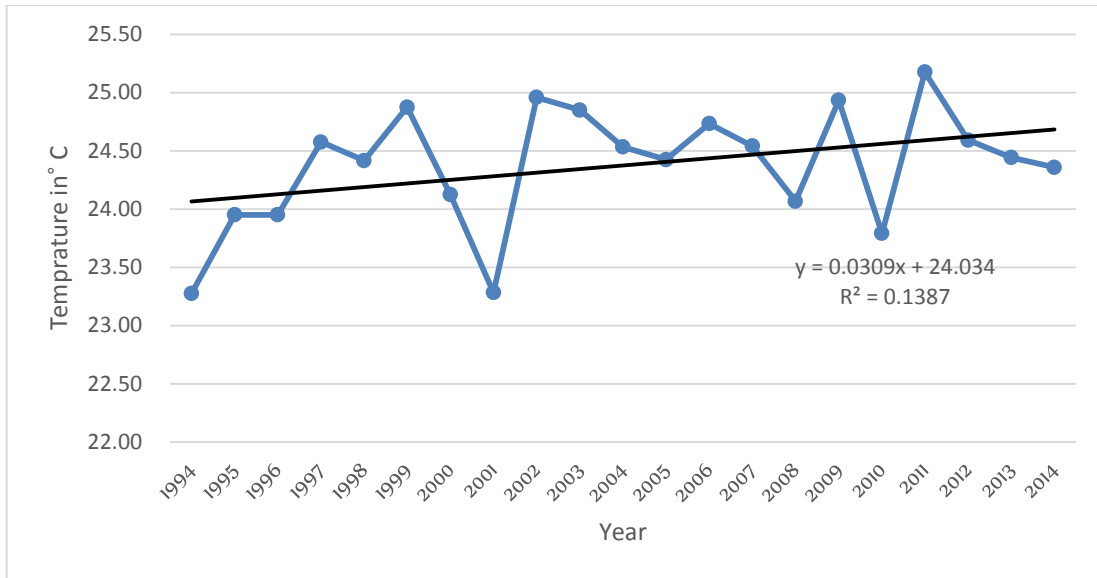


Figure 8. Trend of mean annual minimum temperature

Source: NMSA 2017

4.2.2.3 Average temperature of the woreda

Annual maximum, minimum and average temperatures are presented in Annex 1 and it shows the warmest year was 2011, while the coldest year was 1995. Highest annual range was manifested in 2001, while the lowest range was recorded in 1995. Generally, the trend of temperature shows slight increment from year to year. The average temperature of the study area has increased by 0.72°C in the past 20 years with an increment of 0.36°C in every decades. On the other hand maximum and minimum temperature increased by 0.82°C and 0.62°C respectively in the past two decades.

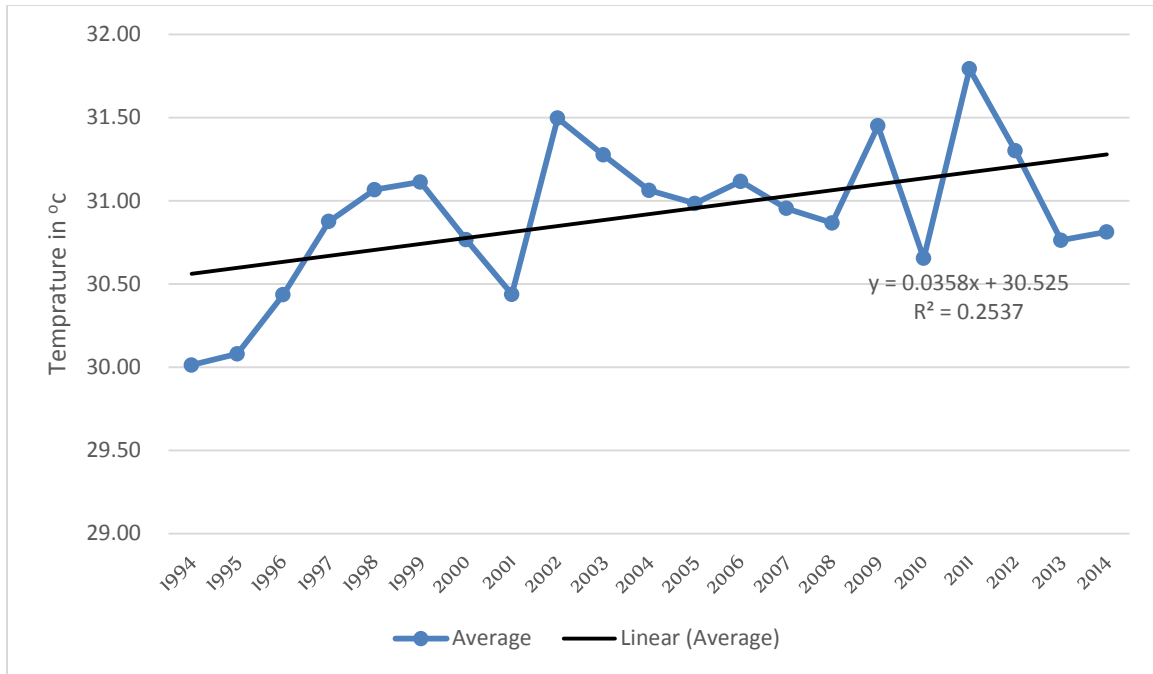


Figure 9. Average temperature of the woreda

Source: NMSA 2017

4.2.1.4. Mean monthly maximum temperature

The mean monthly maximum temperature in Aysaita Woreda for the period of 1994-2014 is 38⁰C which varies between 33⁰C and 43⁰C. Whereas the highest maximum temperature recorded was in June (43⁰C) the lowest maximum temperature was recorded in months January and December (33⁰C). This implies, the metrological data identified that the mean monthly maximum temperature of Aysaita woreda is increasing. Similar to metrological data, the local community perceived as temperature increase in both pastoral and agro pastoral community.

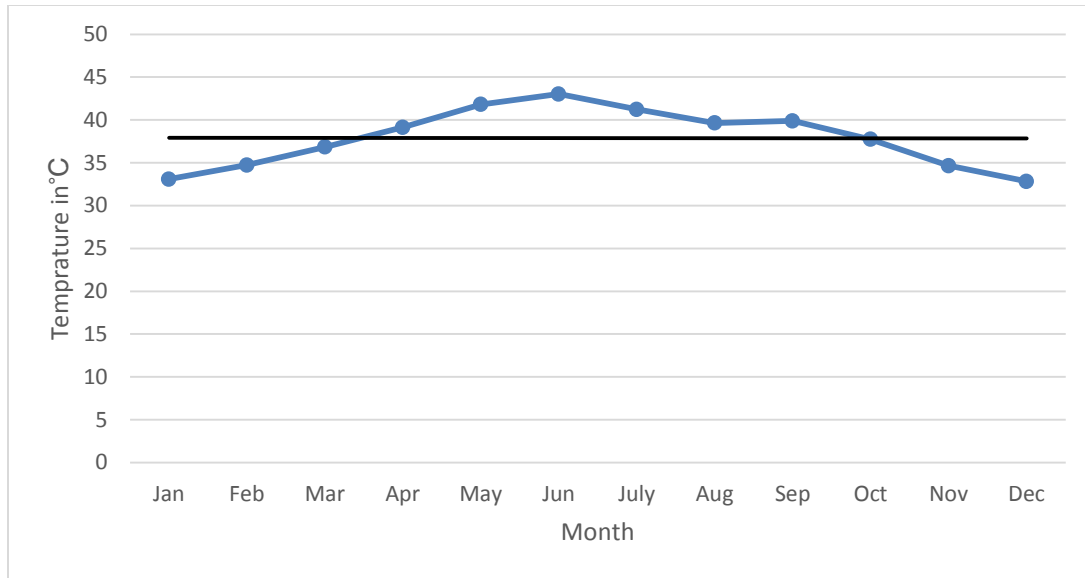


Figure 10. Trend of mean monthly maximum temperature

Source: NMSA 2017

4.2.1.5. Mean monthly minimum temperature

The mean monthly minimum temperature for Aysaita Woreda from 1994-2014 is 24.37°C which varies between 20°C and 28°C. While the highest minimum temperatures observed in June (28°C), but the month with the lowest minimum temperatures is December, which is 20°C. This implies, that similar to local community perception of pastoral and agro pastoral community on temperature, the metrological data also identified that the mean monthly minimum temperature of Aysaita woreda is increasing in month. This indicates as there is increasing of temperature in month.

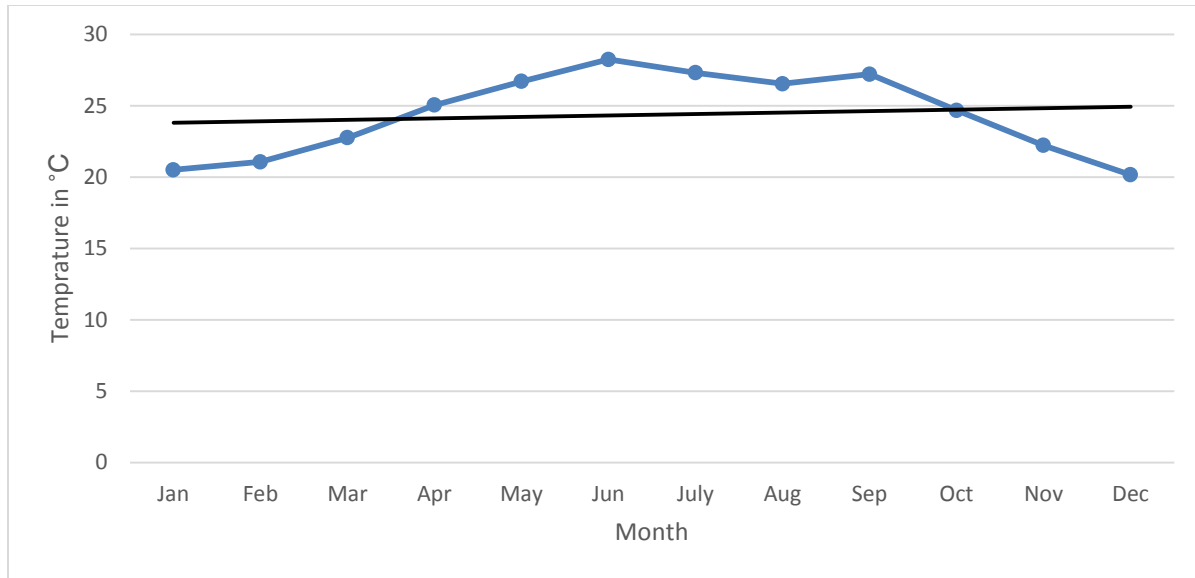


Figure 11. Trend of mean monthly minimum temperature

Source: NMSA 2017

4.2.1.6. Precipitation

Secondly, the local community views change in climate in terms of amount and timing of precipitation. Although the distribution of precipitations varies from place to place and month to month.

Seasonal rainfalls known for the last three decades have currently randomized their timing, shortened rainfall time, and some seasons do not appear at all. Before three decades, the rainfall seasons were known to be classified as “*Dada*” (from December 1-25, which is winter period), “*Sugum*” (from March to April, rainy season), “*Karma*” (from July through September, long rain period), and “*Dabayba*” (from October to November, short rainfall period). Currently, the community believes that the season called “*Dabayba*” is missing. Moreover, the amount of rain has decreased and raining starts late and ends early, shortening the time of rainfall. Although the distribution of rainfall also become varies in pastoralist and agro pastoralist. Even from place to place in their ecology. Finally, such identification of seasons based on their rainfall is becoming hardly possible.

One of the Participants from barga agro pastoral kebele said “.... *Before three decades, the seasons of rainfall could clearly be identified with a regular timing to*

start and end. Besides, all the seasons used to take their turn throughout each year. Now, it is difficult to identify the seasons and the rainfall in some seasons start late and end early, others like “Dabayba” disappeared and also before three decades when the rain was raining it covered a lot of areas but now when it comes cover only little place...”

At karma season (from July through September) time, when the livestock move to “doka” means that the place that take their livestock to search fodder and water at summer time, these pastoral areas with better rainfall called Magara, Hantilale, Undadurga, Uwa and Awra, from zone 4 and zone 5 places where the community moves with its livestock in search of water and fodder during summer time used to have 6-8 months of rainfall in the last three decades. But now, the community moves their livestock back within two months immediately raining stops. This happened because there is a lot of livestock comes to that area from different area. Therefore, it is not enough fodder for their livestock and end quickly. This indicates that the timing of the rainfall is getting shorter and shorter through time.

4.2.1.7. Annual Rainfall Trend and Variability

In Asayita woreda, for the period of 1994-2014, annual rainfall ranging from 0 mm to 38.1 mm with 1994 the moistest year and 1998 and 2015 the driest of all.

The annual trend of rainfall in Aysaita woreda was 125.4 mm and the standard deviation was 61.6. When we compute the coefficient of variance account 49.1% which means this much amount of rainfall is deviated from the mean in the last 21 years.

This has led pastoralist and agro pastoralist to be more vulnerable by decline of pastureland which was help them to get more fodder to their livestock from pasture land and crop productivity decrease due to inconsistency of rainfall (NMSA, 2017). See figure 12 below

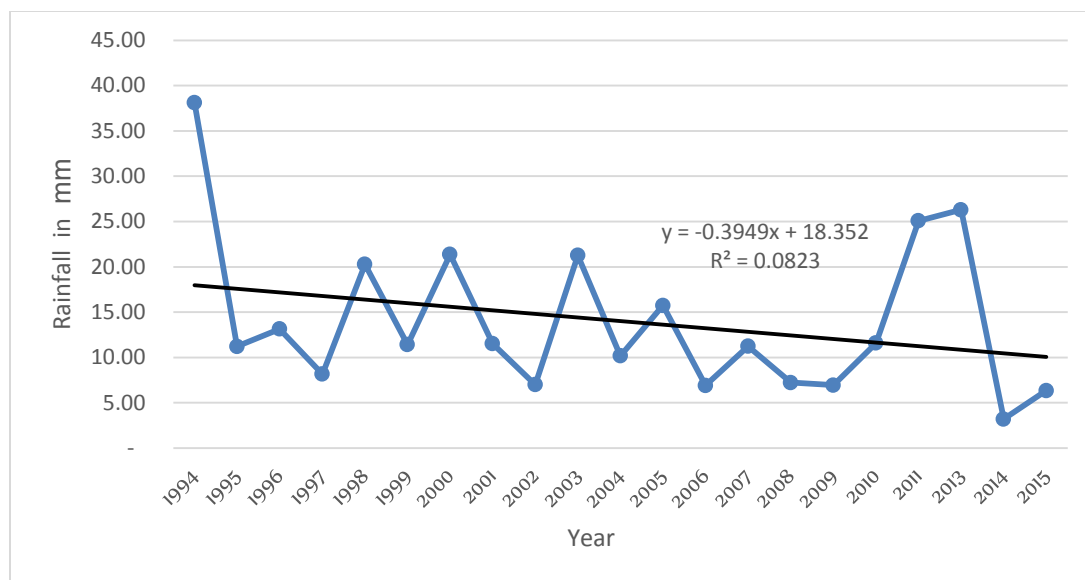


Figure 12. Trend of mean annual rainfall

Source: NMSA 2017

4.2.1.8. Seasonal Rainfall Trend and Variability

As always, Bega (December to February) shows a dry season with few years of rare rainfall whereas a relatively greater amount of rainfall received is during Belg (September to November).

Next to Belg is Spring (March to May) receiving better rainfall. The maximum rainfall in most of years is received in the Kiremt season where peaks of rainfall are recorded for the period 1994–2015.

According the data collected from NMSA 2017, implies 62.43% and 76.4% of spring and bega rainfall was deviated from the mean respectively. Whereas Belg and Kiremt rainfall is deviated 48.8% and 30.1% from the mean. This shows there is a gradual seasonal rainfall variation over the past 21 years in Aysaita woreda. In line with this result also shows 97% of pastoral and 94% of agro pastoral community perceived as rainfall decreased in amount and distribution in their locality.

This rainfall variation in amount and distribution leads pastoralist and agro pastoralist to be more vulnerable by decline of pasture land and cultivated land which was help them to get more fodder to their livestock from pasture land and as well as crop productivity decrease due to inconsistency of rainfall (NMSA, 2017).

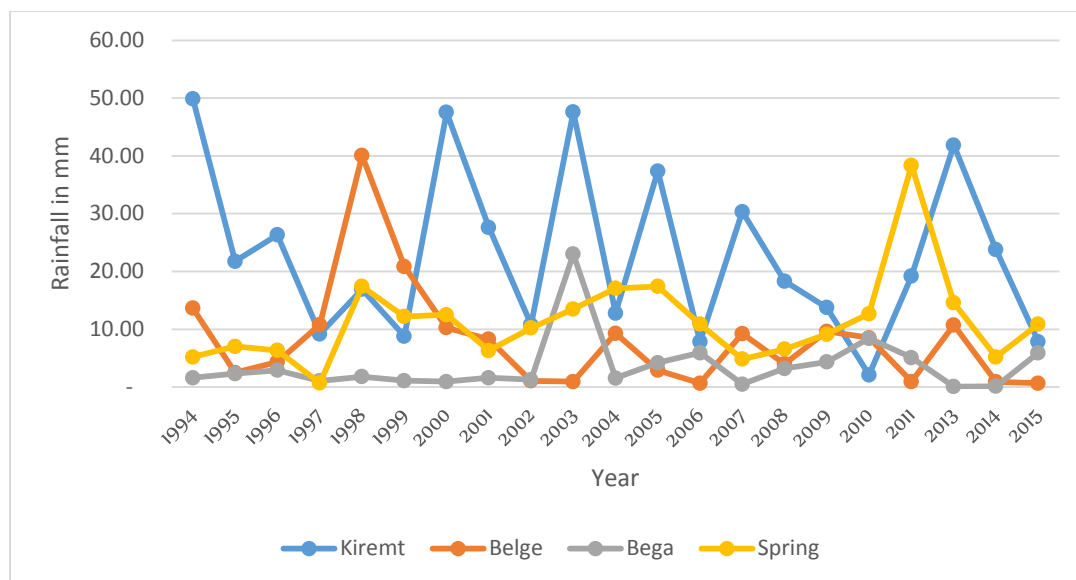


Figure 13. Trend of seasonal rainfall

Source: NMSA 2017

Table 9 shows local people’s perception of rainfall. the pastoralist describe the change of rainfall based on their wealth rank, pastoral/Galifage kebele community from 13 number of respondent better of 11 were said increased rainfall, 2 were said no change, agro pastoral/barga community from 18 number of respondent better of 17 were said increased rainfall, 1 were said no change, pastoral/Galifage kebele community from 19 number of respondent medium 18 were said increased rainfall, 1 were said no change, agro pastoral/barga kebele community from 26 number of respondent medium 24 were said increased rainfall, 2 were said no change, pastoral/Galifage kebele community from 34 number of respondent poor 33 were said increased rainfall, 1 were said no change, agro pastoral/barga kebele community from 43 number of respondent poor 41 were said increased rainfall, 2 were said no change.

Generally, pastoralist and agro pastoralist community perceived as rainfall is decreasing in their locality, and this has led both pastoralist and agro pastoralist community to be more vulnerable due to decreasing of production which pastoralist and agro pastoralist livelihood income depends on livestock and crop production. Due to decreasing of rainfall in their locality pasture land and cultivated land become dry and covered by prosopis juliflora, which was paly vital role for their livestock fodder and crop production. As a result of this pastoralist have faced scarce of production. (see below Table 9).

Table 9: Distribution of the two ways classification of sample HHs by their perceptions on Rainfall and Wealth Status

Kebele	Wealth rank	N	Increased	Decreased	No change
Pastoral	Better off	13	-	12	1
	Medium	19	-	18	1
	Poor	34	-	34	-
Total		66	-	64	2
Agro pastoral	Better off	18	-	17	1
	Medium	26	-	24	2
	Poor	43	-	41	2
Total		87	-	82	5

Source: Computed field survey data 2017

As shown in table 10, This decrease in rainfall as perceived by the local people can be explained in a number of indicators. From the pastoral community 7.5% and from the agro pastoral ones 9.1% of the households have related loss of some plants and animals is the indicator of decreasing trend of rainfall. Early or late coming of rainfall in the community, by 16.7% of pastoralists and 18 % of agro pastoralists, 15.1% of pastoralist and 13% agro pastoral community are perceived as decreased available water is mentioned as an indicator of decreasing of rainfall. Moreover, increased drought and flood, drying of ponds and grazing lands, decreased crop production, and fluctuation of rivers are seen as evidences to the decreasing of rainfall.

Based on this data, pastoralist and agro pastoralist are perceived the major indicator for decline of rainfall in their agro ecology. Most of pastoralist and agro pastoralist elder perceived that by comparing the situation before three decades. Although the community identified that those indicators of rainfall was in the last three decades but now some of them are loss and some of indicator decreased compared to the last three decades.

Table10: Local people's indicator of decreasing of rainfall

Local indicator of decreasing of rainfall	Kebele						
	Pastoral/Galifage				Agro pastoral/Barga		Total
	N	%	N	%	N	%	
Loss of some plant and animal species	5	7.5	8	9.1	13	8.50	
Rainfall come early or late	11	16.7	16	18	27	17.65	
Decreased available water	10	15.1	11	13	21	13.73	
Increased drought and flood frequency	12	18.1	7	8	19	12.42	
Reduced grazing land	15	23	5	6	20	13.07	
Drying of local ponds(Ela)	6	9	10	11.4	16	10.46	
Fluctuation of rivers stream water	7	10.6	13	15	20	13.07	
Decreased crop production	-	-	17	19.5	17	11.11	
Total	66	100	87	100	153	100.00	

Source: Computed field survey data 2017

Table 11: Local people's perception on rainfall in 3 different political regimes

Regime	Climate variables					
	Rainfall					Temperature
	Amount	Duration	Intensity	Starting month	Termination	
Haile Selassie(1930-1974)	High	Long	Low	May	August	Low
Derge(1974-1991)	Medium	Medium	High	June	August	Medium
EPRDF(1991-current)	Low	Short	High	July	End of June	High

Source: Computed field survey data 2017

As shown in table 11, The Aysaita pastoralist and agro pastoralist community households speak of the trends in rainfall and temperature across the three political regimes. They articulated that

temperature is obviously increasing from Haile Selassie Regime (which was low) through the Derge (Medium) to the EPDRF, which is high, while the reverse is true for rainfall: decreases from Haile Selassie through Derge to EPDRF. Similarly, the duration of the rainfall was long during Haile Selassie, medium during Derge, and short for the present. The timing of rainfall with late entry and early exits are also found the Aysaita community trends of rainfall.

4.3. Vulnerability to climate change

4.3.1. Vulnerability for Pastoral kebele

4.3.1.1. Livestock ownership

According having FGD a conversation with the kebele elders (tribe leaders), DAs and kebele leaders, the number of livestock in the pastoral kebele has a decreased trend. In this regard, individual respondents asked the same questions about the trend of animals that they owned and they said from time to time the number of Camel, Cattle and other animals are decreased in number.

One of the reasons for the decline of livestock holding in Galifage areas was reported to be due to shrinkage of grazing land and restriction of livestock movement to the neighboring Regions. This is consistent with the findings of previous studies (Oba 1998, Oba et al 2000, Oba and Kotile 2001, Desta and Coppock 2004), which showed that Borana pastoralism is under increasing pressure due to shrinkage of grazing lands as a result of wide spread of *prosopis juliflora*, demarcation of regional boundaries and. Expansion of cultivation is another factor contributing to the decline in livestock holding. Cattle are the predominant livestock species in all the localities included in the assessment. However, the average household holding of camels and goats is highest in Asayita woreda. But the area are more vulnerable in a unite change of climate in the area and the impact is pronounced more in pastoralists.

Due to climate change induced hazards like recurring of drought leads the pastoralist's livestock's in to death and makes the pastoralist's to be more vulnerable. The declining trend of rainfall in distribution and amount reduce the accessibility of water from time to time which means the pastoralist are more sensitive to the impacts of climate change. This leads the communities to be poorer and reduce their adaptive capacity.

4.3.1.2. Pasture land

According FGD a conversation with the kebele elders (tribe leaders), DAs and kebele leaders, respondent in pastoralist kebele community perceived that pasture land is decreased from time to time. The reason for being vulnerable is increasing population in the study area. This has led pastoralist community to have more livestock. But pastoralist community of communal land for their livestock become small and become decreased. Although their livestock cannot get enough forage from their pasture land, in addition, due to decline of pasture land in other kebeles pastoralist migrate to Galifage kebeles and start using pasture land together because afar pastoralist have the culture of helping each other and risk sharing with their pasture land. Although other reason for decreased of livestock are spread of prosopis juliflora become increased from time to time and this plants cover their pasture land. Due to this pastoralist pasture land become decline which were used for their livestock fodder. This has led Galifage kebele pastoralist community to do not get enough products from their livestock and even their livestock become weak and attacked by disease which has led them to death. According to Aysaita woreda agricultural office report on 2016 stated that even though, pastoral community of Galifage kebele have 2374 hectare of pasture land the community are not using their pasture land due to the above reason.

4.3.2. Vulnerability for Agro Pastoral area

4.3.2.1. Livestock ownership

According FGD a conversation with the kebele elders (tribe leaders), DAs and kebele leaders, respondents agro pastoral kebele, perceived that their livestock production decreased from time to time. The reason for being decreased in their livestock production is firstly, they have not enough pasture land compared Galifage kebele which is used for their livestock forage because the land that they have are classified in to different place such as for farming activities, forest cover, home stead etc. due to this their livestock do not get enough fodder from their pasture land. The other major problem agro pastoralist faced in their locality is spread of prosopis juliflora which has led agro pastoralist to decrease crop production and decline pasture land by covering most of the land. Agro Pastoralist perceived that even if we cut the plants of prosopis juliflora it appears again and again quickly. Due to this Barga kebele agro pastoralist community are getting decreased in

their livestock production as well as in their crop production. This has led agro pastoralist community to be vulnerable.

4.3.2.2.Cultivated land

According FGD a conversation with the kebele elders (tribe leaders), DAs and kebele leaders, Barga/ agro pastoral kebeles farmers are particularly vulnerable to any reductions in crop productivity for a variety of reasons. As indicated above in table 6 of wealth status of the respondent, about 9 farmers from the respondent cultivated very small parcels of land (less than 1 ha), dedicated most of their land to crop production for household consumption and obtain low crop yields, which are insufficient to meet household needs, let alone provided surplus for sale. On the other hand, 4 farmers of participants are characterized as a better of households that they have > 3 hectare cultivated land.

According to Aysaita woreda agricultural office report on 2016 stated, that “Even though agro pastoral community of Barga kebele cover 1984 hectare of farming land from Aysaita woreda the community are not used their faming land properly and do not get enough product”. Even if, productivity has shown a decreasing trend in the kebeles the declining yields in the study area the community usage of agricultural inputs are limited (fertilizers, pesticides, improved seed varieties), the lack of animal traction, the use of low technology practices, spread of prosopis juliflora and land degradation all of which have been identified as constraints to agricultural productivity elsewhere (Randrianarisoa JC, Minten B. 2001 and Minten B, Randrianarisoa JC, Barrett CB. 2007). In addition to shortage of cultivated land with an increase of population and rainfall variability the community faces declining of agricultural products and availability of water which leads their adaptive capacity to be weak.

4.3.3. Perceptions of vulnerability by wealth rank

The following table 12 shows, the perception of vulnerability level in the studied area with respect to wealth rank. The data shows that the ones highly vulnerable are the poor. At the same time, poor vulnerability is higher for the pastoralist than agro pastoralist. As expected, the wealthier are not perceived to be vulnerable in both pastoral and agro pastoral communities.

Over all, from pastoralist and agro pastoralist community poor and medium wealth rank were more vulnerable than better off wealth status group due to imbalance of livelihoods income generating was differ from those wealth group.

Table 12: Vulnerability level and wealth status

Kebele	Wealth rank	N	Vulnerability level			
			High	Medium	Low	Not vulnerable
Pastoral	Better off	13	6	3	2	2
	Medium	19	9	5	3	2
	Poor	34	22	8	3	1
Total		66	37	16	8	5
Agro pastoral	Better off	23	10	5	2	1
	Medium	26	16	6	4	-
	Poor	38	30	5	3	-
Total		87	56	16	9	1

Source: Computed field survey data 2017

4.3.4. Vulnerable groups

Vulnerable Groups

Based on social assessment report for RPLRP in four region of Ethiopia, (2014) has mention that pastoralist and agro-pastoral communities are more vulnerable to shocks and drought due to the fact that they live in the arid and semi-arid areas where precipitation is erratic. This area is highly vulnerable to natural problems such as; drought RPLRP, (2014). Based on the data conducted from pastoralist and agro pastoralist kebele community the way of life in Aysaita woreda is make to be vulnerable. Even if all pastoralists and agro-pastoralist groups are vulnerable, women and children are more vulnerable compared to men and elder the factors make women and children are more vulnerable indicated below.

1. Women and children

Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention, in both pastoral and agro pastoral

community kebeles, Women's make the maximum work among the pastoral communities under pastoralist and agro pastoralist community. Most of work is both the creative and propagative work mainly on their shoulder. women were active members who were responsible to feed the household members, by collecting water from distance area, collecting fuel wood from forest, preparing food for her family, feeding and keep her children. Whereas children are also vulnerable due to less capacity to have resilience from the incoming disease, drought, and also they cannot move long distance to search food or cannot cope from the incoming hazards Thus, women and children can be categorized under the vulnerable segment of the population.



Figure 14. Women collecting water from distance area

Source: Computed field survey data 2017

2. Elderly group

Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention, in both pastoral and agro pastoral community kebeles, the elderly groups are also vulnerable to climate change next to women and children. Meanwhile the elderly people are old, physically weak and face some health problems due to their Ageing. In addition, pastoral elderly group are not working like younger people and can move with their livestock from place to place. At the same time agro pastoralist elderly group also cannot take hard work like farming due to their age and weak health status condition. This

has led pastoralist and agro pastoralist elder group faced the survival of high risks and shocks effects more than youngsters and adults.

3. Men

Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention, in both pastoral and agro pastoral community kebeles, Men are also vulnerable to the incoming climate change, even if the degree of vulnerability to climate change are less compared to women, children and elderly groups, they have face high risks and shocks that make them to do not resist and keep their livelihood. Due to loss of livestock and crop production at both pastoral and agro pastoral community respectively.

As shown in table13, in these communities; women perceived being the most vulnerable and the men being the least vulnerable next to elderly. However, the vulnerability of these social groups is not different whether for pastoralist or agro pastoralists. For example, a proportional size of women (49.4%) is perceived to be vulnerable in the agro pastoralist community while 47% of the pastoral community believes that women are vulnerable to climate change 25.3% of agro pastoral and 27.3% pastoral children taken the second rank being vulnerable to climate change, 13.8% of agro pastoral and 16.7% of agro pastoral of elderly were the third social group said to be vulnerable to climate change, whereas 11.5% of agro pastoral and 9% of pastoral men were the last social group to be vulnerable to climate change

Generally, this data implies that in both pastoral and agro pastoral community of study area women and children have faced major hazards due to overload of work and lack of resistance capacity and this has led pastoralist and agro pastoralist community to be easily become vulnerable which take them to death compared to men and adult community. (see Table 13).

Table 13: Identification of vulnerable components of society

Segments of social components	Kebele			
	Agro pastoral /Barga		Pastoral /Galifage	
	N	%	N	%
Women	43	49.4	31	47
Children	22	25.3	18	27.3
Elder	12	13.8	11	16.7
Men	10	11.5	6	9
Total	87	100	66	100

Source: Computed field survey data 2017

4.3.5. Perceptions of Local Community on causes of vulnerability to climate Change

Drought

According to (Aydahis A. 2011) in his study mention, while drought is not a new occurrence in the study area, it has developed plain and recurrent in recent years. When compared to past three decades, the drought cycle is repeated again and again, this hazard is not giving enough time to recover from its impacts. Predominantly, the last three decades it has seen more recurrent and long drought periods. During the recent drought, the rains were not only scarce but also extremely unpredictable (Aydahis A., 2011).

Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention, Drought make the pastoralist and agro pastoralist community to be exposure for vulnerability by making crop damages, loss of pasture, spread of human and animal diseases and deaths, lack of irrigation, migration; as the area is vulnerable, it is becoming hard to make all the necessary treatments to such effects.

Flood

According to (Aydahis A., 2011) in his study mention, Pastoral and agro pastoral community of Aysaita woreda is most flood-prone as it is exhausted by big perennial river called Awash that

incline from the humid central highlands of the country. Frequent flash and seasonal floods from the Awash River have caused extensive destruction of life and property and massive displacements in the both pastoral and agro pastoral community. The floods also demolished numerous villages, infrastructure, and crop production. Aysaita Woreda have also faced, flooding of the Awash River caused to migration of people and destroyed about of cropland. In addition to that flood bring direct loss of life and property, the floods have led pastoral and agro pastoral community to the diseases such as diarrhea and malaria. (Aydahis A., 2011).

Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention, pastoralist and agro pastoralist community becomes exposure to vulnerability due to unexpected overflow of the Awash River, heavy rainfall on the highland areas, is challenging the pastoralists' livelihood. Tributary rivers to the Awash from highlands like Raya, Kobo, Golina, Elwuha, and Sirinka cause flood enough to destroy crop, irrigation and pasture, mixing toilet wastes with water ultimately to diseases and death.

Lack of drinking water: One of the most decisive factors that made the Aysaita community highly sensitive to vulnerability is lack of drinking water in both pastoral and agro pastoral community. This has almost affected every aspect of their lives.

One of the respondent from agro pastoral kebele of Barga said "... as you can see, the River of Awash is very near to us but its water is not clean as it was before. Specially, within this 2-3 year, a lot of animal died in the river contaminating the river. In this locality, so many children and adult members of the households have got sick because of drinking tainted water from this very river...".

On the other hand, pastoralist have identified that lack of drink water is the major causes in their locality.

One of the respondent from pastoral kebele of Galifage said "... Firstly, to get water in our locality is less due to lack of water capacity and Awash River is from our settlement area. Even if we got drink water which collected from Awash River and Ela or local pond, the water we got is not clear due to waste and animal died

particle is inside of it. The reason for waste of water is Ela is naturally opened for every one and easily waste material and animal can inter to water and died inside of Ela. Whereas Awash River also took a lot waste and died animal within this 3-4 year.

Human and Natural causes:

Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention, pastoralist community of adaptive capacity become less due to Natural causes of vulnerability to climate change as perceived by the community under study including flood, Crop diseases, soil erosion, land degradation are the major variable for the natural cause. In addition, Human cause also decreased the adaptive community which makes pastoralist to be vulnerable. This happened when pastoralist and agro pastoralist community in the study area start using natural resource to different activities in order to survive from incoming hazards in their family such activities have caused climate change. This cause includes water pollution, deforestation, transmitted disease in both human and livestock, air pollution, decreasing of water availability, decreased crop production as well as livestock due to using forest for their fire wood Charcoal activities.

Government intervention. Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention, most of the pastoralist and agro pastoralist livelihoods used to depend on Awash River for their drink water, pastureland and agricultural activities. Currently, such government interventions are making the community vulnerable to climate change.

Areas of Government intervention

1. Sugarcane Factory: the construction of dam on Awash. River has affected the lives of pastoralists and agro pastoralist in two ways: (1) it limits the amount of free water flowing in the area. (2) It damages their shelter and crop during water release at the dam as it results in overflow. In the words of the participants, it goes

“... The government promised opportunities for the community when starting the factory. One agreement was that the community would utilize the River without limitations. Secondly, the by-product called molasses would serve as fodder for their livestock... thirdly, there would be job opportunity created for the community. In reality, none of these promises is kept and the jobs created are for the highlanders because of the backward belief that the Afar people are not willing for jobs. Our children with degree graduates are left jobless.... The factory does not only serve nothing for the community but also worsened the Awash River water availability and resulted in unexpected overflow of the water... “

Settlement Program: Naturally, the pastoral and agro pastoral community under study depend mainly on mobility in search of fodder pasture and water for their livestock. Because of this settlement program, communal land for the livestock lost and there are no places to move to in search of fodder and water as such places are already taken by the government.

One respondent from pastoral kebele of Galifage *“...the government promised us that the infrastructure and fodder communal land for their livestock, clean water for drink, school, health center for human and livestock etc. would be arranged... we got money to survive from the settlement but after few months, it completely stopped. Now there is no place for mobility to take our livestock for searching fodder and water because we are already taken our land by government...”*

Table 14: Local community perceptions causes of vulnerability to climate change

Causes of climate change	Kebele			
	Pastoral/ Galifage		Agro Pastoral/ Barga	
	N	%	N	%
Drought	15	22.7	18	20.7
Flood	11	16.6	12	14
Shortage of drink water	13	19.6	10	11.4
Natural and human causes	8	12.1	10	11.4
Pest and herb infestation	-	-	17	19.5
Government intervention	19	29	20	23
Total	66	100	87	100

Source: Computed field survey data 2017

As shown in table 14, based on FGD, and interview of pastoral and agro pastoral community perception the most significance cause of vulnerability in their locality are government intervention which account 29% and 23 pastoral and agro pastoral respectively. 20.7% and 22.7% pastoral and agro pastoral community were droughts respectively are ranked in significance next to government intervention. Flood account 14% and 16.6% pastoral and agro pastoral respectively. Shortage of drink water in their locality account 11.4% and 19.6 pastoral and agro pastoral respectively. While natural and human cause are account 11.4% and 12.1% pastoral and agro pastoral community respectively. But in the cause of pest and herb infestation have difference in both agro ecology which account 0% and 19.5% pastoral and agro pastoral respectively. The reason behind this difference is pastoral community in their locality do not have any kinds of farming activities, their livelihood activities is only by their livestock products and hand craft activities. Whereas, agro pastoral community have different activities such as; farming, hand craft, livestock raring. This makes them to have varieties of cause as well as income in their locality.

This implies, pastoralist and agro pastoralist to be more vulnerable due to such causes of vulnerability. This has led pastoralist and agro pastoralist community to decrease their livestock production as well as decreased crop production pastoral and agro pastoral respectively. Although

when decreased crop production and livestock production pastoralist become vulnerable disease which has led them to death.

4.4. Pastoral and agro pastoral community perception on impacts of climate change

Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention, Climate change and its impact have needed severe impacts on livestock and crop production up to current time. Both crop production and livestock rearing are practiced in both agro pastoral and agro pastoral area respectively. Therefore, the pastoralist livelihood of the community is easily vulnerable to climate change. Some of impacts of climate change on livelihood of pastoral and agro pastoral stated by FGD participants, community representatives and experts include that the main natural controls to accessing food and producing. The impacts of climate change in both pastoral and agro pastoral community classified in to two. Based on livelihood income and based on natural resource and environment. Impacts on livelihood income pastoralist stated that migration, human and livestock disease and famine. Whereas, impacts on natural and environmental resource pastoralist stated that deforestation, environmental degradation and *prosopis juliflora*.

4.4.1. Impact of Climate change on local community livelihoods

Human and Livestock disease and their death

During FGD participants, community representatives and experts with pastoral and agro pastoral community in different group, identified that the livestock death in the area is affected by various factors such as, shortage of water capacity, scarcity of feed, epidemic of diseases, such disease that have faced in both human and livestock are; ***Livestock diseases*** like Hunkuf, Sangitie, Dagahabe, Abab, Yogoyta, Noke and Kirbi are known ones in this area. Exacerbated by lack of animal health centers and lack of professionals (if any center), foot and mouth diseases of livestock are prevalent. Likewise, ***Human diseases***, such as Labha-dore [TB], Barars [Skin disease], Assa-hutuk, Gurdifi [Kufign], Urigita [Cholera], Bagedo, Malaria and Diahrea are common. Diahrea is the most prevalent of all.

Migration

During FGD participants, community representatives and experts with pastoral and agro pastoral community in different group, stated that pastoralist and agro pastoralist suffer a lot problem such as; hunger, shortage of water availability, livestock death and human death, decreased milk and crop production, etc. this make pastoralist and agro pastoralist to leave their home stead place and went to survive from the coming income of impact on their locality.

Famine

During FGD participants, community representatives and experts with pastoral and agro pastoral community in different group, stated. Pastoralist and agro pastoralist have lost enough production from both livestock and crop. This has led pastoralist and agro pastoralist community affected for incoming impacts due to hunger and lack enough support from government and non-governmental sectors.

As shown in table 15, the most significant impact of climate change is believed to be famine, which accounts for 46% and 47% agro pastoral and pastoral respectively, migration believed to be the second impacts of the community which account 33% and 32% agro pastoral and pastoral community respectively. Whereas, Human and livestock disease and their death are the third impacts of climate change affecting the livelihoods of pastoral by accounting similar percent in both kebeles 21% and 21% agro pastoral and pastoral community were pests and herb infection respectively are ranked in significance next to drought and Human and livestock disease and their death in the pastoral community as impacts of climate change.

This implies, both pastoralist and agro pastoralist community are affected by those variable written below. This has led pastoralist and agro pastoralist community in the study area are facing a lot of hazards which cannot survive from those impacts and this impacts gave for the community an inconsistency of livelihood in their locality. Although this impacts have problem in their health status and which led them to leave their home stead place due to the incoming impacts. see below table 15.

Table 15: Major hazards affecting the livelihood Impacts of climate change

Major hazards' of livelihood Impacts on climate change	Kebele			
	Agro pastoral/ Barga		Pastoral /Galifage	
	N	%	N	%
Migration	29	33	21	32
Human and livestock disease and their death	18	21	14	21
Famine	40	46	31	47
Total	87	100	66	100

Source: Computed field survey data 2017

4.4.2. Impacts on natural resources and the environment

Impacts on environmental degradation

A study by Angassa and Oba (2007) in the range lands of southern Ethiopia concluded that, the events of drought and rainfall variability seriously affects the grazing land of the pastoral communities found there. Climate change is also a major factor for the increased level of deforestation and decline of woody species as in range lands where pastorals and agro pastorals rear their herd as in southern Ethiopia (Angassa and Oba, 2007). Even though the interferences by development organizations, loss of biodiversity has become the major impact of climate change in pastoral areas and according to the study conducted by Bassi and Boku (2007) in the Borena pastoralists of Ethiopia; this is the more improved by the disregard of customary natural resource management strategies by pastoralists. Climate change is also mentioned to cause degradation of soil resources and drying up of wetlands and water points that are very key to the livelihood of pastorals.

During FGD with pastoral and agro pastoral community kebeles in different group, has mention that the major ecological impact of environmental degradation. The range land resources can be expressed mainly by the pasture and water conditions. The recurrent droughts during the last two decades caused in reduced the quality and quantity of feed production. i.e. grass, shrubs and trees.

Over grazing, especially in the grazing areas, increasingly reduced the rangeland's species composition and some traditional grazing lands have been changed to rocky.

Deforestation

During FGD participants, community representatives and experts with pastoral and agro pastoral community in different group, stated It is also another cause for environmental degradation in the pastoral and agro pastoral kebeles. It is mainly practiced during drought period when the pastoral and agro pastoral community start sales of charcoal and fuel wood in order to serve as adaptation or coping mechanism to temporary scarcity of food. Also related to the fading of pasture lands, a number of forage species, mainly grass species, are declining because of the recurrence and extended drought did not give them a time for the dormant seeds of the grass species to grow.



Figure 15. Deforestation in the study area

Source: Computed field survey data 2017

Prosopis Juliflora

Prosopis juliflora is now covers around 3,600 km² in Afar with a possible to spread over 5,000 km² of appropriate environment (Tewodros Wakie et al, 2014:4-5). It also has caused prevalent vegetation changes, although reducing the accessibility of the whole range of savannah species and indigenous trees from the areas attacked. Another estimation about *prosopis juliflora* indicates

that 70 % (or approximately 500,000 hectares in 2006) of all *Prosopis juliflora* in Ethiopia is establish in the Middle and Lower Awash (Rettberg and Müller Mahn, 2012:297).

During FGD participants, community representatives and experts with pastoral and agro pastoral community in different group stated, the spread of *Prosopis juliflora* has affected both pastoralists and agro pastoralist. This has led agro pastoralist to leave their farm land, whereas pastoralist have to change the structure of their livestock and that livestock productivity has been reduced. Animal health problems as well as increased incidence of malaria in the human population have been happened. *Prosopis Juliflora* is also another cause for impacts environmental in both pastoral and agro pastoral kebeles. It is mainly affect Loss of pasture and crop land has been exacerbated by an invasion weed named which is difficult to remove by the community and the government effort as well.

As shown in table 16, 43% and 30.4% agro pastoral and pastoral community were perceived that affecting the impacts on natural resources and the environment were deforestation 39% and 24.2% agro pastoral and pastoral community were perceived environmental degradation respectively, whereas 18% and 45.4% agro pastoral and pastoral community were perceived Invasions of *prosopis juliflora* respectively.

This implies, both pastoralist and agro pastoralist in the study area are faced impacts on their natural resource and as well as in environment. This has led pastoralist and agro pastoralist to do not get what environment gave to their livelihood asset and as well as for their and also spread of *prosopis juliflora* have had an impact on livestock health and crop production by covering farming land and killing livestock after they ate this plants. Table below 16

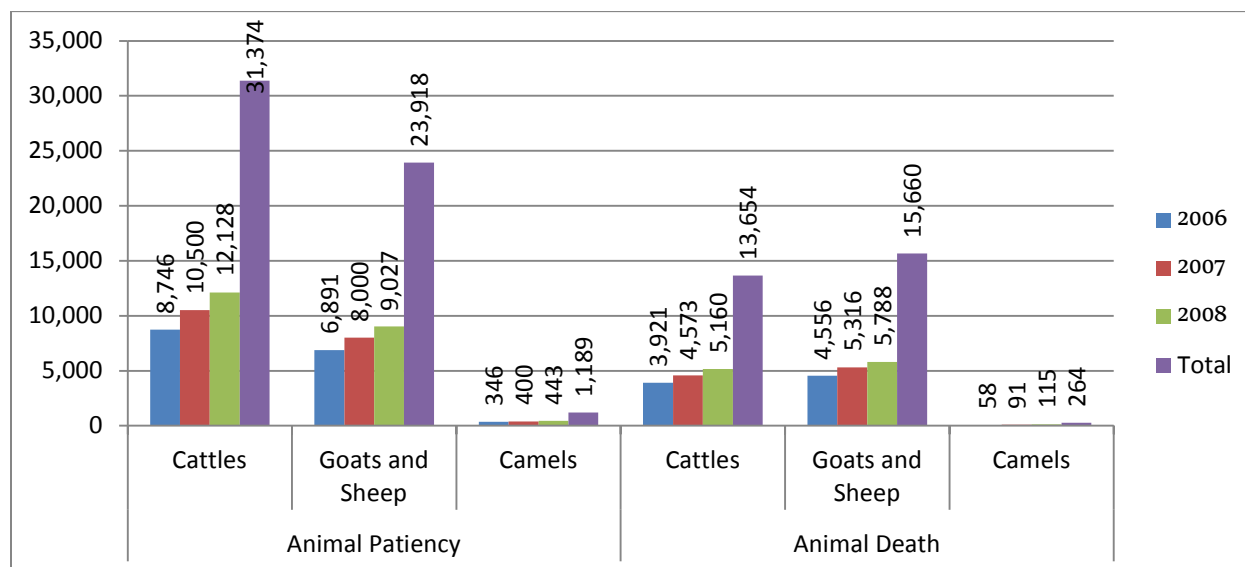
Table 16: Major hazards affecting impacts on natural resources and the environment

Major hazards of impacts on natural resources and the environment	Kebele			
	Agro pastoral/ Barga		Pastoral /Galifage	
	N	%	N	%
deforestation	37	43	20	30.4
Environmental degradation	34	39	16	24.2
Invasions of prosopis juliflora	16	18	30	45.4
Total	87	100	66	100

Source: Computed field survey data 2017

4.4.3. Trend of Animal Patience and Death

The result from the table below indicates that animal patience and death are increasing in three years' time. For examine Animal patience has increased with an average 12 % per year for cattle, 10% per year for goats and sheep, and 8% per year for camels. Animal death also has increased in these three years' time; 10% per year for cattle, 8% per year for goats and sheep and 32% per year for camels, which is the maximum. This has led pastoralist and agro pastoralist community to be more vulnerable due to decreasing of livestock productivity.

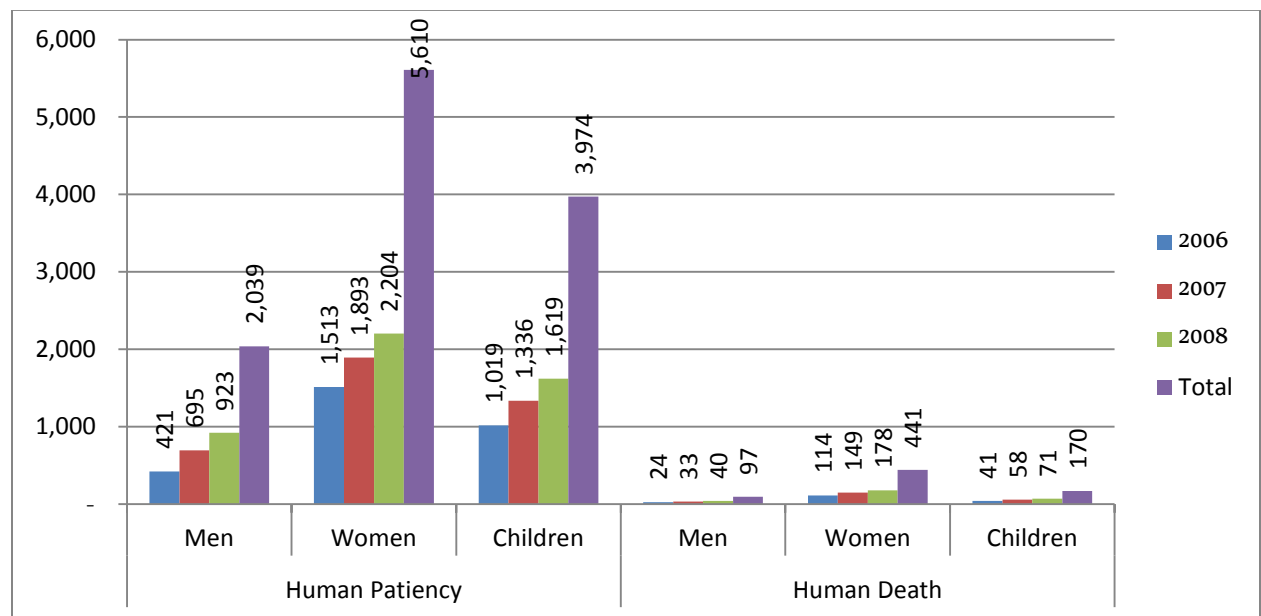


Source: Computed field survey data 2017

Figure16. Animal patience and death

4.4.4. Trend of Human Patency and Death

The data from the community shows that women are most vulnerable to diseases and deaths followed by children and men. Due to overload of work and lack of resistance for incoming disease make children and women more vulnerable to climate change impacts. This finding is congruent with the perception that in pastoral and agro pastoral communities, women and children are the most vulnerable to climate change and thereby the most impacted ones. The figure shows that in the last 3 years' human patency and death are increased. although figure shows that most affected groups are women and children compared to men.



Source: Computed field survey data 2017

Figure 17. Human Patency and death

4.5. Climate Change Adaptation Strategies

Mobility Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention, it is the most widely employed adaptation strategy of Aysaita Woreda community to overcome water and pasture shortages is mobility, mobility from area of scarce water and fodder to areas of abundance. Pastoralists also stated that, this adaptation strategy enabled them to temporarily settle around water points and grazing lands with abundant pasture for their livestock. Mobility has been

servicing pastoralists as successful adaptation to different climatic and environmental hazards as well as to the difficult nature of the arid environment.

a strategy whereby the community moves to water and pasture reserve areas for their livestock during dry seasons like magara, Hantilale, Undadurga, Uwa, and Awra. Table17, shows that, half of the respondents 52% of the pastoral and 30% of the agro pastoral community move in search of water and pasture. This implies, pastoralist and agro pastoralist community have used mobility as their major adaptation mechanism in order to get more fodder and water for their livestock as well as to keep their livestock health status. This has led pastoralist and agro pastoralist to get more livestock products and keep their livelihood status.



Source: Computed field survey data 2017

Figure 18. Pastoral mobility with their house

Fodder Management – Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention, Table 17 show that the respondents there is no such adaptation strategy under practice within the pastoral community and little practice, which is 16% of respondent in the agro pastoral community of Aysaita Woreda. Thus, fodder management is not found to be an adaptation strategy actively employed by the community. In addition, this adaptation mechanism has been used only in agro pastoral community. Due to lack of enough water pastoralist do not use farm activity. Even if

agro pastoralist use this adaptation mechanism, they do not get enough survival income from fodder management due to lack of market sufficiency.



Source: Computed field survey data 2017

Figure 19: Maize biomass as a fodder

Non-farm activities -Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention, this adaptation mechanism is the second most important adaptation strategy to climate change by both pastoral and agro pastoral kebeles of the woreda in the study areas was Non-farm activities. Out of the total number of respondents, 30% pastoral and 34.5% agro pastoral have used this strategy to adapt the vulnerability and impacts of climate change. These activities include selling of different handouts to the community. Such as local mat, Charchol and fire wood etc.

Diversifying Livestock and Crops -Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention, *the* pastoral and agro pastoral community mainly lives on camels in addition to cattle, goats and sheep whereas most agro pastoralists rear cattle, sheep and goats than camels. In terms of crop, the agro pastoralists are engaged in varieties like maize, tomato, onion and grass productions through irrigation. 18% pastoral and 19.5% agro pastoral households indicated that such diversification of crops and livestock account for about of the adaptation strategies employed in the community

This implies pastoralist and agro pastoralist community use diversifying livestock and crop production as one of adaptation mechanism in their locality in order to get more income to their family and to survive from the impacts that have been faced. In addition, agro pastoralist community are get more income compared to pastoralist community due to using different diversification of crop production and livestock production. (see Table 18).



Source: computed field survey data 2017

Figure 20. Diversifying Livestock and Crops activities in pastoralist

Table 17: Local People’s adaptation mechanisms

Climate change mechanism	Kebeles			
	Pastoral/Galifage		Agro pastoral/Barga	
	N	%	N	%
Fodder management	-	-	14	16
Mobility	34	52	26	30
Diversifying livestock and crops productions	12	18	17	19.5
Off/nan-farm activities	20	30	30	34.5
Total	66	100	87	100

Source: Computed field survey data 2017

4.5.1. Local coping Mechanism

Additional Feeding

Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention, due to the decline of feed availability for animals, the pastoralists community have used by cutting trees branches in order to feed their livestock with the leaves and pods of the trees. This has led pastoralist community to get more products by keeping their livestock health and preparing fodder.

Use of Local medicine

According to (SAILSAPC,2011) Local healers exist within each clan. However only little people know the medicinal plants. The knowledge is transferred to their own children. Fathers teach their sons how to treat the people and livestock and even father teach what type of medicine to use and for which disease. In both pastoral and agro pastoral community culture his sons will not start the treatment or medication as far as his father is alive and also this community are perceived that always this medication will teach for his eldest son who will takes the position of his father as a traditional healer. at the same time, if the elder son is not talented enough, the community can approve any brilliant person among the brothers to practice the medical treatment from their father. In pastoral and agro pastoral community, several of the local healers specialize in one or two medicines. The specialized healers are found at different communities. Different diseases are treated differently. The major diseases are getting medicine using plant roots, which can be given either through adenoidal or mouth. Minor disease like headache are treated using plant leaves. There are also specialist's healers in pastoral and agro pastoral community who can treat broken bones and wounds. (SAILSAPC,2011)

Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention, in order to keep the health of livestock and human health these strategies identified in the use of local drug medicine and plants to treat livestock and human diseases.



Figure 21: local medicine in pastoralist area

Source: computed field survey data 2017

Selling of Fuel wood and charcoal

Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention, selling of fuel wood and charcoal is another adaptation strategy which is used by both pastoralists and agro pastoralist. This has led pastoralist and agro pastoralist to get more income generating mechanism in order to survive their family and to cope up with incoming impact of drought.



Figure 22. Income from fuel wood and charcoal

Source: computed field survey data 2017

Change Meal size, frequency

According to FGD pastoral and agro pastorals kebele community has identify that the adult people commonly eat two times per a day whereas children are commonly eating three times. In other way, during the serious food scarcity periods the community has confirmed that the size of meal and frequency will be decreased for all household members. But these reduction activities mainly start with adult and when it became worse it may continue with children.

Change in food habits

According to FGD pastoral and agro pastorals kebele community has identify that pastoralist have been persuading changes in their food habit. The main foods of the community are parched maize flour with milk which is locally known as “Afar *Gaqambo*”, milk and meat are also commonly used foods. However, decreasing in availability of milk and “Afar *Gaqambo*”, at household level, which resulted from drought, the pastoral and agro pastoral community has changed their food habit from “Afar *Gaqambo*”, milk and meat in to *Injera and shero*.

Renting, Rearing, Buying and Selling Livestock

Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention’s the major coping mechanism adopted by households whereby the community sells livestock like cattle, sheep, goats and camels at the time of drought and buys and rears at the time of preservation. Although pastoralist and agro pastoralist community have rent their camel for contraband activities and also oxen are also rent for farming activities. This implies pastoralist and agro pastoralist have been used different adaptation mechanism in order to get additional income to their family. This has led pastoralist and agro pastoralist community are looking to cope up with incoming impacts.

Isolation of Sick animals

Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention, it is a mechanism where households isolate/segregate sick animals from healthy ones to tackle disease transmission. Most of time this adaptation mechanism is done by pastoralist compared to agro pastoralist. this has led pastoralist

to keep the rest of their livestock health form disease by putting the sick animal at different place from the remain herds.



Source: computed field survey data 2017

Figure 23. Livestock disease prevention (isolation)

Sharing risk

Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention's another adaptation strategy with deeply engrained cultural roots where both pastoral and agro pastoral households help each other at the time of high disaster. In addition, this adaptation mechanism in pastoral and agro pastoral community are done not only in hazard time also used in marriage time also help each other. However, this cooperation is decreasing for the last years as the frequency of the disaster increases and the capacity of the households to share weakens.

Local weather forecasting system

Based on interview, FGD participants, with pastoral and agro pastoral community in different group has mention's one of the local coping mechanism in the study area by forecasting the weather condition they search fodder area for their livestock. Although pastoralist prepared them self to incoming rain.

“one of the respondent from pastoral kebele said we have used weather forecasting system to know where the rain is raining now and where would be rain. This make us to be prepare our livestock to move to that area”.

Polygamy Marriage

Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention, polygamy is one of the major adaptation strategy where men have two families /therefore wives/ – one from pastoralist and the other from agro pastoralist to facilitate sharing of crops produced and livestock from the unaffected family to the affected one as a drought resilience mechanism. In the words of the participants, it goes:

“I have two wives in two different locations. One of my wives lives in Galifage pastoral kebele and the other is living at Barga agro pastoral kebele. I have four sons and a daughter form Galifage pastoral kebele and two daughters and a son from agro pastoral kebeles and I own eight cows, two oxen, four goats and a camel in Galifage pastoral kebeles. I also have three hectares of farming land in Barga agro pastoral kebele. I am working with both at farming and livestock rearing because all of my children are helping me in livestock rearing. I share both livestock products (including milk) and crop products from both families equally back to both of them...”

Handicrafts

Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention, afar pastoral women are knowledgeable of making different kinds of handicrafts made from local materials such as grass, skin and hide, wood, etc. The handicrafts are made for home utensils and sometimes sold to generate income. Handicraft that are made by Afar women are include: Qunga, Fidima, “Dibora” local mat, Gadbo, Sifala, milking equipment, “ayni” and “Kaunta” milk collection jar, “olloyta” local bed from wood and skin, rope, leather products, “Eheya” grinding mill made from stones, etc., “Maybaraha” local fan to cope up with coming temperature, “Alayto”and “Gandu” local cosmetics for women.

Afar pastoral Men are also make different activities to help their family such as: “Adytu” local teeth brush, Local Drag, Sale of Natural Products of Animal Feed (Ayso/Grass, Fodder, Forage, Salty Sand. Contraband Market, Charchol Selling, Fire Wood Selling, “Temer” local palm tree, “Biro” maize product selling.



Source: computed field survey data 2017

Figure 24. Adaptation strategies of pastoralist

4.6. Barriers hindering of Adaptation strategies

Based on interview, FGD participants, community representatives and experts with pastoral and agro pastoral community in different group has mention, the participants indicated that there are barriers that hamper the adoption of adaptation strategies to climate change. For the pastoral community, the barriers could be ranked from strong too weak as poverty (25.7%), lack of enough pasture land (23%), limited access and lack of natural recourses (19.6%), Lack of enough water (18.1%), lack of modern knowledge and skills (13.6%). lack of agricultural inputs support from GOs and NGO are not hinder for adaptation mechanism in pastoral kebeles due to pastoralist are not engaged by farming activities.

Although for agro pastoral community, the barriers hinder their adaptation strategies poverty (26.4%), lack of enough pasture land (8%), limited access and lack of natural resources (10.4%), Lack of enough water (22%), lack of modern knowledge and skills (16%), lack of agricultural inputs support from GOs and NGO (17.2%).

Generally, this table identify that pastoralist community have hindered different problem to do not use their adaptation strategies very well. Their major hinder for adoption are poverty, lack of pasture land for their livestock and lack of enough water for their livestock as well as for livelihood. This has led pastoralist to be more vulnerable and to get impacted by incoming drought which cannot give them time to survive from it. This problem has led for disease and death both on human and livestock. Whereas in agro pastoralist community also mentions their hindering adaptation mechanism, thus are; poverty which make them to do not use any adaptation strategies due to financial income and weakness of physical condition, lack of enough water for their farming activities and fro drink, lack of agricultural inputs support from GOs and NGO which help them to get more products from farming activities, are the major hindering adoption strategies in their locality. This has led agro pastoralist to be more vulnerable and to get impacted by incoming drought which cannot give them time to survive from it and This problem has led for agro pastoralist to disease and death both on human and livestock. (see Table 18).

Table 18: Local Barriers that hinder adaptation mechanisms

Local Barriers of adaptation mechanism	kebele			
	pastoral/ Galifage		Agro Pastoral/ Barga	
	N	%	N	%
Limited access and lack control of natural resources	13	19.6	9	10.4
Lack of enough pasture land	15	23	7	8
Lack of modern knowledge and skills	9	13.6	14	16
Lack of agricultural inputs support from GOs and NGOs	-	-	15	17.2
Shortage of water	12	18.1	19	22
Recurring of Poverty	17	25.7	23	26.4
Total	66	100	87	100

Source: Computed field survey data 2017

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATIONS

The purpose of this study is to examine the vulnerability and adaptation strategies to climate in pastoral and agro pastoral households at Aysaita Woreda, Zone One, Afar national state, Ethiopia. To this end, the data collected is analyzed and discussed in chapter four. This chapter, based on the analyses, draws on the conclusion and provides the recommendations.

5.1. Conclusion

The Aysaita Woreda pastoralists and agro pastoralists perceived a considerable degree of climate change for the past two decades and witnessed the changes in different parameters. The change in climate, particularly in temperature has brought with it a change in the livestock condition, health condition of the community people and the physical environment condition. The local people have a perception that the temperature has increase in pastoralist and agro pastoralist areas respectively, with no sign of decrease. Descriptive from metrological data with measures like the mean annual maximum temperature, mean annual minimum temperature, mean monthly maximum temperature and mean monthly temperature reveal a change with a rate of 1⁰C for the past 21 years. Secondly, the local community is aware that seasonal rainfalls known for the last three decades have currently randomized their timing, shortened rainfall time, and some seasons do not appear at all.

Peoples who lining in pastoral area are more vulnerable than in agro pastoral area due to the pasture land are becoming more degraded, shortage of water is more pronounced, wide spread of invasive species on their grazing land, the increasing of livestock disease and death from time to time, increasing of human disease and the decrement of the value of animal products are leading the community to be more vulnerable to the impacts of climate change. On the other hand, agro pastoralists are less vulnerable as compare to pastoralist because their livelihood is depending on both crop cultivation and animal raring. But they also affected by climate change because they have small farming land, prosopis juliflora already cover their cultivated and grazing lands, shortage of water, livestock disease and human disease and crop failerity when there is a little variation in rainfall are the major problems for their vulnerability.

Even if climate change affects all natures in the earth, women are the most vulnerable social groups in the Aysaita woreda community followed by children and the elderly. The community is vulnerable to climate changes that are caused by Drought and flood, tainted the pastoralist community with crop damages, loss of pasture, lack of drinking water, spread of human and animal diseases and deaths. Flood, due to unexpected overflow of the Awash River due to heavy rainfall on the highland areas, is challenging the pastoralists' livelihood. Human and/or government and natural. Natural causes of vulnerability to climate change as perceived by the community under study include Crop diseases, prosopis juliflora, and soil erosion. Human causes of vulnerability to climate change as perceived by the community under study include water pollution, deforestation, lack of veterinary services, lack of agricultural inputs (like fertilizer, improved seeds, pesticides, etc.) poor sanitation. Government interventions like sugarcane factory and settlement programmes are other causes.

The climate change brought about by such agents impacted the Aysaita community in the form of drought, livestock disease, human diseases, migration, invasions of prosopis juliflora which affect both pasture and cultivated land, deforestation due to cutting of trees for different use like; fire wood, Charchol, for livestock fodder etc. Environmental degradation, decreased resistance capacity of community for incoming diseases which has led pastoralist and agro pastoralist to deaths are increasing in number. For instance, Animal death has increased in these three years' time; 10% per year for cattle, 8% per year for goats and sheep and 32% per year for camels.

Mobility, non-farm activities, rearing, buying and selling livestock, isolation of sick animals from healthy ones, sharing and the institutionalization, organization and management of resources for two families – one husband two wives, diversification of livestock and crops as appropriate are the major adaptation strategies in practice.

Even though pastoralist and agro pastoralist community respondent in the study area have perceived as there is climate change in their locality, but they failed to adapt from incoming impact. Pastoralist and agro pastoralist community has mentioned different barriers for hindering their adaptation strategies, which include Limited access and lack control of natural resources, Lack of enough pasture land, Lack of modern knowledge and skills, Lack of agricultural inputs support from GOs and NGOs, Lack of enough water and recurring of Poverty, makes the adaptation process very hardly possible in the study area.

5.2. Recommendations

Based on the findings, the following recommendations are made.

- Government and NGOs empower the community through training to develop the sense of ownership to their natural resources to conserve and protect.
- Government introduce new agricultural technologies, drought resistance crops and animals, early maturing varieties of crops; promote off farming income sources in both pastoralist and agro pastoralist community.
- Government shall increase the resilience of women as well as the community through economy and decision making.
- Government, NGO and concerned bodies provide facilities like infrastructures, credits, strengthening social networks, climate information, local training institutions, veterinary services, schools and health centers.
- Government set back the expansion of weed prosopis juliflora that threatens both pasture and cultivated lands.
- Local or regional governments should control investment on Awash river how to manage it.
- Government should provide agricultural inputs to increase output.

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ANNEX

Annex. 1. Mean maximum and minimum temperature by month and year

Year	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual	
	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	Min	max	Min	max	min	max	min
1994	32.1	20.0	32.6	21.4	33.1	23.0	35.2	25.0	37.5	26.8	38.7	29.6	39.3	20.2	38.1	24.0	38.3	24.9	36.9	22.7	34.0	22.0	32.3	19.7	36.7	23.3
1995	32.2	18.9	33.9	20.9	36.1	23.2	38.1	25.2	40.6	26.2	42.8	27.1	38.8	26.0	35.7	26.0	36.3	26.1	33.9	23.3	33.1	22.0	32.5	22.5	36.2	23.9
1996	31.4	21.3	34.0	20.5	36.5	22.1	38.6	26.1	41.4	28.0	38.9	27.2	38.6	26.2	38.1	26.3	36.5	26.4	33.6	23.3	30.4	20.5	29.4	19.5	36.9	23.7
1997	33.1	20.8	33.8	20.7	36.4	22.2	37.8	25.1	40.5	21.1	41.7	26.9	39.9	28.7	39.8	28.0	39.5	26.9	37.2	27.5	34.2	24.5	32.2	22.5	37.2	24.4
1998	33.4	21.0	35.7	22.2	36.7	23.4	38.6	25.0	41.9	28.1	42.5	28.8	41.2	26.0	37.9	26.2	39.2	27.1	37.6	24.2	35.1	22.3	32.8	18.7	37.7	24.4
1999	33.2	19.9	34.7	20.4	35.5	23.0	39.9	26.5	42.3	28.5	42.7	27.2	40.4	27.2	39.9	29.0	38.4	29.9	35.6	24.7	33.9	21.7	31.7	20.5	37.4	24.9
2000	32.1	19.3	34.1	19.7	36.3	22.6	38.7	24.9	41.7	27.5	43.4	29.3	41.5	27.0	38.6	24.5	39.0	26.9	36.7	24.2	34.1	22.8	32.7	20.8	37.4	24.1
2001	31.6	19.4	34.0	20.5	35.8	22.8	39.4	24.4	42.1	24.5	43.8	24.1	41.3	27.4	38.6	26.4	38.7	26.1	37.7	25.3	34.7	21.4	33.4	17.1	37.6	23.3
2002	32.9	21.0	34.1	21.1	36.9	23.7	38.4	24.8	42.3	27.2	43.0	29.0	42.8	29.9	41.1	27.7	40.0	27.3	38.8	25.1	33.3	21.4	32.8	21.3	38.0	24.9
2003	33.4	21.0	35.7	22.1	36.7	23.9	38.6	25.3	41.9	27.4	42.5	29.5	41.2	28.3	37.9	25.5	39.2	27.9	37.6	24.0	35.1	22.8	32.6	20.5	37.7	24.8
2004	33.1	22.0	33.8	20.9	36.4	22.2	37.8	25.6	41.9	26.5	42.1	28.1	41.2	28.5	40.0	26.5	39.3	26.6	37.3	24.3	35.2	22.3	33.0	20.9	37.6	24.5
2005	32.9	20.5	35.4	21.1	37.2	24.4	39.0	25.1	40.7	27.6	42.5	28.7	39.9	27.4	39.8	26.4	39.5	26.1	37.2	25.3	34.2	21.4	32.2	19.1	37.5	24.4
2006	32.9	20.7	34.5	22.1	37.0	23.3	37.8	25.0	41.4	27.2	42.8	29.1	40.8	27.9	38.8	25.6	38.8	27.1	37.5	24.2	34.8	22.5	32.9	22.1	37.5	24.7
2007	32.0	21.0	34.9	22.2	37.1	23.4	38.5	25.0	41.5	28.1	42.3	28.8	39.3	26.0	38.7	26.2	39.4	27.1	37.3	24.2	34.7	22.3	32.7	20.2	37.4	24.5
2008	32.6	20.3	32.9	19.5	36.6	20.0	39.3	24.3	41.4	26.9	42.5	28.7	41.4	28.0	40.5	26.9	40.4	27.5	38.0	24.5	34.3	22.5	32.1	19.7	37.7	24.1
2009	31.4	20.0	34.0	21.4	36.5	23.0	38.6	25.0	41.4	26.8	43.4	29.6	41.2	28.2	41.0	28.2	41.1	27.5	37.7	25.0	35.6	22.0	33.7	22.5	37.9	24.9
2010	32.6	20.6	33.4	22.0	36.4	21.0	39.5	21.1	41.5	23.7	44.0	24.8	39.9	27.2	39.8	29.0	39.5	29.9	37.2	27.7	34.2	21.4	32.2	17.1	37.5	23.8
2011	38.4	20.9	40.8	21.2	42.2	22.7	46.1	26.1	45.9	27.0	49.3	29.5	48.9	29.9	45.9	26.8	48.6	27.8	45.6	24.8	42.7	24.3	39.9	21.1	38.4	25.2
2012	39.9	21.3	40.5	20.5	42.9	22.1	44.9	26.1	48.4	28.0	49.7	29.5	47.4	28.3	46.8	26.9	48.0	28.3	44.4	24.6	34.8	21.4	32.9	18.1	38.0	24.6
2013	32.1	21.0	34.1	21.1	36.3	23.7	38.6	25.4	40.6	27.1	42.4	29.0	39.9	27.4	37.2	24.5	39.5	26.7	37.3	24.7	34.8	22.8	32.2	19.9	37.1	24.4
2014	31.8	19.7	32.5	21.1	35.4	22.3	38.9	25.0	41.5	26.5	42.7	28.6	41.3	28.0	38.6	26.9	38.7	27.5	37.7	24.5	34.7	22.5	33.4	19.7	37.3	24.4
Average	33.1	20.50	34.73	21.08	36.86	22.76	39.16	25.05	41.83	26.70	43.03	28.24	41.25	27.32	39.66	26.55	39.90	27.22	37.75	24.67	34.66	22.23	32.84	20.17	37.5	24.4

Annex.2. Mean maximum and minimum rainfall by month and year

Year	M												Averag
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1994							101.9	47.8	8.9		32.0	0.0	38.1
1995	0.0	7.0	0.0	14.6	6.5	10.7	54.6		7.5	0.0			11.2
1996						19.1	30.0	29.9	13.0	0.0	0.0	0.0	13.1
1997					2.1	2.1	20.7	4.8	0.0	0.0	32.4	3.2	8.2
1998	0.0	0.0	31.2	21.0	0.0	25.3	7.3	18.1	117.4	2.8		0.0	20.3
1999	0.0	0.0	36.6	0.0	0.0	0.0	8.0	18.4	31.9	30.7	0.0		11.4
2000	0.0	0.0	0.0	37.1	0.4	0.0	37.0	105.6			30.8	2.8	21.4
2001	0.0	0.0	15.0	1.2	2.7	0.0	39.8	43.1	24.8	0.0	0.0		11.5
2002	3.8	0.0	5.1	20.7	4.8	0.0	0.0	32.4	3.2	0.0			7.0
2003	0.0	45.6	0.0	40.5	0.0	7.3	18.1	117.4	2.8	0.0	0.0	23.4	21.3
2004	3.0	0.0	38.0	13.2	0.0	3.2	12.4	22.8	27.5	0.4	0.0	1.6	10.2
2005	0.0	0.0	31.2	21.0	0.0	25.3	18.8	68.0	8.7	0.0	0.0		15.7
2006	0.0	1.2	15.0	17.6	0.0	0.0	23.6		2.0	0.0	0.0	16.6	6.9
2007	1.2	0.3	7.5	6.8	0.2	0.0	54.6	36.4	24.3	3.4	0.0	0.0	11.2
2008	0.0	0.0	0.0	13.2	6.5	0.0	23.7	31.3	9.9	1.5	0.6	0.0	7.2
2009	13.0	0.0	0.0	0.0	0.0	0.0	13.4	27.9	5.4	23.5	0.0	0.0	6.9
2010	0.0	25.2	17.9	16.3	3.8	6.3							11.6
2011				0.0	115.1	0.0	5.1	52.5	2.8	0.0			25.1
2012							4.0	121.6	10.0	20.6	1.6	0.0	26.3
2013	0.4	0.0	15.6	0.0		0.0							3.2
2014	0.0	1.2	15.0	17.6	0.0	0.0	23.6	0.0	2.0	0.0	0.0	16.6	6.3
2015							101.9	47.8	8.9		32.0	0.0	38.1
Max	13.0	45.6	38.0	40.5	115.1	25.3	101.9	121.6	117.4	30.7	32.4	23.4	38.1
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2
Mean	1.3	5.0	14.3	14.2	8.4	5.2	26.1	45.8	16.8	4.9	6.5	4.9	14.0
SD	3.32	12.55	13.66	12.28	27.61	8.65	24.15	36.97	26.93	9.80	13.07	8.18	8.54

APPENDIX 1
ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES COLLEGE OF SOCIAL SCIENCE
DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES
QUESTIONNAIRE FOR HOUSEHOLD HEADS

Dear Respondents: the main objective of this questionnaire is to understand Vulnerability and Adaptation strategies to climate change in Pastoral and Agro pastoral area in Aysaita Woreda, Zone One, (Awsirasu), Afar Region, and Ethiopia. This type of local level study is important for planners as well as decision makers at different level. Therefore, the information that you provide is believed to help the concerned bodies in understanding Vulnerability and adaptation strategies on climate change.

Hence, taking the above objectives into consideration, you are kindly asked to provide the appropriate answer for the following questions.

General information for interviewer

1. Please make a brief introduction to each respondent before starting any question.
2. Please make sure creating the necessary climate of friend ship and trust and ask his/her Convenient time and place to get reliable information.
3. Please ask each question clearly and patiently until the respondent understand the question.
4. Please fill up the questionnaire according to the respondent's reply and don't make Any promise of help.
5. The response you give will not have any negative impact on you.
6. No need of writing your name on the questionnaire.
7. Please respond for in feeling free warty on think is correct.

Lastly, I thank you for your cooperation

Hassen Ali

Questioner number _____

Name of the enumerator _____

Date of interview _____

Part I. General Information

Respondent ID

Village _____ Agro ecology _____

1. Household head characteristics
 - 1.1 Household head's Age _____
 - 1.2 Household head's Gender a) Female b) Male
 - 1.3 Marital status 1 = married 2= single 3 = divorced 4= widowed
 - 1.4 Farming experience 1. Short (0-10 yrs.) 2. Medium (10-30yrs) 3. High (30 + years)
 - 1.5 Household size _____

Part II. Perception and impact context

2. Is today's weather the same as the weather conditions that was 30years ago?
 1. Yes 2. No
3. what do you say about the trend of Temperature over the last 30 years?
 - 1.Increase 2. Decreased 3. Constant 5. I don't know
4. What local indicators do you use to evaluate the temperature trend in the area?

5. What do you say about the trend of precipitation over the last 30 years?
 1. Increased 2. Not changed 3. Decrease 4. I don't know 5. Other (specify)
6. Which local indicator do you use to evaluate today's rainfall pattern?
 1. Loss of some plant and animal species
 2. Increased drought and flood frequency
 3. Rainfall comes early or lately
 4. Decreased available water
 5. Other (specify)
7. What are the major hazards affecting the livelihood in your locality?
 1. Flood 2. prosopis juliflora 3. Livestock diseases 4. Human diseases 5. Drought
 6. Pests and herb infestations. 7. Other (specify)

Types of stress	Different regimes		
	Haile (?-1974)	Derg (1974-1991)	EPRDF (1991+)
Temperature			
Precipitation			
Spread of human diseases			
Spread of livestock disease			
Spread of crop diseases			
Pasture availability			
Prevalence of drought			
Flood			

8. Have you encountered any climate related disasters from 1974 E.C? 1. Yes 2. No.
9. Did these stresses bring you damage on your resources? 1= Yes 2= No
10. If yes indicate the damage you have faced among the following
- 1= property damage including public infrastructures
 - 2= reduction in all agricultural production
 - 3= prevalence of diseases
 - 5= lack of financial resource such as saving, credit and remittance form relatives
 - 7= others specify

Part III. Vulnerability and Livelihood Assets

11. What do you think is the main cause for the climate change?
- 1. Cures/wrath of God 2. Human action 3. Natural process,
 - 4. Both natural and human process 5. do not know
12. Which social groups are more vulnerable to climate change?
- 1. Women 2. Men 3. Children 4. Elder

13. What were the reasons for these social groups being most affected and barrier to hinder them adaptation practice?

1. Limited access and lack control of natural resources
2. Lack of skills and knowledge
3. Poverty
4. Lack of community support
5. Lack of supports from GOs and NGOs
6. Lack of information
7. Others (specify)

14. what are the cause of vulnerability to climate change?

1. Government intervention
2. drought
3. flood
4. Pest and herb infestation
5. Shortage of drink water
6. Natural and human causes
7. others specify?

15. Suppose you have faced a hazard that devastates your properties, do you think you can get financial, material and moral support from your community, government and NGO?

1. Yes
2. No

16. Suppose a drought is prevailed in your locality, would you migrate or resettle to the most of opportunities elsewhere? 1.yes 2. No

17. Do you have own land? 1. Yes 2. No

18. If the answer for question number **16** is ‘yes’ how many hectare ___ and what your land use land cover is?

1. For pasture
2. Crop production only
3. Use for both
4. If other

19. Do you have any skill other than farming in your household? 1. Yes 2. No

If Yes specify_____

20. Do you rare domestic animals? 1. yes 2. No

If your answer to question no 28 is yes, fill the table below

No	Type	Number(Size)	Total value in birr
1	Cattle		
2	Sheep		
3	Goat		
4	Camel		
5	Total		

21. Was there any livestock disease and death observed due to climate Change induced effect in the last 3 years?
1. yes 2. No
22. Was there any human disease and death observed due to climate Change induced effect in the last 3 years?
1. yes 2. No
23. What are the most prevailing problem of livestock production in your locality? multiple answer is possible
1. Degrading of pasture (drought) 2. Livestock disease (epidemic)
3. Absence of animal health treatment 4. Shortage of water
5. Increase in temperature
24. Do you have access to agricultural technologies? 1.Yes 2.No.
25. If yes indicate your access to the agricultural services listed in the table below

No	Agricultural technology	Access		Distance travelled to get the service		
		Yes	No	≤4Km	5-9 km	≥10km
1	Pesticides and insecticides					
2	Fertilizers					
3	Improved seed					
4	Farm machinery and tools					
5	Veterinary service					

26. Would you tell your household source of cash income?

Major Area	Types of Activities	Yes	No
<i>Farm Activity</i>	Selling of crop productions		
	Selling of livestock and their products		
	Selling of fruits, roots and vegetables		
	Selling of fuel woods		
	Selling of grasses, forage		
	Selling of wooden poles		
	Land renting		
Non-farm activity	Dibora		

27. Do you have access to adequate credit? 1. Yes 2. No If yes, how much birr per year could you get credit? _____

28. Do you have access to a nearby market? 1. Yes 2. No If your answer is yes, how far is it?
1. $\leq 4\text{Km}$ 2. 5-9Km 3. $\geq 10\text{km}$

Part IV. Adaptive Strategy for Climate Change

29. Have you ever used any adaptation strategy to adapt with climate change impact?

- 1) Yes 2) No

30. If your answer is “yes” what is your choice of the most commonly used major adaptive

Strategy you have been using to overcome the impact of climate change? (multiple answer is possible)

1. fodder management
2. Livestock diversification and use of drought-tolerant species
3. Herd mobility to search for water and better pastures
4. Off/non-farm activities
5. others

31. Have you ever selected and reared more drought tolerant livestock species and diversify the herd composition? 1) Yes 2) No If yes, what are the more drought tolerant livestock Species? - _____

32. Have you ever migrated to find water and pasture for livestock? 1) Yes 2) No If yes,

33. Have you made adjustment in livestock management? 1. Yes 2. No, if your answer is yes, what kinds of adjustments you used?

1. Destocking
2. Changing type of livestock
3. Separating livestock (Ox and cow in different directions)
4. Selling of livestock

Checklists to Guide Key Informant Interviews

I. Elderly Groups from the Community

1. How long have you been here?
2. How do you characterize the weather of this area (temperature and precipitation)?
3. Have you observed any change in temperature or rain fall?
4. If you perceived the change in climate, what is your local indicator?
5. What change do you observe in rivers, aquifers and other water bodies?
6. In your life, what climate hazards have you seen or have you heard from your family?
(erratic rain, drought, flood)
7. How do you see the general level of education, health and skill of the society? Is it getting better or not?
8. Is there a strong social and institutional relationship (kinship) in your village?
9. Do you have adequate access to public infrastructures like road, electricity, health posts, and water supply? How do you see the service?
10. What do you say about the Natural resources of your village (fertile soil, woodland/ forest, potential irrigable land) etc.
11. Do you think farmers have diversified their livelihood strategies to improve their living?
12. If yes, what are the most common activities being pursued by farmers?
 - a) Microfinance institutions
 - b) Local market

Interview Questions to Key informants

(Woreda Agricultural office, DAs, Clan leaders, religious leaders)

1. What change have you observed in temperature and rain fall?
2. What changes have you observed in crop type? Do you observe crops and livestock's that were not familiar in the area?
3. Which group do you think is more vulnerable and affected? Why?
4. What do you think the cause of vulnerability in your locality?
5. What are the most frequently occurring climatic events that affect pastoral / agro pastoral production?

6. What do you think about the influence of climate change on the pastoral / agro pastoral production system?
7. Do you have the necessary technologies that would enable farmers to boost their pastoral / agro pastoral production?
8. Do you support the communities by providing advice to have better animal species?
9. To what extent are you aware of the current climatic situation of your woreda in particular and the nation in general?
10. What are the major adaptation strategies that you educate the pastoralists/ agro pastoralists to employ?
11. Do you think incentives provided from the government encourage pastoral and agro pastoral communities to cope up with climate related problems?

Interview Questions to Focused groups of pastoralists/agro pastoralists

1. Have you heard about climate change?
2. Who did tell you? Have you heard from Radio? Or from extension workers?
3. Do you think the weather condition is changing? If you say yes, how? Explain
4. Without having instrument to measure the change how do you explain by local indicators?
5. What are the causes of vulnerability to climate change in the pastoralist and agro pastoralist community?
6. Do you observe a change in the rain fall pattern and temperature condition? Which one is increasing? Or Decreasing?
7. Have you observed any climate extremes (floods and drought) in your locality? How many times occurred since 30 years ago?
8. Let us say that there will be a drought or any climate related hazard in the near future, do you think you have?

Check list for Field Observation

The researcher will observe if there is:

- 1.** Crop production and livestock husbandry
- 2.** Government and Non-government activities on environmental conservation
- 3.** Major people economic activities in their environment
- 4.** Grazing land (degradation)