



DILLA UNIVERSITY SCHOOL OF GRADUATE STUDIES

**THE SOCIO-ECONOMIC IMPACTS OF DROUGHT
AMONG THE PASTORALIST COMMUNITIES OF
LIBEN WOREDA**

MA THESIS

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ABBREVIATIONS (Acronyms)

ASALS- Arid and Semi-arid Lands

C.S.A -Central statistic authority

ECA-Economic Commission of Africa Economic Commission for Africa

EPA- Environmental Protection Authority

FAO-Food and Agricultural Organization

GDP-Gross domestic production

IFAD-International Fund for Agricultural Development

IGAD- Intergovernmental Authority on Development

IPCC- Intergovernmental panel on climate change

M.A.S.L-Meter above Sea Level

MoARD- Ministry of Agriculture and Rural Development

MoE- Ministry of Education

MoFED -Ministry of Finance and Economic Development

NBS-NegelleBorena Station

NMA-National Meteorology Agency

OBoFED - Oromia Bureau of Finance and Economic Development

PAs-Peasant Association

PASDEP-Plan for Accelerated and Sustained Development to End Poverty

UNDP- United Nation Development Program

UNEP-United Nation Environmental Program

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ABSTRACT

The purpose of this study is to look into impacts of drought on the socio-economic development of the pastoralist people in Liben woreda East Guji Zone, in Oromiya region. In order to attain the objective of the study the researcher used both quantitative and qualitative research methods and cross-sectional descriptive survey design. The main data sources used were primary and secondary sources. The primary data were collected from livestock owners and informants through questionnaire, key informants and FGD whereas secondary sources were collected from books, journals and annual reports of the woreda. The researcher selected three kebeles out of twelve; the sample items were selected randomly, while purposive sampling used to select key informants. In addition the meteorological data were taken from the National Meteorology Agency of Ethiopia. The rainfall data was analysis using SPI and coefficient variation : The rainfall data of the study area shows that there is a decline trends in precipitation since 1981, the rainfall is highly variable which is erratic and unreliable. The survey results revealed that shortage of rainfall for one or more season has an impact on the livelihood of the communities and which damage their assets. Riptide droughts highly affect the livelihood of the study area, which is predominantly a pastoralist, livestock play a central role. Shortage of pasture, water, market, and prevalence of diseases and cultural view are the main problems for livestock keeping. Drought brought effect on human life and economy. The drought that was observed for the past three decades are periodic drought events in the area, that was highly affected the livelihood of the communities: they loss agricultural products, shifting rain season and, surface and under-ground depletion causing scarcity for animals and humans use For instance, in the 2016 drought event about 40,000 livestock were lost. Governmental and non-governmental organization intervention has been largely through the provision emergency aids with limitation. The intervention started after the death of many livestock .There is no pronounced sustainable measure taken by them. This is because of insufficient finance and low prioritization, and lack of appropriate policy which concerning the pastoralist life style hampered the development of the study area. Thus, to alleviate these problems researcher recommends that drought is a normal occurrence and should be mainstreamed in to development planning.

KEY WORDS:-*Pastoralist, socio-economic impact of Drought, and Traditional drought coping mechanism*

CHAPTER ONE

1. INTRODUCTION

1.1 Background of the study

Dry lands cover 40 percent of the world's land area and host around two billion people, 90 per cent of which lives in developing countries (UN, 2011). In these dry lands some 30–40 million people practice nomadic pastoralism, an extensive grazing system that uses flexible migration patterns to follow rainy seasons in arid regimes (Sonneveld et al., 2017). High proportion of the population is utilizing the arid and semiarid areas. It is apparent that a significant number of people in the horn of Africa are engaged in pastoralism (Sallh and Ahmed, 1993).

In Ethiopia agro-ecology zone is roughly divided into two major parts. The high lands with altitude of over 1,500m.a.s.l and the low lands with altitude of less than 1,500m.a.s.l, the low land area is characterized by low and erratic rainfall with annual range of 200-700mm and temperature between 15-50°C, arid and semi-arid lands cover about 60% of the Ethiopia land surface and are 12 % of human population and 26% of livestock population (Coppock, 1994). The total livestock population of the country is estimated at 47.57 million of cattle, 26.12 million head of sheep, 21.71 million of goat, 1.78 of horse, 0.38 million mule, 5.57 million of donkey, 39.6 million of poultry and 1 million camels (CSA, 2007/8). The country's livestock population is distributed over the highland and lowland areas. Of the total cattle population of the country, pastoralists own about 20 percent cattle, 25 percent of sheep and nearly 73 of the goats' population, all of camels are owned by pastoralists (MoARD, 2005).

Ethiopia is a country of an agrarian economy characterized by high population growth, huge dependence on erratic rainfall, low agricultural productivity, structural bottlenecks and land-locked (PASDEP, 2005; SOS Sahel Ethiopia, 2015). The sector is characterized by low productivity partly due to low investment level in the sector (particularly in smallholder farmers) backward farming technologies, low farm level capacity, land

degradation and recurrent drought (PASDEP, 2005 and EEA, 2005). Agriculture continues to be the backbone of the Ethiopian economy, contributing to about 80 per cent of employment and 70 per cent of export earnings in 2012/13 (IFAD, 2016). The last few years the performance of the sector has notably improved. Data provided by the Ministry of UNDP shows that livestock contributes 12% to the DGP and 47% to Agricultural GDP in the Fiscal Year 2012/2013. In the Ethiopian economy, the livestock sector creates livelihood for 65% of the rural population and accounts for about 12-15% of the export earnings of the country in terms of live animals, meat and hides and skins exports (EEA, 2005).

Pastoral areas in Ethiopia, which cover about 0.7 million square km, are generally known as the range lands. These areas support about 12% of total population of the country, of which 56 % are pastorals, 32% are agro-pastoral land the remaining 22% are urban dwellers (EEA, 2005). Pastoralists relies on livestock diversity to exploit and make use of the diverse rangeland resources, and typical pastoral herds and flocks include grazing cattle, donkeys and sheep and browsing camels and goats. The area had been marginalized by the previous regimes, pastoral livelihood all along was considered not as a life style, but as a source of problem for national security and stability. From the 1970s, especially after the severe drought in 1973, pastoral regions became a focus of attention for government as well as national and international development and humanitarian agencies (Magda and Mulugeta, 2012).

Food insecurity is an enormous challenge to Ethiopian; a brief historical survey reveals that over the latest three decades Ethiopia agriculture has unable produced sufficient quantities of food to feed the country's rapidly growing population (Belay, 2004).

Ethiopia's rain-fed agriculture based economy is highly sensitive to climate fluctuations. Rainfall is the most important determinant of Ethiopia's economic success or failure from year to year (Devereux, 2000; Alemayehu, 2015). One third of Ethiopia's population currently lives in what is categorized as dry land area (UNDP, 2014). The pastoralist's economy in Ethiopia is labor intensive and dependent on livestock and livestock production. Livestock is also the major sources of cash income from the sales of live animals and livestock products like milk, butter, hides, skins and eggs and also sources of

non-food items such as transport services. It is an established fact that, in addition, livestock is a measure of wealth and social status in pastoral communities (SOS Sahel Ethiopia, 2015). Pastoralists are more vulnerable to drought and other calamities and more dependents on external support. Drought is often one of the most devastating but least understood weather phenomena, largely because of its slow onset and its accumulating impacts over time. Pastoral areas in Ethiopia are one of the most drought prone regions facing chronic food deficiencies. Drought has been, and still is a serious problem in pastoral area.

Erratic rain fall and poor rain fall affect pastoralists through short fall of fodder and water. So, the impact of drought is considerable. In Borana, for instance, pastoralists and agro pastoralists face cycles of drought. According to Fassil, drought has been recurring in Borana areas since 1970s. The major drought event in this area occurred from 1973 to 1975, 1982 to 1985, 1993/94 and 1999/2000 had brought about various ecological, economic and social consequences (Fassil, 2001).Consecutively seasons of poor rainfall in southern and southeastern pastoral areas has severely limited feed and water availability, resulting livestock deaths have driven rising food insecurity and malnutrition rates .It is known that Liban worda ,is found southeastern pastoral areas, has been persistently food insecure and recurrently suffer from drought hits due to the failure of rainfall .Although it is obvious that the area has bitterly affected by the last consecutive drought.

1.2. Statement of the problem

Drought negatively affects agricultural production, water supply and other community livelihoods. In some areas of the world, the effect of drought can be far more severe. In Africa, depending on intensity and duration, droughts have led to deleterious effects including crop failure, livestock deaths as well as increased pests and disease outbreaks. Many Sub-Saharan Africa economies are vulnerable to drought effects due to great economic dependence on rain-fed agriculture and livestock production (Tadesse *et al.*, 2008). Horn of Africa region, drought occurrence has become increasingly severe during the last decade, with rainfall totals of at least 50–75 % below normal encountered in most areas, amounts that are not sufficient to support crop and pasture growth for livelihood security (Nicholson *et al.*, 1996; Alemayehu *et al.*, 2015).

Ethiopia faces daunting challenges from high poverty levels, rapid population growth, over-reliance on rain-fed agriculture, high levels of environmental degradation, chronic food insecurity, and frequent natural drought cycles and low level of adaptive capacity to climate variability and change (Kidanu *et al.*, 2009; Alemayehu *et al.*, 2015). The mere fact that Ethiopia gets hit by famine every time drought occurs indicates the precarious nature of our rural economy and rural life as a whole. This is only due to the fact that the great majority of the rural population still relies on what nature can provide and on rain in particular.

Ethiopia is experiencing its second severe drought in less than two years (in early 2015/16 unfavorable Belg rain and late and erratic Kiremt rain). Insufficient rainfall during the 2017 rain season has led to severe water shortage, catastrophic livestock losses, and failed crops throughout the country. The drought in southern Ethiopia comes as the country's north and central highlands communities; the government of Ethiopia estimated that 8.5 million people would require humanitarian assistance. This follows the El-Nino induced drought that resulted in crop losses of up to 50 to 90 percent in some areas, along with extensive water feed shortages in pastoral and agro pastoral areas that resulted in wide spread livestock mortality (FAO, 2016).

There is a population increased in the pastoral areas as in the rest of the country. The grazing land is steadily but surely shrinking due to population increased and the possible large scale of land required for non-pastoral activities and water resources development. Livestock number on the other hand is limited in its growth, which is affected by drought and epidemics, in severe drought season large number of cattle die due to lack of pasture. Recurrent droughts in pastoral Ethiopia have exposed the critical feed shortage that prevails in the country. Between 2000 and 2017, six drought episodes have been registered, with the latest two (in 2011 and 2016/17) devastating pastoral and agro-pastoral livelihoods (FAO, 2017). In former time pastoral society were able to handle one or two failed season without too many problems. Although there were hardships they were generally successful, in caring people and livestock herds large enough for breeding and regeneration through the next good season. They were faced with utter destitution after the failure of single rainy season; even temporary delaying in the onset of normal rain seemed to great problem. As informally observed Liban is one of the most disadvantage areas in the country in terms of economic and infrastructure development. Moreover, it has been recurrently threatened by the drought for at least six of the last ten years and facing seasonal and acute food shortage over the years.

According to Jemjem, (2001) conducted a study on the livelihood of pastoralist communities, Liben has been stricken by recurrent drought and that drought has increasingly devastating effects on the lives of pastoralist and agro-pastoralist communities. Moreover, a document written by Gtz, (2004) revealed that Borena lowland pastoralist had faced persistent drought. Hence, what makes this particular study different was it focused on the socio- economic impacts of drought on the livelihood of pastoralist area specifically in Liben woreda.

Traditional rural Liban woreda is known to be pastoralist/agro-pastoral whose livelihood is predominantly dependent on extensive livestock rearing the most fragile economy. The range resource of the woreda has depleted and its potential rangeland has impoverished due to natural and man-induced factors, of which the major ones are failure of rain and or respective drought, encroaching bushes, poor management, and improper utilization of

range resource. Livestock are source of food, income security, and insurance and above all means of livelihoods in the study area, it has been stricken by recurrent drought.

It is known that Liban worda has been persistently food insecure and recurrently suffer from drought hits due to the failure of rainfall, although it is obvious that the area has bitterly affected by the last consecutive droughts, it is increasingly devastating the lives of pastoral and agro-pastoral communities. Drought has been still a prominent factor in Liben worda the effect of the previous drought still persists, some household still dependent on relief aid. Therefore, the socio-economic impacts of drought on the livelihood of pastoralist in Liben worda needed to be investigated.

Above all, since above stated studies and documents never mentioned the socio-economic impact of drought on pastoralist, particularly in Liben worda. Thus, this study hopes to fill the gaps and attempts to investigate the major impact of drought on the socio-economic development of pastoral area of Liban worda.

1.3. Objectives of the study

1.3.1. General objective

The general objective of the study is to look in to the perceived socio-economic impacts of drought among the pastoralists in Liben woreda

1.3.2. Specific objectives

The specific objectives of the study area is to

- Examine rainfall and temperature trends and variability of the last 35 years
- Investigate the incidence of hydrological drought with respect to seasons /months
- Assess the impacts of drought in economic (livestock asset, and price), ecological (pasture, water resource, and crop production) and social (human and livestock health, and formal education) of the woreda.
- Examine indigenous early warning system that the local people use to reduce the impacts of drought in the study area.
- Examine the existing roles of government and non-governmental organization to avert the impacts of drought.

1.4. Research Questions

Based on the specific objectives of the study, the following research questions have been formulated

- How were the rainfall and temperature trends your area look like?
- What are the critical problems you face during the drought event?
- What is the impact of the drought on the livelihood of people of the woreda?
- What are the traditional coping strategies in response to drought?

- What are the roles of governments and non-governmental organization to support the livelihood of Pastoralists during drought event in the study area?

1.5. Significance of the study

The result of this study was over view how the impact of drought towards the livelihood of the people in Liben woreda .As a result, it might help to the woreda/ stakeholder provide information to implement appropriate strategies to overcome the impact of drought. This study might help to development practitioners and policy makers to acquire better knowledge to carry out development interventions, who are committed to improve the livelihood security of the pastoralist on the area of planning and disaster management, indicate or encourage the degree of awareness towards using alternative income sources. Identify traditional coping strategies in response to drought and increase awareness at community level, the knowledge that could assist communities in rebuilding and strengthening their coping strategies in response to drought, to identifying the nature, extent of drought and provide some possible recommendations to improve pastoralists lifestyle. The results of the study can also be made ready and documented at district level so that it served as source material for further research development strategies.

1.6. Scope and limitation of the study

Any study from the early beginning will have its own scope to determine the level and extent study. Similarly, this study would have also its own focus. It has, spatial and temporal .Regarding the spatial scope of the research, it is mainly focused on the socio-economic impact of drought in Liben woreda.On the other hand, with regard to the temporal scope of the subject matter, the study principally focuses on the period since 1981.

The quest for smooth conduct of the study was expected to face certain challenges and limitations. Throughout the whole courses of this study, the researcher faced problems such as shortage of relevant literature, documents, accessibility of transport from center of the woreda (Negelle) to distance kabeles, the settlement pattern of the people (Very

scattered),and the peace and stability condition of the kebles and financial insufficiency even if sponsored by university ;knowledge gap in research experience; and shortage of time since the researcher was in-service trainee .On the other hand, the currently global pandemic disease (COVID-19) that the governmental and NGOs to lockdown impacts the study schedule but the researcher reshuffled activities and rescheduled then attain his goals. Above all, the researcher's commitment patience, tolerance and persistence minimized the possible impacts of those expected constraints if not completely avoided.

1.7. Organization of the thesis

This particular study was organized in to five chapters. The first chapter deals on the introduction of the study; incorporating background, statement, objectives, research questions, significance, scope, limitations, operational definitions and organizations of the study. The second chapter focused on the review literature of the study. The third chapter presented the methodology of the study that includes, research design, methods, source of data, population, sampling techniques, and data gathering tools, procedure and method of data analysis. The fourth chapter focused on data analysis and presentation. Finally, the last chapter incorporates summary, conclusion and recommendations.

1.8. Operational definitions of terms

Agricultural drought: occurs when there is insufficient soil moisture to meet the needs of particular crop at a particular time

Agro-pastoralist: is defined as those who practice some degree of mobility but obtain less than half their income from livestock, with most of the remainder coming from crop cultivation

Borena Zebu cattle: had identities that their fur is colored in white-gray, usually short horned or no horn, docile in temper, huge body mass (more than 200kg average maturity weight) and relatively high milk production

Botulism: is a paralyzing disease of animals, birds and humans caused by a potent nerve toxin produced by the bacteria clostridium botulin

Bovine Pasteurellosis: bacterial pathogens associated with the bovine respiratory disease

Bush Encroachment: means the former grass land has become gradually invaded by Shrubs and bushes

Deforestation; it refers to the uncontrolled removal of forest vegetation

Drought: is defined as an extended period – a season, a year, or several years of deficient rainfall relative to the statistical multi- year average for a region

Destocking: refers to reducing the animal stock during drought

Ella: traditional water well

Geda: The most democratic and sophisticated traditional administrative system of the Oromo People

Hirba: traditional gift of live animals to the poor or a disaster victim

Hydrological drought: refers to deficiencies are surface and subsurface water supplies.

Jemejem Zebu; which are characterized by their multi colors (influenced by black and fur) usually sharp horned, aggressive tempered, weightless than to 200 kg on average at maturity, and less milk output

Kwashiorkor: a malnutrition disease, chiefly of children, caused by severe protein and vitamin deficiency

Marasmus: is a form severe malnutrition characterized by energy deficiency. It can occur in anyone with severe malnutrition but usually occurs in children body weight is reduced to less than 62 % of the normal (expected) body weight for the age.

Meteorological drought: is usually based on the long-term precipitation departures from normal

Over cultivation; farmer are forced to cultivate the same plots of the lands over and over again

Overgrazing; large number of cattle are grazed on limited area of land for a long period of the time

Pastoralists: are defined variously in the literature as those who obtain more than half their income from livestock and livestock products and who characteristically practice mobility

Primary live stock market; Supply >500 livestock within a week the participants is mostly the farmer.

Secondary livestock market; supply 500 – 1000 livestock within a week there are high participant of trader.

Range land: is uncultivated large area of grassland

Restocking: refers to the rebuilding or replacement of livestock

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Definition of drought

Drought a condition of abnormal dry weather within a geographic region where some rain might usually be expected. A drought is thus, quite different from a dry climate, which designates a region that is normally, or at least seasonally dry. The term drought is applied to a period in which unusual scarcity of rain causes a serious hydrological imbalance: water supply reservoirs empty, wells dry up, and crop damage ensues. The severity of the drought is gauged by the degree of moisture deficiency, its duration and the size of the area affected. If the drought is brief, it is known as a dry spell, or partial drought. A partial drought is usually defined as more than 14 days without appreciable precipitation, whereas drought may last for years (Encarta, encyclopedia, 2004).

Drought can be defined in three ways: an extended period of below normal rainfall, a long term depletion of ground water, or the stunting of vegetation growth due to lack of water, or drought can be defined according to meteorological, hydrological or agricultural criteria; Meteorological drought is usually based on the long-term precipitation departures from normal, but there is no consensus regarding the threshold of the deficit or the minimum duration of the lack of precipitation that make a dry spell an official drought. Agricultural drought is typically evident after meteorological drought but before a hydrological drought (NASA, 2000).

Drought is defined as an extended period – a season, a year, or several years of deficient rainfall relative to the statistical multi-year average for a region (UNEP, 2007). The Meteorological drought is defined as a situation, when, the seasonal rainfall over the area is less than 75% of its long-term average. A rainfall deficit between 26% and 50% of its average rainfall is classified as moderate, and more than 50% is classified as severe drought (Govind Katalakute et al., 2016).

2.2 .Drought and desertification

Drought and desertification are at the core of serious challenges and threats facing sustainable development in Africa. These problems have far-reaching adverse impacts on human health, food security, economic activity, physical infrastructure, natural resources and the environment, and national and global security. Drought is exacerbated by activities such as overgrazing and poor cropping methods that reduce the water retention of the soil, and by improper soil conservation techniques, which lead to soil degradation (ECA, 2007).

Desertification occurs in cropland, Pasture and wood lands. Loss of soil, deterioration of soil, and loss of natural vegetation all lead to desertification. Drought, a period of unusually dry weather, can cause loss of vegetation, which in turn lead to desertification. Drought has also mistakenly been called primary cause of desertification. Desertification can occur without drought and drought can occur without resulting in desertification. By themselves, they do not degrade the land. However they intensify the pressure that lead to mismanagement of land, plant and water resource. While dry land, rainfall is low on average. It is extremely variable from year to year and from place to place. The seed of many plants can remain dormant through several years of drought, waiting a good rain to sprout. Drought may become catastrophic and resulting in loss of human life due to lack of necessary resource such as water.

Desertification is caused by multiple direct and indirect factors. Among the typical direct causes of desertification in the region are poor agricultural practices such as continuous cultivation without adding any supplements, overgrazing, poor land management practices, and lack of soil and water conservation structures. Deforestation, especially to meet energy needs and expand agricultural land, is another serious direct cause of desertification. Biomass constitutes 30 per cent of the energy used in Africa and over 80 per cent used in many sub-Saharan countries. More than 15 million hectares of tropical forests are depleted or burned every year in order to provide for small-scale agriculture or cattle ranching or for use as fuel wood for heating and cooking. It is estimated that two-thirds of African land is already degraded to some degree and land degradation affects at

least 485 million people or 65 per cent of the entire African population. 70 per cent of Ethiopia is reported to be prone to desertification (ECA, 2007).

2.3 .History of drought in Ethiopia

Drought can occur in many parts of the world, Drought is wide spread in many part of Africa one of the worst droughts in the recent years has been in the Sahel. The Sahel has long experienced a series of historic drought; the frequent of drought in the region is thought to have increased from the end of the 19th century (Wikipedia Sahel-drought, 2010).

In Ethiopia, the history during the period between 253 B.C and the 1st Century A.D, one drought/famine was reported every seven years. From the beginning of A.D to 1500 A.D, there were some devastating famines known as ASAH, FASSAS and HGLAH during which millions perished. During this period, 177 drought/famines, about one in nine years, were reported in the country. Information from 1500 to 1950 is based on recorded data and hence is more reliable. From the 16th Century to the first half of the 20th Century, 10,14,21,16 and 8 droughts/famines were reported respectively, suggesting 69 events in a period of 450 years. This shows on an average the occurrence of one drought every seven years. The two notorious famines known as QUACHINE and KIFUQEN, which devastated major areas of the country, were reported during this period. The reports from 1950 onwards are well documented and contain interesting scientific data. The analysis of the rainfall data during this period indicates that 18 droughts/famines were recorded in 38 years, suggesting the occurrence of drought every two years. The highest frequency of droughts/famines occurred in the 2nd Century A.D. followed by the first part of the 20th century, and also an increasing trend from the 16th Century onwards. The deciduas'' analysis shows that the decade 1970- 1979 was the worst period, having seven disaster years. The worst period appears to be the decade beginning in 1980 and the worst drought year was 1984. The areas that were affected severely were mainly the northern parts of the country (EPA, 1998).

In Ethiopia, the history of drought is as old as the country itself. Between 253 B.C and first century A.D. drought occurred every seven years. Form the first century A.D. up to

1500 AD there were 177 drought (famines) which killed millions of people. Between 1500 AD and 1950 sixty-nine drought events were occurred i.e. one drought event in every seven years (Mesfin, 1986).

Famine has been a recurrent feature of Ethiopian history, the first recorded occurrence dating from the 13th century. In the last one hundred years, there have been 10 famine, including the great famine of 1888-92 in which as many as one-third of Ethiopia's people died. In recent decades, famine has repeatedly struck northern Ethiopia: Welo and Tigray in 1953, Tigray in 1958, and Welo in 1966 and 1974. The famine of 1984-86 was exceptional among recent famines in that it encompassed most of the country (USAID, 1987). The famines in Ethiopia occurred periodically through the history of Ethiopia, from first half of 9th century, example:

Table.2.1. Drought history in Ethiopia

FAMINE	DESCRIPTION
1535	Famine and epidemic in Tigray
1540's	Famine
1567-70	Famine in Harar
1611	Famine in northern province due to heavy rain
1634-35	Famine in Tigray
1650's	Epidemic
1700	Famine in Shewa
1702	Starvation
1747-48	Famine
1783	Famine
1789	Famine in all provinces
1796	Famine
1797-1800	Famine
1829-35	Famine in Shewa
1880-81	Cattle plague causes famine
1888-89	Famine in southern most province
1913-14	Famine in the northern province Amhara, Tigray
1929	Famine in Amhara
1965	Famine in Tigray
1966	Famine in Amhara
1973	Famine in northern province
1983-85	The worst famine in the northern Ethiopia

Source: Wikipedia, 2018

2.4. The main causes of drought

Drought as natural hazard is the single most important weather related natural disaster often aggravated by human action (chetti, 2002). Overgrazing on pastoral and deforestation are often contributory factor for drought; drought has an uncomfortable environmental effect in warm climate (P.K Duff, 2002).As in most of the famines that have resulted from drought, the Dust Bowl was created, not because of a cycle of nature, but by human carelessness and disregarded for the rhythms of the environment (Lee Davis, 1987).

2.4.1 Climate change and variability

In its fifth Assessment report the IPCC, a group of 1,300 independent scientific experts from countries all over the world under the auspices of UNs, concluded there's more than 95% probability that human activities over the past 50 years have warmed our planet. The planet's average surface temperature has risen by about 1.62⁰F (0.9⁰c) since the late 19th century, a change driven largely by increased CO₂ and other human made emissions in to the atmosphere (NASA, 2000). Multiple independently produced datasets confirm that from 1880 to 2012 the global average (land and ocean) surface temperature increased by 0.85 (0.65 to 1.06)⁰c. From 1906 to 2005, Earth's average surface temperature rose by 0.74 ± 0.18⁰c (Wikipedia/global-warming, 2018). Activities resulting in global climate change are expected to trigger droughts with a substantial impact on agriculture throughout the world and especially in developing nations overall, globally will result in increased world rainfall. Along with drought in some areas, flooding and erosion will increase (Wikipedia /drought, 2018). Changing global climate, coupled with expected increase in evapo-transpiration due to increased temperatures, the ASALs are expected to experience frequent climatic extremes, increased aridity, increased water stress, diminished yields from rain-fed agriculture, and increased food insecurity and malnutrition (Thornton et al., 2014; Francis Opiyo et al., 2015).

The Sahel drought is an indication of long term trend towards greater aridity in West Africa and other parts of the arid and semi-arid zones. The Sahara is spreading south because the various rainfall belts were moving south. Most part of the world experience fluctuation in climate. But semi-arid regions are more vulnerable to the effect of such fluctuation. In these areas rainfall has become very poor. Human activities such as cutting trees and degrading the soil might have resulted in making the climate even drier. Ethiopia is one of the sahelan countries, which are affected by frequent drought occurrence (Grain, 1982). As a UNEP, expert put it: In general, the drier the climate the greater the rainfall variability and the higher drought risk. The pastoral area of Ethiopia is located at the outer margins of the countries. Climatic conditions are characterized by hot weather, Low rainfall with erratic distribution and varying from year to year and within season (Taffesse.2000).

Global warming more carbon dioxide (along with some gases) is being released in to the atmosphere from burning fossil fuel and the Clearance of tropical forests. Carbon dioxide allows incoming sunshine to heat up to earth but, holds back the heat would otherwise be radiated back out in to space, the heat stay in the atmosphere and average global temperatures rise. This is called the greenhouse effect most climatologists' believe it will be causing a significantly warmer global climate by the early 21 century (Alan Grainger, 1982).

Climatologists to believe that many of the droughts in tropical regions are associated with global patterns of sea surface temperature anomalies (difference from normal) such as El-Niño. During an El-Niño, the anomalously warm equatorial pacific ocean warms the over lying atmosphere, which lead to changes in large scale atmospheric circulation patterns, and increased probabilities of drought in many parts of the world.

Climate variability and change are among the major environmental challenges of the the 21st century (parrz et al.,2007).Climate change affect with increased average annual temperatures ,reduced and increased variability in rainfall ,reduces crop yield and threatens food security in low-income and agricultural economics(Meybech et al.,2012)

Climate variability is variation in the mean state and other statistics (such as standard deviation, coefficient variation, etc) of the climate on all temporal and spatial scale beyond that of individual weather events. Variability may result from natural internal process within the climate system (internal variability) or from variation in natural or anthropogenic external forcing (external variability) (IPCC, 2001).

2.4.2. Environmental degradation

There are number of traditional practices which can degrade the environment, now days, environmental degradation is a result of an increasing demand for the limited resource on the surface of the earth caused by a rapidly growing population. The major causes of environmental degradation are desertification, overgrazing, over-cultivation .Land degradation cause decline in the productivity of the land. This results shortage of crop .If this condition worsens from time to time, the land became arid, the aridity of the land lead to drought. The occurrence of drought causes famine and starvation (Tekolla,

1977).The global climate change and resulting unfavorable weather pattern is also a great worry for the sensitive pastoral ecologies. The increasing population and livestock pressure coupled with the disruption of the traditional management system and alternation of land uses has also lead to significant rangelands degradation(SOS Sahel Ethiopia,2015).Land degradation is one of the major causes of low and in many places declining agricultural productivity and continuing food insecurity and rural poverty in Ethiopia (Thornton, 2014). Land degradation reduced livestock productivity as a result of reduced grazing resources, loss of nutritious plants and grass species (Fitsum *et al.* 1999; Temesgen, 2014).The poor households that are affected by drought and desertification do not have adequate resources to deal with food shortages. As a result, the millions affected face food insecurity and hunger. If land degradation continues at the current pace, it is projected that more than a half of cultivated agricultural area in Africa could be unusable by the year 2050 and the region may be able to feed just 25 per cent of its population by 2025(ECA,2007).

2.5. Livestock distribution in Ethiopia

Currently a huge livestock population exist in Ethiopia .As a result most of the rural communities depend highly on animals for food, income, drought power and social interaction ,in the low lands pastoralist keep mixed herds of camels, cattle, sheep, goats, and donkeys. In the high lands, settled farming communities are reliant on the animals (Charles H. & Alistair: 2002).

Ethiopia is believed to have the largest livestock population in Africa. This livestock sector has been contributing considerable portion to economy of the country ,the total livestock population is estimated at 47.57 million of cattle, 26.12 million head of sheep, 21.7 million head goat, 1.78 million of horse,5.57 million of Donky,0.38 million of mule,39.6 million of poultry and 1million camels(CAS,2007/8).with livestock ownership currently contributing to the livelihoods of an estimated 80 per cent of the rural population(USAID,2010).

Pack animals including horse, mule, donkeys and camels constitute to about 5% of the total animals population in the country. Camels are found in the low lands for transport,

riding, ploughing, milk and meat and to provide hide. Equines are more limited in the country and they are concentrated in the highlands of the country (National Atlas of Ethiopia 1988).

2.6. Economic importance of livestock in Ethiopia

Drought is a predictable events in the Horn of Africa, and when combined with other factors ,it causes conflict and terrible human misery .The previous drought(1983-85,1991-92,1998-99) caused losses in cattle population of up to 60% (Wikipedia , 2006). The economic value of livestock and livestock products is greater in the agricultural sector. Livestock are economically important for food, draft power, export benefit, transport services, manure and fuel. They are essential for the fulfillment of protein requirements of human population, in the form of meat, milk, butter and other product. In mixed farming system, 26% of livestock is used for food and in pastoral system, 61% is used for food Livestock are source of cash income for small holders, mixed farmers and pastoral households. It has been estimated that over 85% of farm cash and 90% of pastoral unit income are generated from livestock (Annual Report on the Ethiopia Economic: 1999).recent. It contributes an estimated 47% to agricultural GDP and 12% to cover all GDP (IGAD, 2012/13).

Livestock constitute a major economic factor in the pastoral and agro-pastoral communities, more precisely, livestock are a depository for savings, a reserve for contingencies, a self-reproducing asset and sources of energy for farm, livestock play also a central role (*Kassa Belay et al, 2005*). Livestock contribute a lot both to the household and to the export benefit of the Ethiopia. Live animal hides, and skins wool and hair of animals bring income to the small households and to the national level. In the Ethiopian economy, the livestock sector creates livelihood for 65% of the rural population (EEA, 2005). Livestock in pastoral regions accounts for an estimated 40 per cent or so of the country's total livestock population. Noteworthy is that cattle from pastoral areas provide also draft animals for the Ethiopian highlands. Despite the important contribution to the national economy, pastoralists and agro-pastoralists are among the poorest and most vulnerable rural households in Ethiopia (IGAD: IFAD, 2016).

2.7. Pastoralism in Ethiopia

Pastoralists are defined variously in the literature as those who obtain more than half their income from livestock and livestock products and who characteristically practice mobility to avoid risk, respond to variable climatic conditions and ensure healthy livestock and rangelands. A further category of agro-pastoralists is defined as those who practice some degree of mobility but obtain less than half their income from livestock, with most of the remainder coming from crop cultivation (Magda Nassef and Mulugeta Belayhun, 2012). Pastoralism term used to describe an economy based predominantly on the herding of animals such as cattle, goats, sheep and camels. Pastoral societies are most common in central and southwest Asia and East Africa. However, pastoralist societies exist as far north as the Arctic circle. Pastoralism is particularly well suited to life in harsh environments such as arid grasslands and semi deserts. The herds produce dairy food, blood, meat, Wool, hides and dung pastoralists are often nomadic or semi nomadic (Encarta, encyclopedia 2004).

It is estimated that the Somali pastoralists constitute 53 per cent of the pastoral population followed by the Afar 29 per cent, the Borana 10 per cent. The remaining 8 per cent are found in Gambela, Benishangul and Tigray regions (Gebremichael, 2015). Generally, the pastoral land of Ethiopia are divided into five areas namely, Northeastern, Eastern, southern, southwestern and western. These areas are estimated to cover 78 million hectares or about 60% of the total land area of the country. The pastoral areas are considered below 1500 meters elevation, using rainfall and temperature region, the climate of the pastoral low land is broadly categorized arid 64%, semi-arid 2% and sub humid 15 % (Coppock, 1994). The country's livestock population is distributed over the highland and lowland areas. Of the total cattle population of the country, pastoralists own about 27 percent, 26 percent of sheep and nearly two-third of the goats' population, all of camels are owned by pastoralists (EEA, 2005). Ethiopia has witnessed a decline in per capita land holding due to high population growth. Pastoral and agro pastoral areas of Ethiopia are largely located in the lowlands which cover about 60 per cent of the territory and are home to about 12-15 per cent of the country's total population (IFAD, 2016).

Traditionally in Ethiopia, Pastoralism considered a backward way of life, and the people who depend on it for their livelihood regarded as insufficient land users. “Low less ‘and’ aim less’ wanderers. The Amharic term for pastor list in ‘Zelan’ (literally, ‘Wondered’), and is commonly used derogatorily. The Pastoralists are blamed for damaging the rangelands through bad management, over stoking and overgrazing (Getachew, 2000). Because of insufficient watering and grazing of resources people in their area are forced to move from one place to place. This, of course, means that the people are not sedentary, but neither is they nomads in the strict sense of the term, the move such a way that they match their needs to the periodic supply of pasture. The pastorals more seasonally and they also get back periodically to where they have been. This is the management of the general enrolment (Taffesse, 2000).

In relation to the highlands, pastoral’s inhabit the low land periphery which encircles the highland because of their remoteness and distance from the major populated entrees infrastructure and communication are generally poorly developed (Richard Hogg,1997). Even by the standard of Ethiopia, pastoral areas have the lowest access for basic public services such as education and human health services. Infrastructures such as roads, telephone, markets, etc. are poorly developed. Poverty and food insecurity is widespread. Pastoral areas under consideration are also rich in natural resources including surface and underground water, minerals, fishery and energy. The rich deposited of natural gas, geothermal energy, metallic and non-metallic minerals is a clear indication of the rich wealth potential areas. Another important wealth’s resources are wide variety of flora and fauna national parks; it is also primary interest for archeological and Socio-anthropological studies. The pastoral areas, therefore must not be taken as areas only fit for livestock producing (Tafesse, 2000)

2.8. Agro- pastoralist in Ethiopia

There is a wide spread misconception that pastoralist largely survive only the milk and meat. Most pastoralists have too few animals to allow for a purely pastoral diet consequently grain has increasingly become an important part of the daily intake. Another misconception about pastoralists is that almost all of them are nomadic, always on the move with their livestock, 40-50 % of the rural people in southeast Ethiopia

actually agro pastoralist. The most common agro pastoral system in pastoral area of Ethiopia is sorghum / maize/ livestock farming, small scale irrigation is increasingly being used to establish private and group farms for growing vegetation (Tafesse, 2000). The coverage of invasive species is estimated to extend over 1 million hectares in the four major pastoral eco-systems of Ethiopia, implying that this expanse of land is no longer available for grazing. Added to this is the loss of prime dry-season grazing reserves close to major river systems due to various state and private investments and projects. Successive poor/failed rains in 2016 and 2017 have impacted on pasture and water availability (FAO, 2017).

9.1. Pastoralist's Drought coping strategies

African Union (2010) reports that pastoralism has “evolved over generations as a response to marked rainfall land temperature variability,” and that flexible and mobile pastoralism has great potential for reducing poverty, generating economic growth, managing the environment, and promoting sustainable development. Other research has shown that pastoralists have an intimate relationship with their environment and a rich knowledge that enables them to both protect and exploit the changing rangeland conditions on which they depend (McGahey et al., 2008).

Pastoralists as a matter of necessity have for many years developed a number of droughts coping mechanism, which for many years have enabled them to live through events. Their adaptive, coping and risk management strategies in the events of drought including mobility, livestock sales, herd splitting, livestock diversification (Huho,et at,2011) . In order to cope and adapt with the unreliable rainfall and pasture distribution, pastoralist must practiced; Resources exploitation mobility and escape mobility (Oba, 1997) Herd diversification is common adaptation strategies practiced by most of pastoralist in Ethiopia. This strategy involves use of a broad array of livestock species, which utilize different parts of the forage and have varying resistance to drought (Kashaye, 1998)

2.9. Indigenous Borana range management

Mobility is the prime feature that characterizes Pastoralism in Ethiopia, as also elsewhere. Mobility is the art of rangelands management, and adaptation to temporal and spatial resource dynamics in the system. By moving from place to place between seasons pastoralists effectively utilize resources and maximize the productivity. Pastoralists have, over generations, developed a good natural resources and livestock management systems. These practices are governed by complex and interesting local institutions/indigenous institutions which develop laws and rules to abide by the knowledge and skill acquired pass to generations through local institutions (SOS Sahel Ethiopia, 2015).

Borena pastoralists have managed this range land using their own life teaching experiences knowledge without any external support for many centuries. This indigenous range management system is based on an interactive action between plants, grazing animals and human with a biotic, component of rainfall and soil playing an important role. The function of the herder is to manipulate animal movement in accordance with available forage and water resources. Traditionally if an area is overgrazed, Borana pastoralists were obliged by their Gada system to move to other areas, which were less inflicted until the abandoned range had recovered.

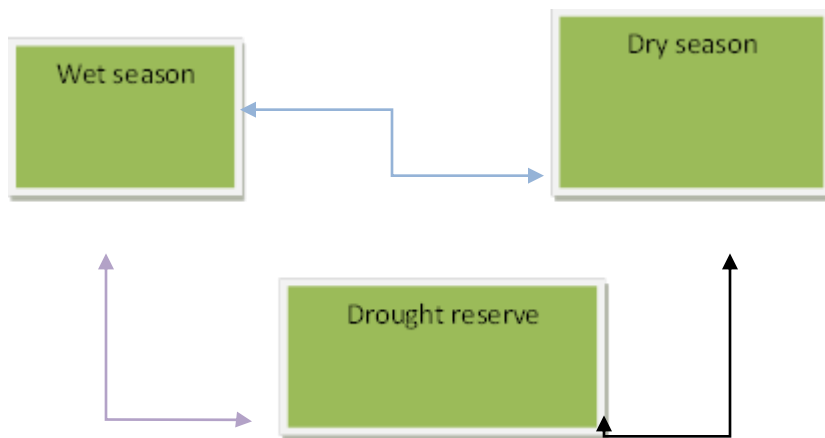


Figure.2.1 Traditional range management system

Grazing pressure was regulated in a rotating system between wet season grazing area, dry season grazing area and drought reserve area. When an area was closed, another area was opened up for use. Livestock movement /mobility are the principal mode indigenous range management (GTZ, 2004: vol II).

2.10. Traditional range and water management system

Different pastoral groups across the country share a few common characteristics in range and water management. Access to water from permanent water sources in dry season grazing areas is likely to be controlled more strictly, especially in times of scarcity to support a limited number of people and livestock (Sandford, 1983).

Ethiopia's Borana have some of the most elaborate water control and management systems in the country. In terms of access to land (pasture), management is traditionally the responsibility of territorial units (*deedhas*), the boundaries of which are porous and changeable depending on the resources available.

A complex customary administrative structure, the *gaada*, administers the *deedhas*, according to the customs and laws of the Borana, the *adaseera* (Tache, 2000; Magda Nassef and Mulugeta Belayhun, 2012).

The main characteristics of the TRMS are

- Mobility of human and livestock
- Common land ownership and management
- Wet and dry season rotation grazing regulating by the type of water source and availability
- Herd splitting in to wara and fora herd
- Special grazing reserves near and around permanent water sources (deep wells, Permanent rivers) set a side of drought period
- Controlled fire as a tool to control bush and trick and enhance growth of high quality grass species.

Over the centuries the Borena pastoralist have developed and practiced on elaborated range and water management system. To move their animals in search of water and fodder, both animals and herding household members grouped according to their age and ability to migrate, elders, children women with small children take care of the old, weak and milking animals as well as those with calves (Wora herds), they stay at semi sedentary camps (Ollas) near permanent water points the herds use the grazing land around the semi-sedentary encampments. Able-bodied man and women herd the healthier animals, Non – lactating animals young, Stock bulls and steers (fora herds) in the distances wet or dry season grazing area where pasture is abundant. The use of grazing land rotation during the wet and dry season is a sustainable use of natural resource and reduces over grazing. Grazing of wet season rangeland depend on temporary water source in natural depressions and excavated small ponds and seasonal rivers. When these temporary water source dry up at the end of the rainy season the herd move on to the untouched dry season pastures around clusters of Permanente deep well (ella) or Permanent River.

Wet and dry season

Grazing area

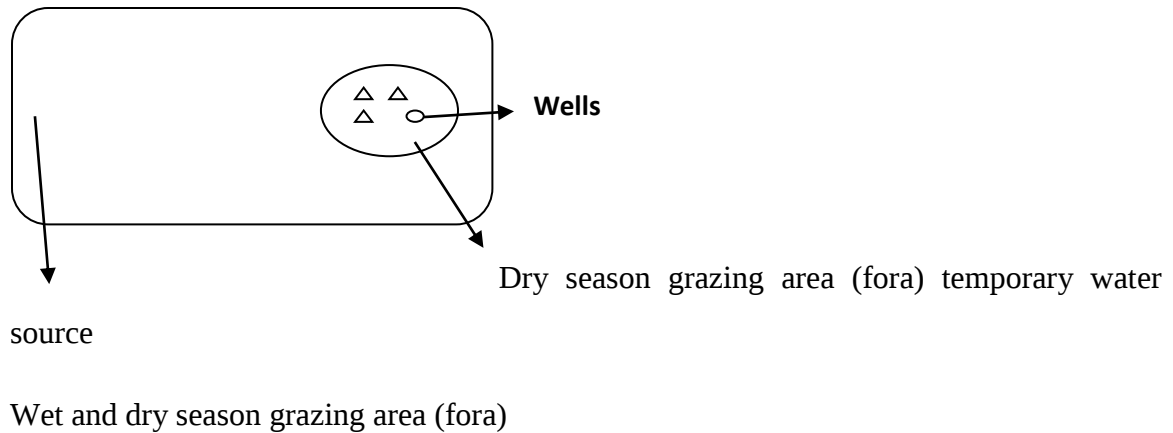



Fig.2.2.Traditonal water and range management method

Each well (ella) is the property of the clan that initiated the digging, but other may also use, it as long as there is enough water. The clan alliances is responsible for the excavating and maintain wells, the alliance contributes labor and ox, and members regulating livestock watering each day. An elaborate system of authorities manages the well and the associated grazing areas.

- Adhedha is a common grazing area surrounding specific water points and well clusters
- The Abba Dhedha (Jarsoabedha is an elders or group of elders) who oversee herds movements and announces the opening or closing of wet and dry seasons grazing areas.
- Jarssa Ardha are group of elders who coordinate range management of each ardher (sub-unit of dhedha)
- The Abba Herega is the water manager he coordinates the use and maintenance of the water points. He establishes watering rights by fixing water rotation schedules
- A Hayyu is a member of Gada council representing the clans; the hayyu councilors make sure the wells are used properly.

This integrated range and water management system uses the natural resources in an efficient and sustainable way and results in high livestock productivity and hence good food security (GTZ.2004:vol.I).

2.11. Problem in connection with range management

Now a day, indigenous rangeland management system has been weakened by external influence and intervention and internal factor such as:

2.11.1. Governmental and non-governmental organization developed new water sources

For centuries, pastoral communities have developed a sophisticated network of water resources, including rivers, rainwater and groundwater-fed permanent sources. In Ethiopia's arid areas, where pastoralism is the dominant livelihood, practical field experience over the past forty years indicates that water development divorced from an in-depth understanding of pastoral livelihoods (Magda, N. and Mulugeta, 2012). Permanent large ponds boreholes with diesel and solar pumps, some of these new water sources did not consider the indigenous grazing patterns. They were constructed and are being constructed in the wet season grazing area where livestock supposed to stay only for few month, they have encouraged permanent settlement in the wet grazing areas and then over grazing. The water points are not well distributed over the rangeland. The far remote area, which has lack of water and livestock, came back to the permanent well, earlier before the acute dry season. This ecologically unwise water development without considering the future effect, it would have on the range and on the traditional range management system will lead quickly to over grazing of the areas adjacent to this water points (GTZ, VII, 2004). Traditional range management practices have deteriorated, and indiscriminate water development has led to the degradation of some wet season grazing areas (Sara Pantuliano and Mike Wekesa, 2008).

2.11.2. Expansion of agro –pastoralist

Pastoralism is uniquely well adapted to dry land environments. As an economic and social system, it operates effectively in low and highly variable rainfall conditions. However, in Ethiopia pastoralist livelihoods systems are becoming increasingly vulnerable; grazing land has been taken away from pastoralists for other purposes, such

as farming and settlement along pastoralist migratory routes (Sara Pantuliano and Mike Wekesa, 2008).

Human population in the pastoral area like other part of Ethiopia has been growing at a rate faster than that of the resource. The expansion of farming into grazing area has resulted in the reduction of grazing. There is no doubt that agro-pastoralism does have negative impact on the pastoralism interims of reducing access to traditional valuable grazing area on water points. The problem increases as the density of agro-pastoral farming increased. Communal grazing land is currently under pressure of competing interests, important grazing areas such as bottomland riverbank and swamps area increasingly occupied mainly for cultivation purposes. Therefore, they are no more accessible for livestock use. In some areas and rangelands were used by both domestic and wild animal. As a result, livestock producers are forced only to concentrate out in the plain, losing their mobile life style. This led to overgrazing and increased mortality (Taffese, 2000). In Borana rangelands there is crop cultivation encroachment. Borana communities were highly involved in crop cultivation as an alternative means of livelihood (Tilahun et al., 2017).

2.11.3. Bush encroachment

This phenomenon has been observed across much of the world's arid and semi-arid biomes (Andela et al., 2013; Siraj Kelil Gobelle et al., 2018). It is particularly visible in African savannas and grasslands (Mitchard and Flintrop, 2013; Siraj Kelil Gobelle et al., 2018). In Ethiopia, grassland ecosystems cover about 72.9% of the land area (Robin et al., 2000). Borana rangelands in the southern parts of the country were considered to be one of the best grazing lands (Coppock, 1994).

However, these rangelands are experiencing increasing pressure from livestock and human populations, bush encroachment and tick infestation (Ayana, 2007). Bush encroached areas show an increased density of Acacia species. Bush encroachment is the major problem in the Borena rangeland. The present estimation indicates that more than 40 % of the rangeland encroached by harmful bush. The plant population of unpalatable bush, shrubs and herbs is increasing, while palatable vegetation. The major causes for the

bush encroachment are ban on range burning. Overgrazing, drought, weakening of the indigenous range management system, effect of bush encroachment are shortage of livestock feed shrinkage of grazing land, increasing of tick population and harboring of predators (GTZ, 2004: Vol.II).A study conducted by Daniel (2010), showed bush cover within Borana rangelands increased from 51% in 1986 to 53.8 % in 2002, and to 57% in 2010 (SirajKelil Gobelle and Abdella Gure,2018).In Borana rangelands, bush encroachment is considered as one of the major problems affecting rangeland ecosystem structures and functions. Several studies reported the adverse effects of woody plant encroachment on grass productivity and the diversity of the native vegetation (Cop pock, 1994 et al and Ayana, 2007).Other major cause of the rangelands degradation and loss of productivity is the impact of bush encroachment that reduced rangelands utility (SOS Sahel Ethiopia, 2015).

2.11.4. Ban on bush burning

Intervention by government to improve grazing was the official ban on bush burning practice by pastoral Borena, Afar, Somali & other. Until recently, any person found burning the old grass is caught and penalized by the PAS and district court .The ban on bush burning has resulted in the reproduction of pests. For instance, livestock cattle get sick, die due to tick and snakebite infection moreover, the noxious bush has overtaking large areas and reduced the available grass land. This has aggravated scarcity of land and grazing for the livestock (Getachew, 2000).

2.11.5. Private feed reserves /enclosure/kalo/

Land was communal in the Borena pastoral System, respect, agreed rule and regulation, As a principle of feed conservation, a Borena, pastoralist established a communally utilized feeds reserves (kalo) system for calves and weak animals, to be used during drought years and prolonged dry season .In contrary the past, recent trend show that the right and wealthy pastoralist have started fencing their own private (kalos) feed reserves. These created sense of individualism, which is threat for pastoral mode of production; the privately owned and fenced “kalos” are inhibiting livestock mobility, which is the principal concept of pastoral range management techniques (GTZ, 2004:Vol.II).

2.12. Impact of drought on the socio-economic of pastoralist area of Borena

The region/Sahel is especially vulnerable to impacts of drought and desertification due to widespread poverty, the fact that a large share of Africa's economies depend on climate-sensitive sectors such as rain-fed agriculture, poor infrastructure, heavy disease burdens, high dependence on unsustainable exploitation of natural resources, and conflicts. The poor households that are affected by drought and desertification do not have adequate resources to deal with food shortages. As a result, the millions affected face food insecurity and Hunger (ECA, 2007). Drought is expected to have significant impacts in most of the climate sensitive sector in Ethiopia. In the ASALs, for example, frequent droughts are associated with the deterioration of livestock condition, increase incidence of certain disease and livestock deaths, altered health structure and a collapse of livestock market (Speranza, 2010).

Food availability in Ethiopia has been below requirements for the last two decades or so, In particular, people living in the drought prone areas of Eastern and Central Zone of Tigray (Tigray region), Wello, North Gondar and North Shoa (Amhara region), and Borena, and Haraghe (Oromiya region)are severely affected by lack of food (Mulat Demeke et al.,2004). As shown below;

Table 2.2: Drought/disaster affected population

Drought/disaster affected population Year	Disaster/drought affected population (million)	Proportion affected (%)
1980/81	2.82	7.7
1981/82	3.70	9.8
1982/83	3.30	8.5
1983/84	4.21	10.5
1984/85	6.99	17.0
1985/86	6.14	14.5
1986/87	2.53	5.8
1987/88	4.16	9.3
1988/89	5.35	11.6
1989/90	3.21	6.8
1990/91	7.22	14.8
1991/92	7.85	15.6
1992/93	4.97	9.6
1993/94	6.70	12.6
1994/95	3.99	7.3
1995/96	2.78	4.9
1996/97	3.36	5.8
1997/98	4.10	6.8
1998/99	7.19	11.7
1999/00	10.56	16.6
2000/01	6.24	9.6
Average	5.37	10.3
2002/03	14.3	22.0

Source: FAO; Mulat Demeke et al., 2004

Pastoral areas in Ethiopia are characterized by frequent drought with high livestock mortality which often results in threatening viability of pastoral livelihood, famine and deaths in human population. For example, the 1973/74 drought that affected the pastoral areas in general and the Afar pastoralist in particular decimated 72% of the cattle herd, 45% of sheep, 34% of goats and 37% of camels. In both the 1983-5 and 1990-2 droughts the Borana pastoralists in southern Ethiopia lost 50 to 60% of their livestock inventory (Desta et al. 2002 and Coppock 1994). The 1984-85 Borana drought wiped out 90% the calves (Cossins and Upton, 1988). The 2005/6 drought that hit Afar, Borana and Somali has claimed a huge loss in livestock wealth. Among all other factors such as human and

livestock disease outbreaks, conflict and insecurity (Solomon, 1999). Drought is one of the natural phenomenon that has been affecting the livelihood of both cultivators and pastoralist. Its impact is felt more in arid and semi-arid areas. Serious drought occurrences have decimated a high percentage of the livestock population (Taffesse, 2000).

Drought may become catastrophic and result in loss of live due to lack of necessary resources (Encarta, Encyclopedia, 2004). Terms of trade get disturbed, because the supply of cattle for market increase, their price falls sharply and the price of grain shoots up causing marketing imbalance (Taffesse, 2000).

Ethiopia's pastoral communities, the effects are decreased per capita holdings of livestock, an increased trend towards agro-pastoralism (Yemane, 2003; Magda Nassef and Mulugeta Belayhu, 2012). The drought of 1991-92 seriously affected the Borena population and their livestock, during the first years of the drought the shortage of grass and fodder affect the health of the livestock and in consequence the declines in production milk caused food shortage for the people, shorting of water become major problem in the second phase of the drought and followed by the outbreak of disease. Traditional coping mechanisms like, wide ranging movement of people and livestock to escape the drought could not take place due to political and tribal conflict; Further, the unrest severely affected the supply of grain to local market. Hardly any food was available and livestock price collapse. The Borene lost up to 70 percent of their cattle herds as well as many camels, sheep, donkeys and horses. In some lowland area these figure probably rose to 80 percent of the total livestock population (Richard Hogg, 1997). Preliminary estimates indicate that between November 2016 and April 2017, more than 1.5 million livestock perished in southern and southeastern areas, representing an economic loss of over USD 350 million (FAO, 2017).

2.13. Government and non- governmental organization intervention

The government intervention measures following recent drought (2000) that ravages pastoralist communities in arid and semi-arid area in Ethiopia have been largely through the provision of emergency food aid. Other intervention strategies executed by the government included water and livestock based intervention. Water related intervention

includes water trucking, borehole development and maintenance, distribution of water tanks and construction of water pans .Livestock based intervention include destocking , provision of livestock health services and livestock feed.

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1. Description of the study area

3.1.1. Location

The former Borena zone is re-organized or classified in to two zones at the end of 2002namely;Borena zone and Gujji zone.Gujji zone located South and Southeast part of Ethiopia in Oromiya region. Liben woreda is one of the twelve wored as in the zone, which found in the Southeastern part of Gujji zone. Up to 2015,Liben woreda consists 37 kebeles, later it classified in to three woreda, namely;Liben, Gorodola and Gumedalo wered as,Now Liben woreda has 12 kebeles and located between $5^{\circ}4'30''\text{N}$ - $5^{\circ}32'30''\text{N}$ latitude and $39^{\circ}22'30''\text{E}$ - $39^{\circ}58'30''\text{E}$ longitude. It is 595 km far from Addis Ababa. The woreda is bordered in the North by Bale and East by Somalia regional state: Southwest and North by Gorodol a woreda and South by Gumedalo wereda (Guji Zone Finance and Economic Development office, 2014/2015).

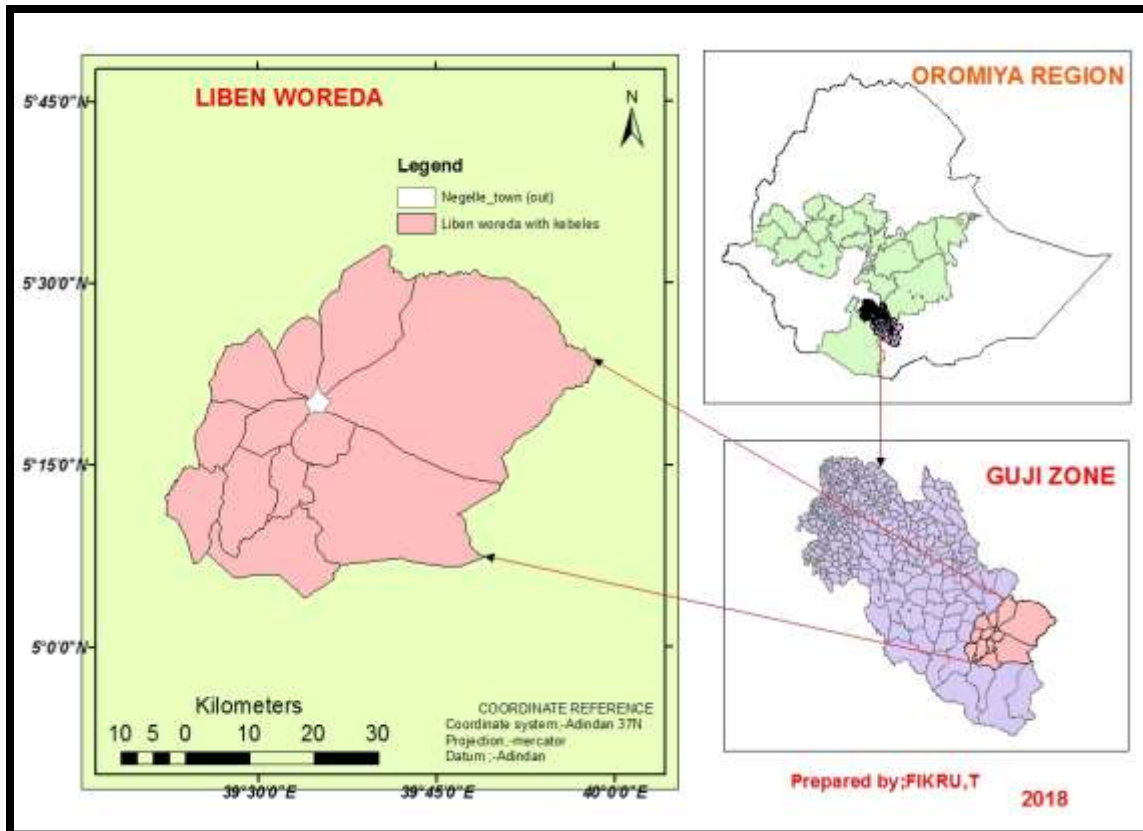


Figure.3.1.Liben woreda/study area map

3.1.2. Climate

The climatic condition of the study area is characterized by arid and semi- arid low lands, its altitude ranges from 500 up to above 1,500M.a.s.l. The rainfall pattern of the area is bimodal with a tremendous variability between season, locality and years. The annual rainfall of the of the area varies from 592-1200 mm with unreliable amount and erratic distribution, It is known that Liben has been persistently food insecure and recurrently suffer drought hits due to failures of rain fall. The major rainfall season locally called Ganna (spring) commences in the early of February up to April and the short rainy season locally called. Hagaya “(autumn) late September up to November, it is reliable. Its mean annual temperature ranges from 24⁰c Minimum up to 28⁰c maximum (Agricultural and natural resource development office of the woreda, 2018).

3.1.3. Human and animal population of the study area

Liben woreda has total human population of 88,352, out of the total population of the woreda 100% are living in rural parts of the woreda and the sex ratio is 50.5%, the crude density of the woreda is 4p/km².

Table 3.1 Liben woreda Population distribution

	Sex	2007E.c	2008E.c
Urban	Male	0	0
	Female	0	0
	Total	0	0
Rural	Male	43,435	44,624
	Female	42,563	43,728
	Total	85,998	88,352
Total	Male	43,435	44,624
	Female	42,563	43,728
	Total	85,998	88,352

Source: BoFED of Oromiya population projection 2014/2015

The study area has high potential of livestock and the estimated total population of livestock are about 215,562 heads of cattle, 101,107 sheep, 1249,201 Goats, 205,954 camels and 20,371 equines and 10,765 chickens. There were traditional beekeeping activities in the long run; Presence of high flora, water point and colony is potential for beekeeping (Liben woreda pastoral development office, 2015).

3.1.4. Livestock market

Occasionally, Seasonal shortage of rainfall, due to its impact on feed availability; they forced high supply to the market. This forced supply is constrained by the inability of the pastoralist to plan sales in accordance with market need (Belachew and Jamber, 2002). There are total of three market sites in Liben woreda, these includes Mugayo, Alage and

Negelle town. Among these except Negelle market which gives secondary service, all other give only primary service, moreover, the number of market in district is not enough in comparison to the area of the district (save children, 2005).

3.1.5. Topography and land use

Attitudinally, the study area extends from 500 up to above 1500 above sea level. The total area of the woreda is 659,291 hectares and the potential arable land is 65,213 hectares, which is 9.9 % of the total area of the district, from this potential arable land 29,684 is cultivated. The major crops cultivated are maize, wheat, teff, barely and haricot bean, produced in the autumn (meher) and spring (belg) seasons. Pulse and oil crops are also produced. Manuring and fallowing are the commonly practiced system of soil fertility maintain ace in the district. Using artificial fertilizer is increasing from year to year (Agricultural and natural resource development office of the woreda, 20018).

3.1.6. Vegetation

There are remaining parts of juniper, bushes and shrubs and grasses high forest woodland in the woreda. The acacia species are the major types of shrubs that are found in the area either in pure or mixed vegetation form, the woreda agricultural office estimated that forest cover 26,566 hectares, bush land cover, 212,543 hectares, and grazing land, 279,542 hectares. Deforestation is the major problem in the area. The place which is covered by forests is now becoming desert .There are no more juniper trees that covered the land before. There is no reserved area for wild life conservation, but spotted hyena, leopard, monkey, pig, ape, Columbus monkey, fox, and bush-buck, lion and elephant are sparely found in the district (Agricultural and natural resource office of the woreda, 2018).

3.1.7. Drainage basin of the area

The wereda is drained by Genalle in the northeast and Dawa /awate rivers in the west and South frontier. Liben district lies between, Dawa River from the west and Genalle River from east (the two rivers are approximately 150 km a part) and they are the only

permanent water sources in drought years. Regarding lake and spring, there is no well-known lakes and spring in the woreda (previous Borena planning and economic, 1998).

The major water sources for livestock in Liben district for dry season are ponds, rivers, and traditional wells, for rainy season surface water is the major one, there is shortage of water in different parts of the district particularly during dry season (Pervious Borena planning an economic Bureau, 1998).The majority of the population in the woreda uses unprotected (untreated) water; such as spring water, hand dug wells, rivers, and rain water. Statistical abstract of woreda water and energy office in 2015 the number and type of portable water sources to the district is deep-well 8, shallow-well 8, hand dug-well 43 and spring development is 14(Guji zone Finance and Economic development office, 2016).

3.1.8. Mining and industry

There are different important mineral resources in the district like, Gold, feldspar, quartz, dolomite, emerald and other, but the amount of deposit is not known, only a few of minerals are extracted and explored in the woreda kebeles in Alagee,Mi'esa and Kobadi. Nowadays some private and group licensed explorers and extractors are seen in the area of different mines under Guji zone investment office Industry in the district only small-scale level. There were five small scale industries; flourmill sawmills and metal and wood work, they are owned by privately (Finance and Economic office of Guji Zone, 2016).

3.2. Research Methodology

The approach employed in this research was a mixed that means both quantitative and qualitative methods. Because using multiple approaches can benefits from the strengths of each approach and counterbalance their different weakness and provide a better understanding of research problems than either approaches alone. In this study, the researcher mixes quantitative and qualitative data in order to provide a comprehensive analysis of the research problems. It could also provide more comprehensive answers to research questions going beyond the limitation of a single approach (Creed,et al.,2004). It

is also practical in the sense that the researcher is free to use all method possible to addresses a research problems (Creswell, 2009).Furthermore, it helps to confirm, cross validate findings within the study.

3.2.1. Study design

Research design is plans and procedures for research that span the decisions from broad assumptions to detailed methods of data collection and analysis (Creswell, 2009). Based on a research question, the researcher used cross-sectional descriptive survey design, such design also used to obtain general overview of the subject and to generalize study findings from sample to population.

3.2.2. Sample size determination and sampling techniques

Sample size of the study could be determined depending on the nature of the study, cost, time and participants involved in the study. Since involving all population in the study area is too costly and time taking, the researcher took a sample. In Liben woreda there are 12 rural kebeles, almost all are affected by recurrent drought, then the study was focused on the three rural kebeles(Seminto and Mugayo(kelada), and Alage) to make this study manageable and based on accessibility of transport from center of the woreda (Negelle) to distance kabeles, the settlement pattern of the people (Very scattered),and the peace and stability condition of the kebles. The total numbers of sample size are 370 out of this 360 respondents were drawn from 3,673 households from the sample kebeles. To select the 360 target households the researcher used simple random sampling method and also purposive sampling was used to select 10 key informants from governmental and non-governmental offices. In this study the researcher used the desired level of precision at $\alpha=0.05(5\%)$ variability and 95% of confidence the formula used to determine the sample size of the study is:-

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

$$n = \frac{3673}{1 + 3673(0.05)^2}$$

$$n = \frac{3673}{1 + 3673(0.0025)}$$

$$n = 360$$

Therefore 360 sample respondents were selected.

Where n =sample size= sample frame, N =household size 3673 e =margin of error at 95 percent confidence level. In this case margin of error equals 5% i.e. $e=0.05$.The 95% confidence level was chosen in this study because the study deals with human being with accuracy of information is subject to human bias. Therefore, the sample size for the survey was 370.This was to ensure that the sampled mean was closer to the population mean and minimize error. Sample size in each kebele was obtained by dividing the total number of rural household in each sample kebele by the total number of rural household in the selected kebeles and then multiplied by the sample size of the selected kebeles.

Table 3. 2. Sample size in each kebele

k/no	Sample kebeles name	Total no of rural household in each kebele	sample in %	Sample size from each kebele
1	Seminto	1415	39	139
2	Mugayo(kelada)	998	27	98
3	Alage	1260	34	123
	Total	3673	100	360

3.3. Methods of data collection

The researcher proposed to use primary and secondary data source. Primary data was obtained from the respondents such as from livestock owners and from experts, through questionnaires, interview and focus- group discusses as well as observation.

Secondary data was obtained from concerned official documents, related book, journal, thesis reports, Websites, unpublished, verbal information and official documents available in the wereda and NMA.

3.3.1. Questionnaires

For data collection the researcher employed a questionnaire as the major tool. The questionnaires were composed of closed and open-ended questions as well as pre-code question, which were distributed to the respondents. Closed ended questions have advantage to fill by the respondent and they are easier to analyze, interpret, administer and economical, whereas the open-ended questions have benefits to allow obtaining greater depth and most of the respondents specially the pastoralists (livestock owners) are illiterate so the questions were filled by the researcher with the help of translator. Finally the researcher decides to use questionnaire because it is the most appropriate tool to obtain quantitative as well as qualitative information relative to the other methods and it is easy for the researcher to construct the questions and analyze the responses.

3.3.2. Personal observations

Observation is the most commonly used technique in collecting primary data. The main advantage of this method is that subjective bias is eliminated and the information obtained under this method relates to what is currently happening. It was employed to observe the overall living condition of the households.

3.3.3. Key informant interview

Interviews were the main method of generating data for understanding the situation of the people of study community. Peoples' knowledge, experiences, opinions, beliefs, needs, and constraints were discussed and shared with a large number of people, either individually and/or in groups . The duration of the interviews ranged from a relatively short time (less than an hour) to long interviews that managed under multiple visits.

3.3.4. Focus group discussion (FGD)5 respondents

Another method used for primary data collection is focus group discussion. Focus group discussion is one of the most important research methods for gathering qualitative data. This method was used to collect data on community level and with the expertise as to get general information about the impact of drought and coping strategies that have been practiced by the community.

3.4. Data analysis and interpretation

The collected data was processed, analyzed and interpreted in both qualitative and quantitative methods. The qualitative information gathered using direct observation; focus group discussion, open-ended questions, interview and verbal information was analyzed and interpreted using qualitative technique (narrative way). In this method, the existing situation of the problem was organized, summarized and explained thematically for the comparison and analysis of attributes, whereas the quantitative data generated by questionnaire and from secondary sources, from wereda administration offices and national metrological authority were analyzed by use of software like micro soft Excel and meteorological data of the study area recorded about 35 years was analyzed by help standard precipitation index and coefficient variation . After which the result including demographic information, household characteristics, and metrological data were summarized in tabular and graphical forms.

Based on data from National Metrology Agency of 35 years rainfall and temperature data of study area was analyzed to observe the trend of rainfall as shown below:

Drought hazard measurements could vary depending on the types of drought being dealt. For example, the magnitude of meteorological/hydrological drought is often measured by standardized precipitation Index (SPI) method or by classifying percent deviations of rainfall observations from the long term average and the rainfall variability measured using coefficient variation. If the rainfall observation “x” in time” t “is less than 1 standard deviation from the long term average, it might be categorized as moderate drought. If it is 1.5 or 2 standard deviations below the normal, it is classified as severe

drought etc. When rainfall observations are above the mean, they represent wet conditions to an extent of flooding (NMA, 20017).

The Standardized Precipitation Index (SPI) is calculated with the following equation:-

$$\text{SPI} = (\text{X}_{ij} - \text{X}_{im}) / \delta$$

Where,

SPI- is the Standardized Precipitation Index

X_{ij} - is the seasonal precipitation at the i th rain-gauge station and j th observation,

X_{im} - is its long-term mean and

δ is its standard deviation.

The coefficient variation is calculated with the following equation:-

$$\text{C.V} = (\delta / \text{X}_{im}) 100$$

Where,

C.V- is the coefficient variation

δ is its standard deviation and

X_{im} - is its long-term mean

CHAPTER FOUR

4. RESULTS AND DISCUSSION

4.1. Respondents Demographic and socio-economic characteristics

4.1.1. Livelihood of the respondents

Table 4.1 below shows that 55% of sample respondents were identified themselves as engaged pastoralist who sources their livelihood in livestock rearing, and the remaining 45% are as agro-pastoralist who sources their livelihood from both livestock rearing and crop production. Even if the majority of the sample respondents responds(55%) that the main sources of livelihood are pastoralists, but according to pastoralist development office of the woreda (2019); none of the other than pastoral way of life does not mean than all pastoralist living in Liben woreda do not conduct agricultural activity apart from livestock production. In line with this, key informants mentioned that they built rent house in the town, bee farming, gum production, fuel wood and charcoal trading activities were preferred as an additional sources of income. From this one can understand that the source of income in Liben woreda is not only limited to livestock rearing but also the area has other varieties of sources of income.

Table 4.1.Livelihood of respondents

No	Livelihood of respondents	% of respondents
1	Livestock rearing	55
2	Both livestock rearing and crop production	45

Source: Field survey, 2019

The Household results indicate that 82.1% of respondents were married, 3.6% were divorce while 14.3% were widowed. There were 78% males and 22% females among the respondents. Most of the respondents were aged between 36 and 55 years .Most(55%) household had between 5 and 7 members ;24% had a between 8 to 10 members;14% had between 1 and 4 members and ;5% had between 11 to 13 members; and the least 2%

households had above 14-16 individuals. As an educational category shows that 84% of the respondents had no formal schooling, with only 14.3% attaining primary level education; 2.2% degree and above. 51% of households had children in school and only 49% of children not attained school. As far as religious concern most (83.8%) of the respondents are “waqifata” while the rest are protestant, Muslim, orthodox, account 7.3%, 3.9% and 1% respectively (Table 4.2).

Table 4.2 Household Characteristics of pastoralists in the study area

No	Characteristics	Category	%
1	Sex of respondents	Male	78
		Female	22
2	Age of Respondents	20-35	15
		36-55	67
		Over 55	18
3	Marital status of Respondents	Married	82.1
		Divorce	3.6
		Widow	14.3
4	Education level of respondents	Illiterate	84
		1-8	14.8
		9-10	-
		11-12	-
		Degree and above	2.2
5	Religion of respondents	Waqifata	83.8
		Protestant	7.3
		Muslim	3.9
		Orthodox	1
6	Household size of respondents	1-4	14
		5-7	55
		8-10	24
		11-13	5
		Above 14	2
7	Children attained school	No attained school	51
		Attained school	49

Source: field survey, 2019

The analyzed data of distribution of socio-economic characteristics of the households results indicates the sources of livelihood for the households of the study area are both rearing of animals (pastoralism) and crop production, but according to pastoralist

development office of the woreda, even though, they engaged in crop production pastoralist account 55% and the rest are agro-pastoralist 45% (Table 4.1). As Table 4.5 shows that the all sample household with 43 % owning 1-10 cattle, 77 % owning 1-10 sheep, 69% owning 11-20 goat, 46% owning 11-20 poultry and only a few households owned 44% and 25% 1-10 donkey and camel.

All the respondents mentioned drought (shortage of forage and water), human disease, livestock disease, crop failure and poverty as the major constraints on their wellbeing. The major problems encountered with regarded to livestock keeping includes shortage of pasture and water, livestock disease (100%) and 68%livestock market (Figure 4.1).

About 78% of the respondents indicated that the main sources of water for livestock were traditional wells (ella), 16% in water dams/pond, 9% in motorized pump water, and 4%in stream except stream which were managed (specially wells) by community(Table 4.3).66% of the respondents sold above 10 poultry; 67 % sold 5-10 goats ; 64% sold 1-5 sheep;48% sold 1-5 cattle in the last one year (Table 4.4).64% respondents sold livestock during drought time; to generate income. Almost all of the respondents mentioned that they lost their livestock during 2016 drought event (Table 4.8) .According to Liben woreda pastoralist development office estimated that the woreda lost about 40 thousand livestock in 2016 drought event.

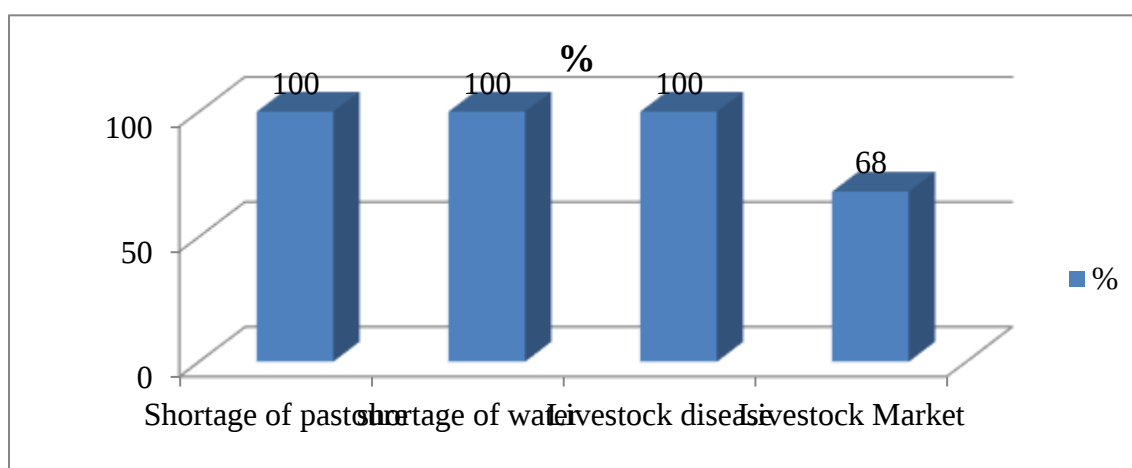
Table 4.3 water sources of the study area

No	Water sources	%
1	Traditional wells	78
2	Ponds/dams	16
3	Motorized/solar pumps	9
4	Stream	4

Source: field survey, 2019

Table 4.4 proportion of livestock sold in the last one year

No of livestock	Cattle	Sheep	Goat	Camel	Donkeys	Poultry
	%	%	%	%	%	%
0	52	13	0	77	98	0
1-5	48	64	33	23	2	9
5-10	0	23	67	0	0	25
Above 10	0	0	0	0	0	66



Source: Field survey, 2019

Figure 4.1 Major problem encounters with livestock keeping

Source: Field survey, 2019

Table 4.5 Type and Proportions of Livestock Owned by Households

No of livestock	Cattle	Sheep	Goat	Camel	Donkeys	Poultry
	%	%	%	%	%	%
0	-	10	-	63	56	10
1-10	43	77	26	25	44	44
11-20	33	13	69	12	-	46
21-30	19	-	4	-	-	-
31-40	3	-	1	-	-	-
41-50	3	-	-	-	-	-

Source: Field survey, 2019

4.2. Occurrence of Drought in the Woreda

From the analysis of rainfall anomalies in figures 4.2, 4.3, and 4.4, there were more negative anomalies reordered as compared to positive ones. This shows that more periods insufficient precipitations were experienced in the study area. Moreover, negative rainfall anomalies indicated the increment of frequency and severity of droughts. The mean annual rainfall is 643.1mm with standard deviation 181.8, this demonstrated by the periods when precipitation was consistently below the long-term annual average. For instance, in a year's period between 1984, 1988, and 1990 to 1992, 1994 and 1997 to 2001 and 2003/2004 and 2007 the area was hit by frequent droughts. Similarly in the period between 2009 and 2016, the study area experienced precipitation below the long term mean. Severe drought occurred in 1991/1992, 1999/2000, and 2015/ 2016.

According to the data obtained from informants and secondary source, the woreda has been experienced repeated drought events in 1984, 1988, 1991, 1992, 1994, 1997/8, 2010, 2012, and 2016. Supporting this pastoralist development office data in table 4.7 and NMA data's in figure 4.2 illustrates, drought cyclic fashion episode was in period of four years, reduced two years and finally between one to two years. As collected information starting from 1981 up to date (2016) between range of 35 years in figure 4.2 shows these observed drought years the study area experiences drought, which defined as deficiency in its water supply due to constitutently below average precipitation, the memorial and the most severity drought events was 1991/92, 1999, 2012, 2015 and 2016 locally called the year of collapse both for human and livestock.

Table 4.6 Thirty years cyclic drought episode in the study area based on memory documentation

Observed drought year	Memory Documented events
1985	High severity, death in livestock, food insecurity challenges for human and hungry
1988	Serious severity, high lose in livestock and high food insecurity risks and hungry
1992/93	High severity, deaths in livestock, cause high poor formation exposure, food insecurity and hungry
1994/7/8	Serious severity, high lose in livestock and high food insecurity risks and hungry
1999/2000	High severity, high livestock lose, lose in agricultural products and food insecurity challenge observed
2010	High degree severity, lose in livestock, lose in agricultural products, high exposure to need in food aid and emergency water supply
2012	Observe high degree severity in livestock lose, lose in agricultural products, and challenge in food security with high number of people in need for aid and emergency water supply exposure
2015/16	High degree severity, lose in livestock, lose in agricultural products, high exposure to need in food aid and emergency water supply

Source: Liben woreda cultural and development office and key informants, 2019.

In table 4.7 above drought occurred years and its consequences were presented .Hence, observed drought was let the community to economic impact, social impact, and agricultural impact. The severity of drought causes very serious problem for animal life, causes outbreak of disease, animals death, economic loose of pastoralists and finally lead to poverty .These memories documentation along with NMA data analyzed in figure 4.1.

During the drought events and its damages in the area and the number of need of help may increase radically; the change in wealth level from have to not have may increase. According to woreda development offices in recent information in drought year 2016,about 40,000 of livestock was dead, and 87.8% of crops were lost and 482,884 people was required food aid.

4.3. Rainfall and temperature trends analysis

Based on data from National Metrology Agency of 35 years rainfall and temperature data of study area was analyzed, to observe the trend of rainfall as shown below:

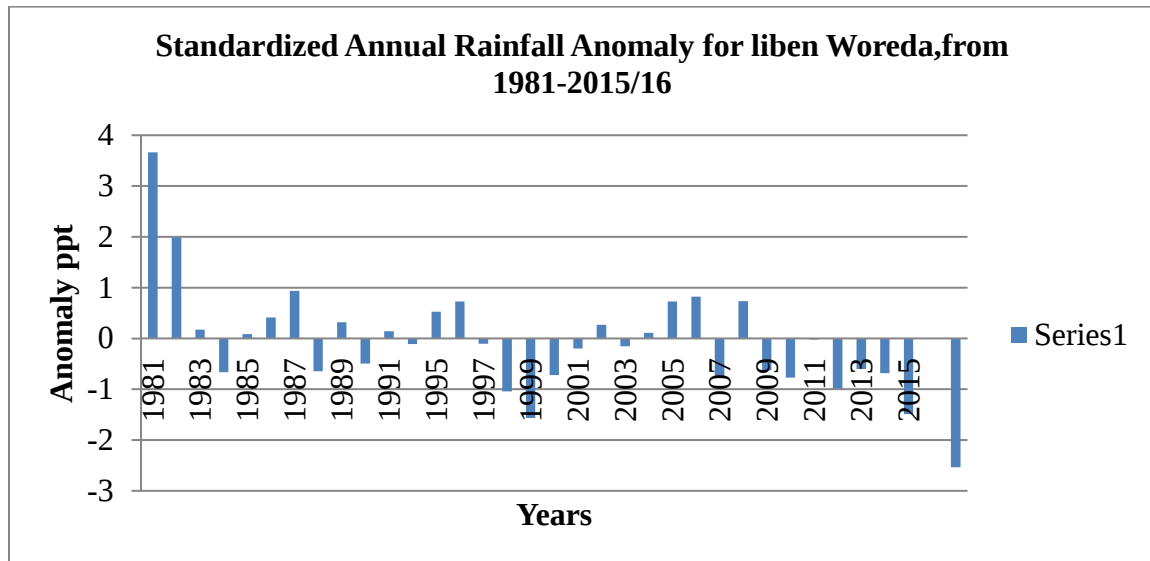


Figure 4.2.The standardized annual rainfall anomaly in the study area for about the period of 36 years i.e. from 1981-2016

Source: National Metrology Agency(NMA), 2019

Figure 4.2 shows that in the study area the mean annual rainfall is 643.1mm with standard deviation 181.8. Therefore, the normal rain fall ranges from 461.2 mm to 824.9mm. The coefficient of variation of annual rainfall is 28.27 which is highly variable. As the figure 4.2 shows the rainfall anomalies in the study area for a period of 36 years beginning from 1981 to 2016. The long-term annual mean from the rainfall data collected for the period was 643.1 mm. Negative precipitation anomalies featured in 1984, 1988 and 1990 with, -0.66, -0.64 and -0.49 which are below the long-term annual average, respectively. Even if there is missing value of meteorological data the year between 1991 and 1992 there was severe drought events in the woreda according to respondents and memorial documents of the woreda (table, 4.6). There were negative precipitation anomalies in 1994, and between 1997 and 2001 with the highest anomaly of -1.56 which is below the long-term mean being recorded in 1999. The year 2003, 2004,

and 2007 precipitation was below long-term annual mean with the year 2007 recording -0.75 which is below the long term annual mean. Similarly, from 2009 to 2015 precipitation was below long-term annual mean with the year 2015 recording -1.49 below long-term annual mean

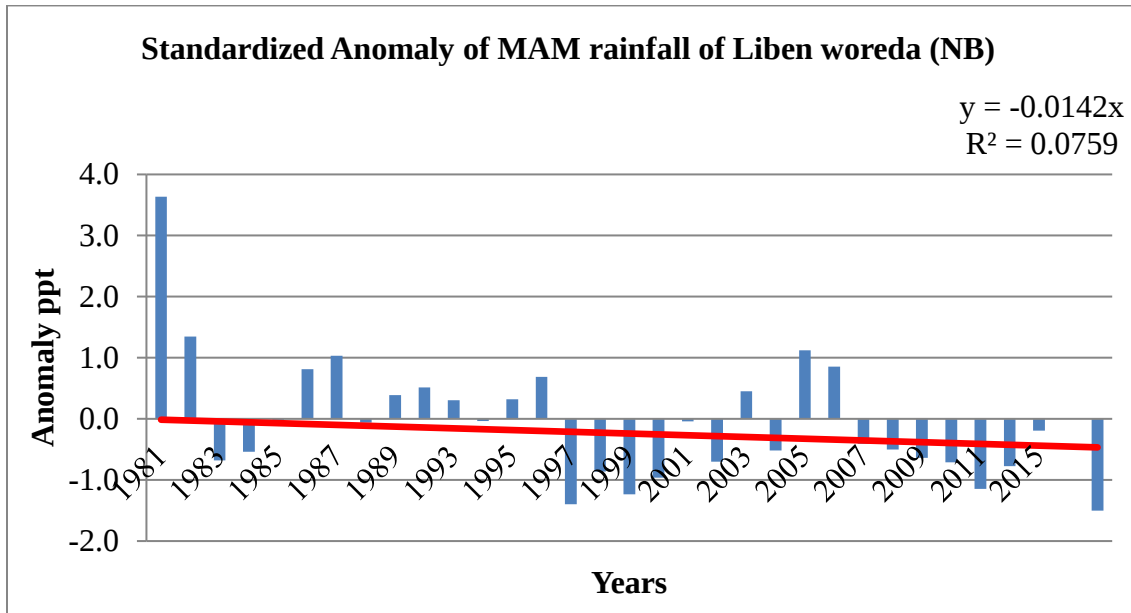


Figure 4.3. The standardized anomaly of March, April, and May (MAM) rainfall in the study area for a period of 35 years i.e. from 1981-2015/6.

Source: National Metrology Agency, 2019

In Figure 4.3. it was indicated that the mean rainfall of the study area during March, April, and May (MAM) is 390.17mm with standard deviation 155.91. Therefore, the normal rain fall ranges from 234.26 mm to 546.08mm. The rainfall anomalies in the study area for a period for 36 years beginning from 1981 to 2016 negative precipitation anomalies featured in 1984, 1994, 1998, 1999, 2000, 2002, 2004, 2007 to 2014, in these years precipitation was below the long term annual mean. Therefore drought occurred in the study area. Additionally as table 4 indicated the coefficient of variation of MAM rainfall is 39.96 which is highly variable.

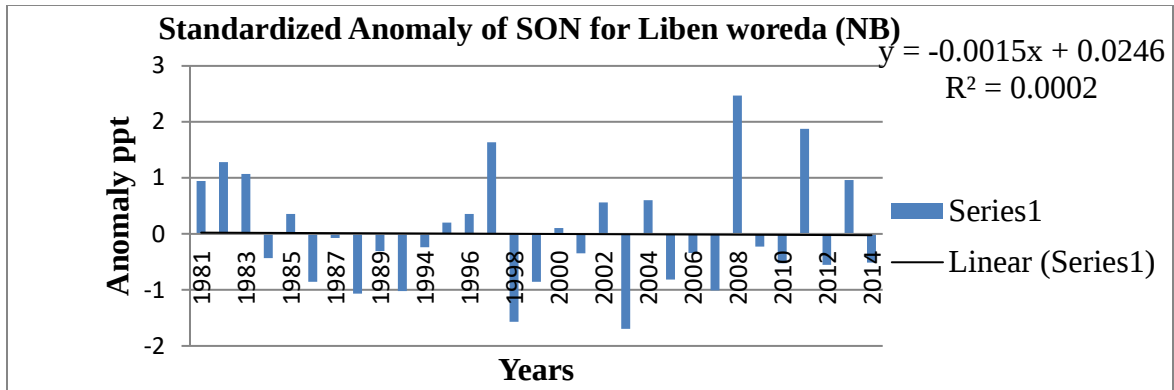


Figure 4.4. The standardized anomaly of September, October, and November rainfall in the study area for a period of 35 years

Source: Source: National Metrology Agency (NMA), 2019

The above figure 4.4. shows that the mean rainfall of the study area during September, October and November (SON) is 230.4mm with standard deviation 89.6mm. Therefore, the normal rain fall ranges from 230.4mm to 320.07mm. The negative precipitation anomalies features recorded in 1984, 1986, 1988, 1990, 1998, 1999, 2001, 2003, 2005, 2007, 2009, 2010, 2012 and 2014, which is below the long term annual mean, there was drought events in these years. As table 4, the coefficient of variation SON rainfall is 38.88 which is highly variable.

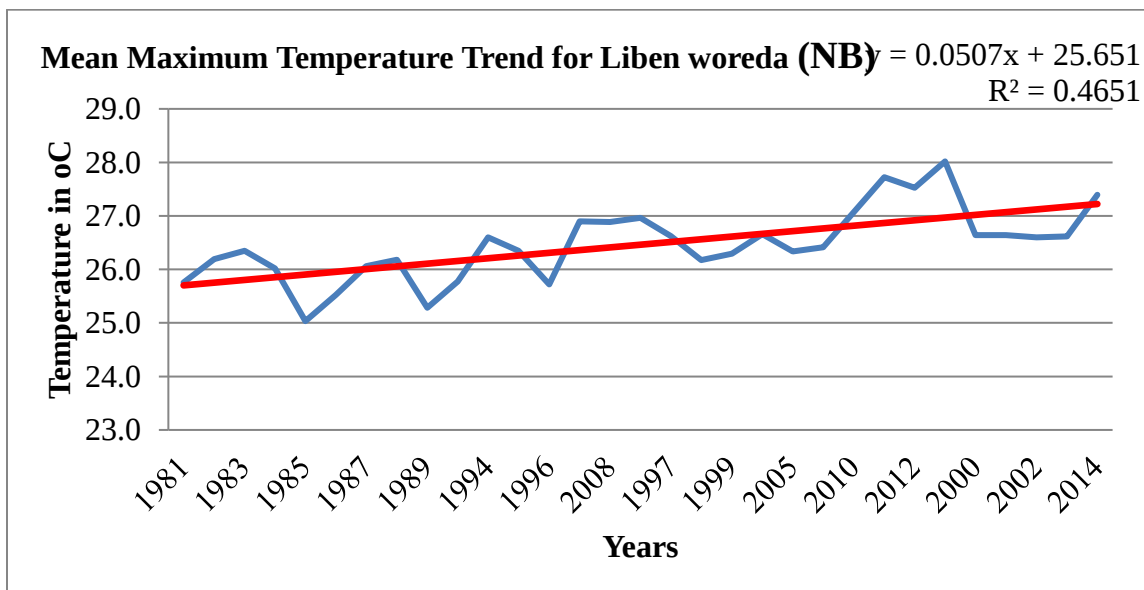


Figure 4.5 mean maximum temperature trend of Liben woreda for about 35 years

Source: Source:National Metrology Agency(NMA), 2019

Figure 4.5 showed that the mean annual temperature range between 15.4°C and 26.5°C and it shows that the temperature trend of the study area has been increasing from year to year.

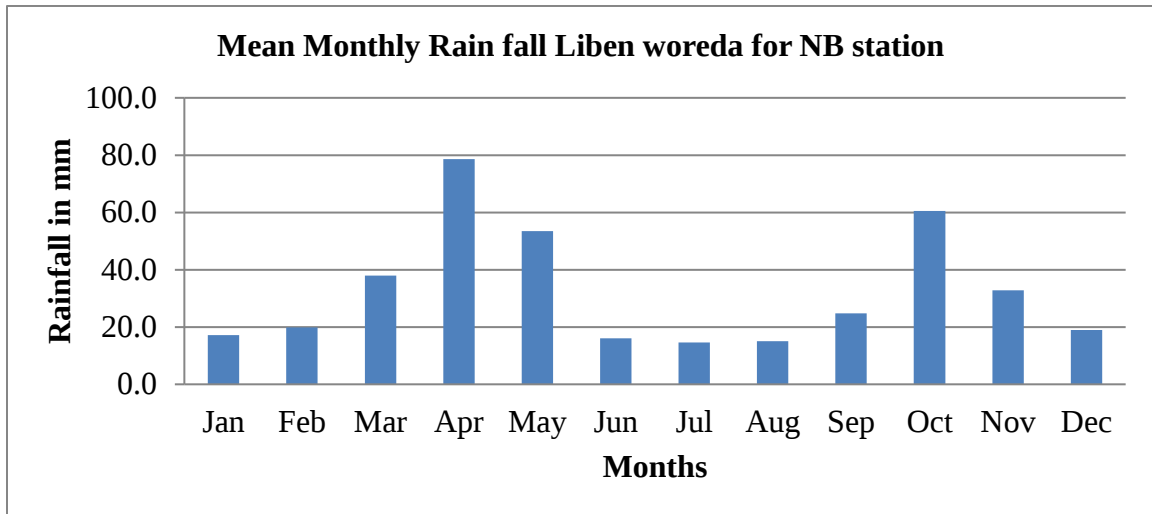


Figure 4.6.Distribution of rainfall of the area in different months/ seasons

Source: Source:National Metrology Agency(NMA), 2019

Table 4.The coefficient variation of Rainfall of Liben woreda for about 36 years

Month Variable	JJA(Summer Season)	Autumn(SON) season	Winter(DJF)Season	Spring(MAM) Season
Long term mean	19.3	230.4	30.3	390.17
Standard deviation	17.68	89.6	29.68	155.91
Coefficient variation	91.6	38.88	97.95	39.96

Source: National Metrology Agency(NMA), 2019

In figure 4.6 the annual rainfall patterns are characterized by bio-modal rainfall system/by two wet and two dry seasons. As table 4. shows that the mean rainfall during spring season (March, April, and May) is 390.17mm with standered devation 155.91 and the mean rainfall during Autuman (September, October and November) is 230.4mm with standered devation 89.6mm. The coefficient of variation spring season (March, April, and May) and Autuman season (September, October and November) rainfalls in the study area is 39.96mm and 38.88mm respectively, which is highly variables and/or as the figures 4.3 and 4.4 shows there was negative anomalies. As figures and table 4 illustrated that the rainy seasons of the study area are characterized by its unreliable and erratic, which affect water and pasture of the study area in turn it has great impact on the livelihood of the community.

There are four seasons known in the study area; the dry seasons known as winter ('Bona') and summer ('Adolessa') and rainy seasons known as autumn ('Hagaya') and spring ('Genna').

Spring (Genna)

The above figure 4.3 showed that spring is a long rainy season in the area, mean rainfall is 390.17mm, commences normally around mid of March and continues up to the second half of May. According to agricultural and natural resource development office (2019), it is the major crop production season, especially for maize, barely, wheat and sorghum and also contributes to the availability of pastor growth and ground and surface water. Livestock physical condition in this season is best as compare to the other seasons of the year, but due to the variability of rainfall in the study area impacted the agricultural products as well.

Autumn (short rainy season)

Figure 4.4 and table 4. showed that autumn is a short rain season mean rainfall is 230.46mm, starts from mid of September to mid of October (to mid of November). According agriculture and natural resource development office, 2019. Autumn is known

to be the second production season in the area, but the long-term precipitation data and coefficient variation data indicated that this season also affected by frequent drought.

Winter (Long dry season)

As the meteorological data indicated in figure 4.6 and table 4 winter is the long dry seasons lie in the months of December, January, February and continuous up to mid of March. It is known by disaster death of livestock and human food insecurity, which are normally expected every year in this season. Normally there is no any precipitation expected and crop production, in this season except land preparation for spring (ANRDO, 2019).

All respondents (100%) responded that the incidence of drought in the study area were common during winter season. The researcher was trying to investigate reason why commonly drought occurred in this season. The main reasons suggested by the whole respondents was, because of the rainfall of the area is unreliable and erratic. The long dry season come next to autumn (short rain season) and also the partial or almost complete failures of spring rain and autumn rain, this had negative impact on pasture condition, water supply and crop production during winter season. In the case of trend in these weather element observations both respondents and NMA data has shown the likely equivalent result as studied in figures 4.2, 4.3, 4.4 , 4.6 and table 4

4.3.1 Perception of the people about drought

Respondents perceive drought differently. Most (84%) respondents perceived that drought to be an act of God led to depletion of pasture, water and hunger.16% of respondents perceived that drought can be caused by the deficiency of rainfall as a result of climate change (Table 4.6).

Table 4.7.The respondent Perceptions and understanding of the cause of drought

Number	Perception/causes of drought	% of respondents
1	Act of God	84
2	Climate change.	16

Source:-Field survey, 2019

Furthermore, data from household survey on perceptions and understanding of drought were corroborated and expounded by key informant interviews and FGD. Most key informant's mentioned that drought was perceived to be an act of God .They argued that when people in the community fail to follow traditional practices, norms and value, and perform bad deeds that are against community values, the consequences of this is usually a punishment in form of lack of rainfall which can be continue until that time when people seek God's. This indicates that most sample respondents in Libenworeda have lack of awareness about climate change and environment related problems.

4.4. Impact of drought on the Socio-economic characteristics of the respondents

All (100%) respondents considered effects of drought were depletion of pasture and water resources, loss of livestock, poor human health and livestock health and 97.2 % of them mentioned reduction in livestock prices and the other 87 % stated crop failure.

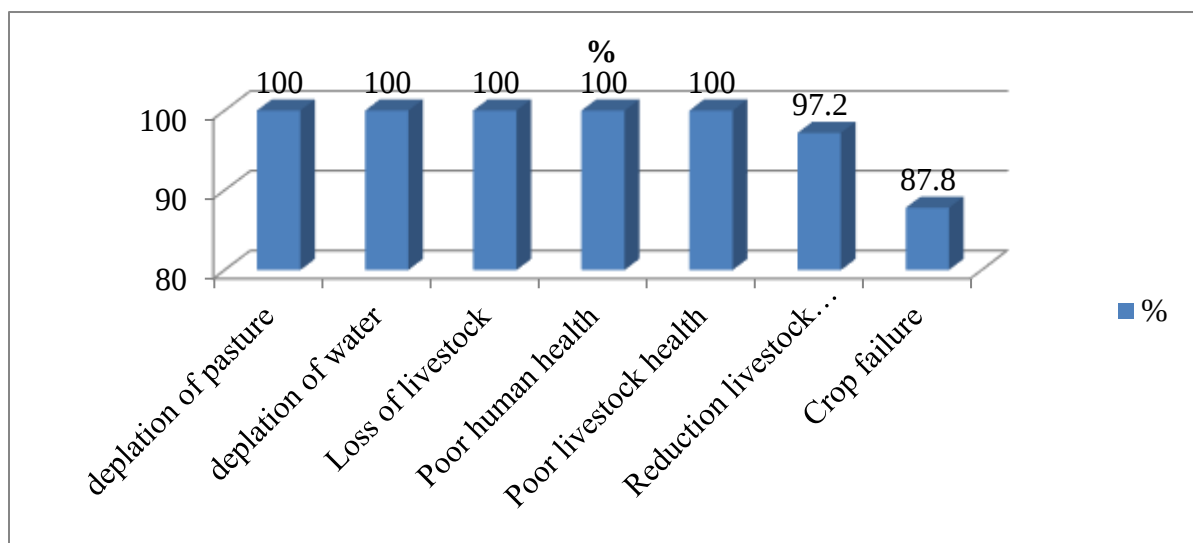


Figure 4.7 Socio-economic impact of drought on pastoral and agro-pastoral household

Source: field survey, 2019

Seven predetermined socio-economic parameters were used to guide discussions and interviews on socio – economic impacts of drought. They included livestock population,

human and livestock health, livestock market (prices), crop production, water resources, range resources and formal education.

4.4.1 Impact of drought on livestock

Key informants and focus groups discussion members mentioned that in the past they used to keep large number of cattle but nowadays they lost most of the cattle .They argued that this was made possible by abundant availability of pasture, less frequent droughts and minimum incidences of insecurity in the past. In last 30 years, large numbers of cattle were decimated by drought. In line with one of the discussants replied that “20 years ago I have thirty five cattle with 11 camels but now I have only 4 cattle and 2 camels. I lost the rest all them by the drought occurred in 1992/93”

According to the respondents their main sources of livelihood are adversely affected by drought. They stated that drought causes livestock mortalities, prolonged breeding time, depletion of forage and water resources and failure of crop production due to prolonged drought events directly cause livestock death. They mentioned that infants (calves) and aged livestock are first to succumb to drought. Infant herds hardly get enough milk to suckle from their mothers do not get enough milk while the old herds are often weak and lethargic to walk for long distances in search of water and pasture. As indicated in the literature climate variability has adversely affected the livelihoods of people in developing countries where a large proportion of the population is heavily dependent on pastoralist. Similarly, climate change has exacerbated poverty, food insecurity vulnerability of those communities in sub-Saharan Africa (Mesfin, 1986).

Moreover, the other FGD members claim that livestock species composition has changed by the effect of drought. The number of cattle and sheep tremendously reduced although there was decline in all types of species .They further mentioned that cattle and sheep are easily vulnerable to drought because they are grazers which are not adapted to browning. Lactation period reduced and resulted to a very little amount of milk and lactating animals do not give milk. The area was historically known by its special breeds of cattle known as ”Borena Zebu”. They had identities that their fur is colored in white-gray, usually short horned or no horn, docile in temper, huge body mass (more than 200kg

average maturity weight) and relatively high milk production. The high content of fat in their milk makes them comparative to the “Jemejem” breeds. However, a Zebu with those characteristics is not commonly seen in the today's Liben woreda. In fact its absence is not without reason. The “Borena Zebu” are highly voracious as compare to the neighboring “Jemejem Zebu”, which are characterized by their multi colors(influenced by black and fur) usually sharp horned ,aggressive tempered, weightless than to 200 kg on average at maturity, and less milk output. The “Borena Zebu” consume high amount of dry matter and water per day and at the same time they need feeds of high energy or high nutritive values to compensate their high energy output. They have been surviving by grazing on the species of grasses cited below. But now it looks that the environment has already selected its ideal friends –the fittest breed that can survive on the available scars resource. There is a great fear in the pastoralist elders and pastoralist production experts that is environmental or natural selection will inevitably kick out the “Borena Zebu” forever from the area.

Due to drought the natural cohesions are changed from time to time. For instance; camels gives birth in a year, and lactates for one year after give birth. But currently because of drought and its consequence, camels breeding duration is prolonged significantly. Its breeding time varies. Sometimes they give birth in every two years and the other time in every three years. This is because of the effect of drought female camels do not come to heat regularly. Likewise, in the case of cattle, the pre-drought breeding time was one year. Due to the drought effect; this time is prolonged to two and/or more years. Similarly effects were also registered on goats and sheep. These two types of animals used to give birth twice a year but currently reduced to only one in a year as a result of the drought effects.

Moreover, since grasses get depleted, mortalities of cattle also lessened. The secondary data obtained from Liben woreda pastoralist development office indicated that in recent drought event (2016) mortality of livestock are about 40,000 thousands (cattle account 82.5%),it estimated that the woreda lost 926,700,000 ETB. This indicates that a great crisis occurred in the woreda with the effect of drought.

Table 4.8 Loss of livestock from sample respondents during the 2016 drought event

No of loss of livestock	% of respondent lost Cattle	% of respondents lost Sheep	% of respondents lost Goat	% of respondent lost Camel	% of respondents lost Donkey	% of respondents lost Poultry
0	1	2	87	77	98	-
1-5	32	81	13	23	2	-
6-10	59	17	-	-	-	-
11-15	8	-	-	-	-	-

Source: Field survey, 2019

The above table illustrates that from total sample respondent 67% of respondents lost above 5 cattle, and 98 % of the respondent lost 1-10 sheep and only 2%, 13%, 23% of the respondents lost 1-5 donkey, goat and camel respectively. This indicates that cattle and sheep highly affected by drought than the rest livestock.

Table 4.9. The major change agents for livestock population in the study area at HHs in the past 10 years

No	Species of animals	Drought	Distressed sale (emergency sale)	Disease	diversification sale	Predator
1	Cattle	54%	25%	14%	7%	-
2	Camel	-	10	90%	-	-
3	Sheep	51%	30%	19%	-	-
4	Goat	12%	40%	48%	-	-
5	Donkey	15%	15%	35%	20%	-
6	Poultry	-	65%	20%	-	15%

Source: Field survey, 2019

According to the respondents in the above table 4.9 major factors causing reduction in the livestock population in household level are drought, distressed sale(emergency sale), disease, diversification sale, and predator for chicken and although the degree of importance is influencing the overall reduction of animals population varies from species to species, for cattle species drought is number one factors to reduce its population, it has influenced the reduction by 54%, i.e. it is estimated that drought exclusively caused the

death of 54% of cattle reduced from the population existing decade ago. distressed sale is second important factor and its influence in the difference was found to be 25%.Disease come third important agent(14%),then diversification sale influenced by 7%.From the above data we understood that the effect of each of this decreasing agents is ,however ,not similar across species .For instance, drought was seen to be the first problem for cattle ,but drought was not problem for camel, goat and donkey species and it effect in reducing the population of these species was seen to be 0%,12%,and15% respectively. Except cattle and sheep the major problems of other animals were disease. According to tables 4.8 and 4.9, camel and goat was seen to be the most drought resistant animals among pastoralist livestock animals. On further probing on why they still keeping cattle despite experiences of decimation by drought, several responses were brought. Respondents mention that cattle are important in many cultural activities in Woreda/ Borena community.

4.4.2. Impact of drought in range lands resources

Vast pastoral low lands of Borena (Liben woreda is its part) are historically known to be one of the best range land area in the country. However, according to key informants and focus group discussion, nowadays this fame has become the history of the past events. They informed that decades gone there used to be a perennial and delicious grasses species locally called 'halchlisoo" (*cymbopogon commutatus*) and "matguddessa" (*centuries caliaris*) in some parts of the woreda and "garrii"and "gaaguroo"(*heypernia hirta*) grown commonly in the woreda. According to elders respondents these grasses are the best species of pasture both in their nutritive (fatty animals) and milk production values. The population of these species has been reducing since the very early years of the last decade and totally disappeared during the second half of the decade, These perennial grasses have replaced by invader annual species of herbs and bushes as well as thorny bushes of poor palatability and nutritive values .It is believed that the grasses have eradicated through reparative droughts hits on the area. Naturally these grasses use their underground or root reserves to slowly regenerate themselves during rain seasons, in normal rainfall years after normal dry seasons. However, the area has never received rains of normal patterns in both seasons (Figure, 4.2, 4.3 and 4.4), such pattern of weather

condition would seriously influence the growth of perennial biomass. Condition of vegetation provided signals of a looming or occurrences of drought. Respondents mentioned that gradual disappearance of grass and shrubs, change of their color from greenish to brown, coupled with continuous grazing leaves bare grounds and stumps of grass and shrubs. All (100%) respondents and key informants indicated the grazing lands of area have been reducing; the main factors they suggested that for the reduction of the rangelands are expansion of farmland, expansion of bush encroachments, increase livestock population, repeated drought, Population growth and expansion of Privet enclosure. The Liben worda pastoral society has not developed the habit of manual preparation, storage and communal reserving livestock feed for dry season, but now to avert this problem the NGOs take initiative and established 8,080 hectares of communal feed reserves in 11 kebeles benefited 214 peoples (pastoralist office of Gujji zone ,2019)

The encroachment of the rangelands of the study area with the invasive species is threatening livestock production/species as it limited available forage. This in turn has its own impacts on the quantity and quality of livestock product. According to Natural Gum Processing and Marketing Enterprises Negelle Borena Office, 2019 the worda is richly endowed with species in general acacia, bowelled, and also rich of Senegal, acacia seyal and boswellia, these invasive plants the enterprise used for economic advantage and converting troubled rangelands in to productive resources; some of which are the main sources of commercial gums and incense.

Table 4.10.Amount of gums buys in 2015

No	Types of production	Amount in quintal	Price in kg(in birr)
1	Senegal mucha	470	35
2	Seyalmucha	230	20
3	TikurEtan	210	22
4	NechEtan	250	120
5	Abeker	—	45
6	Kerebe	—	450

Sources: Natural Gum Processing and Marketing Enterprises Negelle Borena Office, 2019

According to this office the major constraints mentioned for the production of gums are such as lack of market or market problems, government gives low attention to gum production, and acacia species are not well diversified.

4.4.3. Impact of Drought on livestock market

Livestock specially; cattle, goats and camels have big demand for their local and national economic benefits which is used for export market and local market in high number market stock production. Before discussing effects of drought on livestock prices and market, a question on whether respondents generally sell their livestock was posed. It was observed in the survey that the community, there was a concurrence that they do not too sale livestock animals (especially cattle), they want to keep as many animals as possible because the ownership of cattle is one of the best units to secure different social values family needs. Livestock/cattle wealth is a means to secure; daily sustenance for family, asset for the next generation (children), social prestige and honor, leadership in the community and ability to give gifts "hirba" and "dabaree" for the poor. Key informants and members group discussion mentioned that during drought there is high supply, low and unstable prices and animals are in poor body condition. If herds have moved to distant grazing areas, access to urban based market is difficult.

As illustrated in the Table 4.4 the responses show no any animals is reared for market except chicken (65 % for sale). However, it was seen that goats, normally and during emergencies are readily (more frequently) sold as compared to other livestock species, and on average. 40 % of goat is for market; this makes goats to be most important among the common livestock in the area in terms of generating income for the households. The animals salable at the next stage are sheep's (30%), cattle sold 25 % and the least salable animals are camel (10%). Respondents were further asked why, when and where they sell their livestock. They stated that we/they sell livestock to buy food, buy livestock drug and health medicine, buy cloths. Some rich farmers sell livestock to build houses in Negelle town. Finally on the question of where and how far travel to go to sell their livestock,

respondents stated that they take their livestock to nearest livestock market and average 25km they travel to reach market.

According to respondents(table.4.11) the livestock prices vary depending on seasons and body condition of livestock .During rainy seasons or just before the onset of drought when the body conditions and weight of livestock is good, different species of livestock bring good income example ,a mature cattle can sold between 12,000 -20,000 birr. Sale of livestock during drought seasons result in drastic decline of livestock prices. Respondents mentioned that mature cattle can fetch as low as between 400-500 birr. This is attributed to poor body condition and poor life weight of livestock caused by drought; also they stated that there is low demand for livestock during drought season.

Table 4.11.The range of medium size livestock price in Liben woreda, 2016

Period	Medium size/a mature livestock types		
	a cattle price ETB	a shoat(sheep and Goat) ETB	A camel ETB
Normal event	12,000-20,000	1000-2000	25,000-40,000
Drought event	400-500	100-200	10,000-15,000

Source: field survey, 2019

4.4.4. Impact of drought on animals' health

According to Liben woreda livestock Veterinary post office ,2019, each kebeles of the woreda has veterinary post ,but according to respondents the services they delivery not satisfactory .In spite of improvement of animals health facilities in the woreda the farmers says "their livestock health is deteriorating; supplies of veterinary drug are not the issue since the private sector is now is also involved in veterinary drug supply but curative treatment is expensive and beyond the reach of many farmers". As one respondent stated that “Cattle used to feed on good grass and they were not attached by disease. Now, because of lost grassland and a parasite, different diseases are becoming contagious in cattle now”.

The disease, which never existed before come with time of change in climate, climate change driven disease were observed in different period that harming the livestock health and reduced production of livestock. In table 4.9 in the study area except cattle and sheep the major problems of other animals were disease and key informants of pastoralist office informed that in 2016 drought events loss of camels were due to disease(Table 4.8). According to the office during drought time (2016) different livestock disease occurred:

Table. 4.12. The major livestock disease observed during 2016 drought event

N_o	Animal diseases	Affected animals
1	Anthrax	-large animals–cattle, camel -Small animals (shoats)
2	Pasteurellosis (Bovine pasteurellosis)	-Large animals-
3	Trypanosomes	-both
4	Botulism	-both
5	Rabies (zoonotic)	-if the drought is sever it breakout, but not observed in 2016 drought event in the area.

Sources: Liben woreda Livestock veterinary office, 20019

4.4.5 Impact of drought on human health condition

In a focuses group discussion session there was a concurrence that drought result in poor human health. Further discussion on how drought result in poor health elicited two important responses. First they mentioned that the most direct impact of a shortage of rainfall on a pastoralist livelihood is the drying up of water sources and decline forage resources for livestock greatly influences livestock conditions, milky production and ultimately pastoralists livelihood security, which is primary depends on livestock and its

products. They further mentioned that the communities have experienced more frequent crop failure, reduced yields and resulting in decline level of nutrition. This lack of adequate food result in general body weakness and malnutrition and disease are common as result of malnutrition such as kwashiorkor, marasmus (stunt), measles, iodine deficiency ,iron deficiency ,and mental retardation and .Secondly, drought lead to depletion of water resources which exacerbates poor sanitation. According to key respondents (health officer) mentioned that they also use land dug wells for domestic and livestock use. They further stated that water from the traditional- wells are not clean and consumed without any kind of treatment. Additionally, the wells are not protected and therefore they are prone to contamination from people, livestock and wild animals, all these results in perennial water borne diseases such as;

Table 4.13.The major human disease that occurred during 2016 drought

No	The Major Diseases
1	Malnutrition in children causes; kwashiorkor, marasmus, measles, acute watery diarrhea
2	Malnutrition in pregnant mothers causes; iodine deficiency ,iron deficiency ,under wait ,and mental retardation
3	Bloody diarrhea
4	Measles

Source: Liben woreda health office 2019

Finding from the Liben woreda public health officer disclosed that in the drought year 2016 has resulted in widespread shortage pure drinking water and food insecurity, malnutrition among community members and particularly the most vulnerable groups including children, lactating, pregnant mothers and the elders.

4.4.6. Impact of Drought on Crop Production

The research revealed that the expansion of farming in to grazing area has resulted in reduction of grazing resources for the mobile livestock herds, who largely on the communal ownership of land .In figure 4.8 below show that there is similar trend in Liben woreda. As Liben woreda pastoralist development office, 2019, farming is key practice along with pastoralism to sustain food security, and as one of alternative livelihood asset in addition to livestock rearing but the area is highly exposure and sensitivity to climate variation (Figure 4.2, 4.3 and 4.4), drought hardly affect the activity. In addition to livestock resources the abundant of arable land covered with ,bush, grassland and some woodland recorded as production area for farming, at household level some pastoralists produce crops like maize ,wheat ,teffe ,barely and bean, For example in the study area district organized information shows that three kebeles in the past were considered agro-pastoralist, today around 45% of the populating are categorized as agro-pastoralist (Table 4,1).

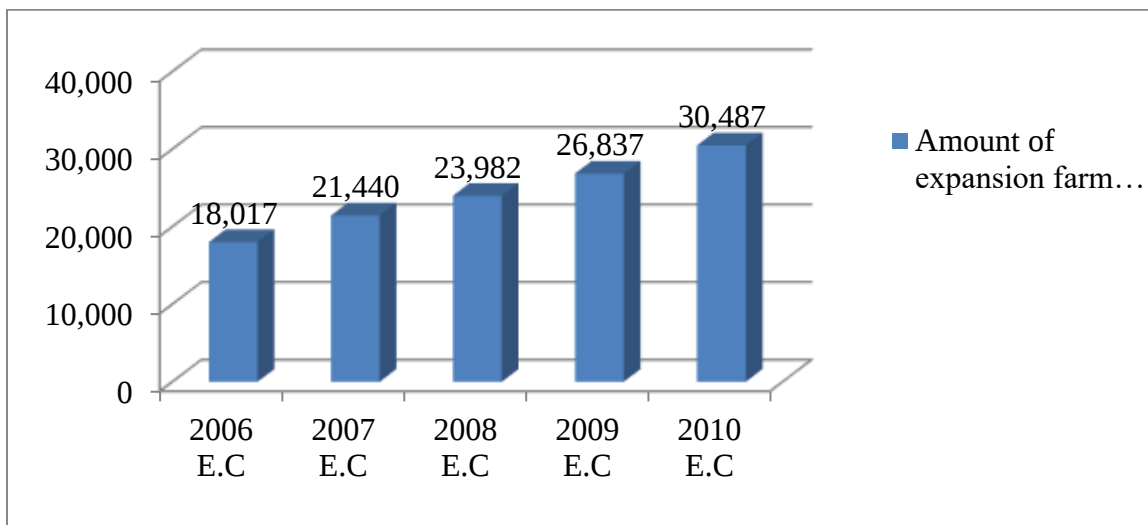


Figure 4.8.expansion of farm land in the study area

Source: Liben woreda agriculture and natural resource development office, 2019

Figure 4.8 show that there is alarming rate of expansion of agriculture land in the study area especially in wet land (dry season grazing area), which affect the movement of animals and the availability of pasture in drought/dry event.

According to organized questioner the respondents do not have hope about agriculture and its promising to meet the demand of food security ,most of the time in the area farming practice is not promising sector due to its sensitivity of climatic condition. As figures 4.2, 4.3 and 4.4 shows in the study area climate variation is highly observed, that can affect the farming practice. For example in the study district organized information of key informants and respondents a show that's few kebeles for long in the past were considered as semi-arid; today they are classified as arid. With regards to crop production; several years ago it was possible to harvest maize crops within 4-6 months duration, wheat within 3 months, barely from 2-3 half months, teff up to 3-4 months; but now it become impossible, and harvesting time is total shifted following the shift in rainfall offset and onset. Some of crops species is not properly growing in the area because of desertification or poor/insufficient rain, extreme temperature and drought events. The agro-pastoralist have not yet develop the habit of reserving appropriate seeds and preparedness, most of the time the farmers despaired to get appropriate evariety of seeds and they obliged to sow any available type of seeds they come across. This time they use the highland variety of seeds, commonly available on market, which are very dormant at germination and grow, and need high moisture. According to the woreda agriculture and natural resource development office (2019) data in the drought event of 2016 total 23,563 hectare(87.8%) of land covered by crops was lost. In the area losing of agriculture crops was not new events extreme temperature and dryness of soil can called as agricultural drought observed for many years. As table 4.14 proves that there was huge loss of yield in 2016 production year.

Table.4.14.The amount of plan and actual production of crops in Liben woreda, 2016

No	Type crops	Hectares	Plan production in quintals	Actual production in Quintals
1	Mize	1,970	69,120	0
2	Wheat	20,172	345,244	42,016
3	Teff		76,668	16,200
4	Barely		45,368	5,325
5	Bean(haricot)	4,641	100,127	6,150

Source; Liben woreda agriculture and natural resource development office, 2019

According to the Key informants and FGD land preparation for farming activity is taken by oxen's power, but this farming type is not effective during this events, this type of seasons can weaken the oxen and limit the practice of farming activities, so that during drought extreme temperature, water and pasture scarcity periods farming is not something possible; this can be reasoned as limitation in food security. According to Liben woreda food security and risk preparedness office (2019), every year there are people need aid for temporary or permanently .Temporary beneficiaries are those created due to risk events exposed to aid, the number of these people varies from time to time based on the degree of risk. As drought period extends beneficiaries increased, while as a period of drought decreased the number of beneficiary also decreased, as office data show 2016 drought event the number of beneficiaries in both normal and emergency period were about 42,808.

4.4.7. Impact of Drought on water supply

The secondary data obtained from save the children office of the woreda shows that the recurrent drought hit in the area has caused the ground water table of the area to get deep and deep from time to time, when compare with the level during decades ago, the depth of the wells (the chain of people to fetch up water from traditional wells at a time) has increased from 6-8 to 10-12 people. Moreover, the most alarming issues is that most of the potential traditional wells (ella) have completely dried up so that, in the large portion of the area there is no more reliable water sources for long dry seasons, except few deep traditional wells, and also few deep solar and motorized pump water sources which is built recently (Table 4.15).This has happened as the result of respective failure of rain seasons.

It is clear that during dry season demand for water use both animals and human increases in the area, at the same time(season) accelerated depletion of water caused due to high temperature during long dry season (December to February months) and short dry seasons(September to November months)associated to evaporation (Figure, 4.5).This seasons can cause high water demand for human and animal use, at some time water

sources face high evaporation system, high water depletion were caused and the demand for both human and animal cannot achieved.

According to key informants, in most of the area during drought time water use for animals and humans use is for single sources this has a great impact on water quality. This can results for out break of water-borne diseases, and along dry season almost surface waters are depleted; pounds are dry, few of private and communal deep wells, deep solar and motorized water pump sources are only extended to live near end of the long dry season, but it is not enough for people and livestock. The season is suffering seasons for human and animals searching for water specially most of the animals get the water below the normal. The supplies of water for animals through gaps of days differing from stock to stock, ranges from one dry up to twenty days (which called living without water for supposed days), based on the number of living without water can categorized as one day gap, two days gap, and three days gap.

One day gap without water for livestock like, Cattle, Goats, sheep, Donkeys, and Hens are common but for Camels it is for 15-20 days at the same time as water scarcity increases it is common to supplies water with gaps of two-three days for some stocks like cattle and donkeys. For Goat, Sheep, and Hens not promising to supply water with in short period this can contravene the advisable sufficient supply of water for animals due to the scarcity; the water intake of livestock varies greatly between species and between animals of the same species depending their environment, age, and types of feed and production environments. This can stated as insufficient of water supplies animals, during the 2016 drought event the woreda (water and mineral energy office) provide for three months 750, 000cm³ of water .This activity involves delivery water by wheeled transport to reduce the scarcity of water; this intervention helped the people get water for domestic use, water needs for schools were scattered for and weak livestock left at home also benefited for water trucking. Community key informants and participants of focus group discussion stated during drought time both surface and ground water can highly affected by this seasons weather condition. During the dry season when the surface water is declined, problem in scarcity of water increases and people mobility for searching water around neighboring woreda and rivers(Ghenalle and Dawa) and around some permanent

ponds are increasing .For example many pastoralist may parish around rivers called Dawa and Ghenalle during long dry season and simply this seasons can be said seasons of water crises animals and humans move long distance and spend long time in due for drinking water, animals can move average 20-30kms to search water the same as to human .According to Liben woreda water and energy office the coverage of drinking water is about 33.1%.Here large number population (human and animals) lives in the woreda ha no sufficient and quality water for drinking even during normal seasons.

Table 4.15. Water sources built by government and non-government organization

No	Types of scheme	No of scheme	
		Function	Un function
1	Hand Dug wells	31	11
2	Shallow well with DGW	3	6
3	Solar scheme	5	1
4	Motorized scheme	7	1

Source: Liben woreda water, mineral and energy office, 2019

4.4.8. Impact of drought on formal education

In table 4.2 shows that 49 % of the respondents does not take their children to school. They argued that lads and young girls play critical roles in taking care of livestock and therefore they considered not taking them school .During drought events young boys and girls help the old folk's/elders looks after the few livestock left behind near the homesteads, while the warriors, teenage girls and the middle aged roam with livestock for far distance.

Key informants from the education sector revealed that most pastoralists from Liben woreda view formal education with contempt since they do not understand the value of education on their livelihood. The office mentioned that apart from low enrolment rates, there are high drop-out rate sespecially in winter/stress season (it is long dry season in the study area), for example (Table 4.16) data indicated that 2016 from total students (28,471) the drop-out rate is reach about 15% (4,272).But it varies from school to school due to the availability of school feeding program and watering. According to sample household respondents stated that there is primary schools close to their village

approximately they travel 2-4km, but there is no secondary school in the near distance so that they are forced to stop student attend secondary school, only rich farmer send their students in distance areas ,in Negelle and Kallad secondary school .They mentioned (Key informants from the education sector) that drought is major contributory factor for poor enrolment rates and high drop-out rate ,during drought episodes households use school going children to herd livestock near homestead and therefore they cannot be enrolled in school .Secondly ,teenage pupils drop-out of school to follow their elderly family members who roam with livestock in search of water and pasture during drought time ,additionally there is only two secondary school in the woreda ,and there is one boarding school which is also found in Negelle town ,so this circumstance one of factors of poor enrolment rate.

Table 4.16. Impact of school feeding program number of student attends and drop-out in 2016 drought event

No	Kebelles and school which have /not SFP		No of registered students	% in drop out
1	B/dhera			
	Feeding program	Name of school		
	School feeding program	B/dehera /p/s	428	4.9
	Do not have school feeding program	Dadii	118	24.4
2	Alagekebelle			
	School feeding program	A/qalqalcha	582	10.2
	School no feeding program	Malbaa	186	27.3
3	Kaladakebelle			
	School feeding program	Mugayoo	628	13.4
	School no feeding program	Raboshe	219	20
4	Miessakebelle			
	School feeding program	Misa	544	12
	School no feeding program	Handarka	125	25
5	Simintokebelles			
	School feeding program	D/adama	842	2
	School no feeding program	F/agarsu	125	4
6	Gobicha			
	School feeding program	l/gulla	775	9,3
	School no feeding program	Marsha	292	23.9

7	Dhakakelakebelle			
	School feeding program	Dh/kala	317	7.3
	School no feeding program	I/geedi	261	

Source: Liben woreda education bureau, 2019

4.5. Indigenous weather forecast and drought coping methods

Almost all the respondents use traditional sources i.e. use of rainmakers and seers, was the only source of information on weather forecast, relied on by the pastoralists/agro-pastoralist in the study area. The traditions of Liben woreda communities have socially recognized and respected elders who are specialized by forecasting weather conditions, social-political and socio-economic incidences to will be happened in the area. The followings are some of prediction media of Liben community/Woreda.

4.5.1. Indigenous weather forecast

a. Ayyaana (Oromo calendar)

There are 28 Ayyaanas with which Oromo count the days, months and cycles of seasons in a year. Each day in a month, months in a season, and seasons in a year have specific Ayyaanas to start and end with. If this normal calendar (Ayyaanaa) for days or commencement of seasons is disturbed and shifted forth or back with one or more days, it is, culturally, an indication of bad performance of the next season.

b. Patterns of stars

There is a star (or groups of stars) that culturally identified as the indicators of the weather conditions of the current or upcoming season. For example, there is a group of seven stars which is locally named as Buusan, it is 'long cycle stars'' according to the elders, that changes its position with seasons, not daily. It has a particular position on the sky in a particular season. Therefore, the elders believe that unless the "buusan" is situated in an appropriate position, the onset of the upcoming season is not expected on its calendar. The elders usually use moon to identify the position of the "buusan". Normally, during the major three months of long dry season (December, January, and

February), the moon and the "buusan" are expected to be situated beside to each other on the 9th of December, 7th of January and 5th of February in the local calendar. But if this arrangement is changed to the 10th, 8th and 6th of December, January, and February, respectively, it indicates that something unusual or undesirable will happen in the calendar, and the performance of the upcoming big rainy season is unreliable.

c. Livestock condition and behavior

Behavior of animals such as congregation in one spot while sleeping in the barn, defecating /urinate while sleeping ,depressed, eat voraciously the while day ,unattractive body coats or skins, on the watering days; they always feel discomfort after being watered, and settle around the watering trough until forced away by the herders. Pastoralists usually predict by seeing the physical appearance of animals such as smoothness of the hair and shining of the body coat. If the hairs appear rough and the coat is not shiny drought is anticipated .Similarly if animals are not alert enough (very weak, sleepy and stay longer in the barn in the morning and defecting/urinating while sleeping) is an indication of drought .Also during nights, if the animals are not sleeping in the barn while sleeping and instead congregating together at one spot, is also considered as an indicator. When people observe the animals showing these signs, they say that the animals are feeling sad about the upcoming drought. The bulls do not come to heat .Even if grazing and water are available, animals feed voraciously (i.e. responding to the low nutritional value of dry grasses)

d. Gadaa cycle

Each Gada has a life span of eight years, the informants indicate that Borena people are divided into major groups, Saboo and Goona, the same Aba-Geda administers these and the Gadaa of each party in the Oromo socio – political structure is known by specific events that are traditionally believed to be fortunes or misfortunes. There are Gadaas whose reign is known by surplus production but accompanied by war. Others are specified by drought but peaceful. And some come up with disease and wealth, and the like. The community has noted out these events specific to each Gadaa through long years' experience in the Gadaa system as they were repeating themselves by cycle after 40 years of one full cycle of the Gadaa. The empowerment of one party in Gadaa will be

repossessed after 40 years .Therefore, just prior to commencement of the governance of the party ruling the Gadaa (the region), the community predicts from their experience in the previous cycles (if during their grandfather time stress it repeat again until something done) about the food security situations during the coming reign .In fact not every community member is gifted and recognized for prediction.

e. Wildlife and birds

In good years some birds sing repressively in the vicinity. Some of these birds are (their local names) Huummoo, Laakkamaa,Raphasoo and Yaasumma. These birds keep silent (do no sign) in bad years, according the key informants from the community.

f. Weather condition and wind direction

The elders (key informants) mention that in bad years, the daytime is usually spent cloudy ,but at night the stars are naked and there is a clear sky without any cloud cover, again there is unusually stormy wind or unusual calmness(absence of wind at all) in bad years .The wind direction is also unusually changed to the direction as if it were in other season(the wind direction in dry season and wet season are different ,according to the elders).In good years, everything is normal ;there is even pattern of cloud, and normal direction and gentle movements of wind over the year.

g. Postmortem Reading of Gastric Intestinal Truck(GIT)

There are elders who are specialized by forecasting weather conditions just by reading the laying status of gastro -intestinal organs and tissues like colons (large intestine, locally known as uusaa), gastric fat layer (moora), and sometimes small intestine of ruminants (particularly cattle and goats).From the GIT "Book" they read and forecast not only the general condition of weather but also the problems to be happened specially on livestock.

4.5.2. Indigenous drought coping Mechanisms

If the recognized elders forecasted that the drought is likely to happen in the area, of course the above mention traditional indicators, they immediately warn their community

to take preventive measures as soon as possible. Few of these measures are discussed below.

a. Praying For Mercy

All community members will be gathered under big trees like "Odaa, qilxadambi" or gathered at "melkaa"(around river banks) and sloughs animals; like old cows and bullocks (sangaa) for feast and pray to God to bring rains and reduce risks of drought .During the pray the presence of recognized spiritual and administrative leaders, like; the Qaalluu, Gadaa, Hayyuus, Ayyaantuu and Raaga, is so important.

b. Culling calves

If the upcoming drought is anticipated to be serious ,the pastoralist kill all infant calves or wean those who can survive on grazing , and prohibit milking of the calves (harkuus)(the calve less dams).

c. Early migration

The respondents indicated that although it is not the whole pastoral community, people have used to escape from drought risks by early migration. When they confirm that the drought is likely to happen, the pastoralist move a part or all of livestock, at least one month earlier of the onset of the actual dry season, to highland (ambaa) or any other safe areas like riversides or range potential areas to spend there the whole dry season up to next rain season. Again after they reached the destination, they continue praying for God in assembly for social security and betterment of weather conditions.

In focal group session it was mentioned that mobility is still practiced although not as much as in that past. However, it was the main strategy in the past year owing to availability of vast lands and various options of permanent grazing reserves and water resources. Moreover, in the past households kept large numbers of livestock and therefore during drought episodes they move their large herds to prevent massive livestock mortalities .Although mobility is still practiced. Factors such as reduction of grazing

range are; the availability of few grazing reserves and water resources, insecurity and reduction households' herd restrict movements of people and their livestock to nearby grazing reserve and water resources.

d. Hand feeding

Hand feeding is the practice of providing the animal with different feeds and water in or around the settlement .This practice in the fact no manageable with big herd size. It is often practiced by the households with small herd size or in other families it meant only for the herds seeking especial care like weak animals and milking stock and calves. In drought periods some households feed their stock in their locally on hey and straws, purchases licks and minerals, and shaded leaves and falling green-leafed trees .Besides, they water the animals regular at home .This is protect energy loss of the animals would have been trailed long distance for search of feed.

e. Drilling deep wells (traditional wells)

The community has a long experience of extracting water from deep traditional wells (ellas) in arid environment. They dig wells using human labor by contributing money and live animals to feed the excavators. Each well has owner and the manager, however, the excavation, maintenance and utilization is communal .In dry seasons or dry years the community increases labor to dig more new and deepening the existing wells to extract enough water for "worra" herds and families.

f. Distressed sale of animals

Normally in dry seasons (especially during food shortage) the community sales their animals to purchase food grains for their family. There are times when they sale out exhaustively all their animals including the productive assets like breeding animals. Distress sale is common in droughts (table 4.9).During the focal group discussion ,respondents mentioned that they sale livestock to get money to buy food staffs for their family, such as grains ,cereals ,tea leaves and sugar and other stuffs.

g. Herd diversification

Herd diversification is a practice that involves keeping a variety livestock species. This strategy is important to pastoralist livelihood against drought but also against livestock diseases. Key informants concurred that households kept diversified species of livestock in the past. Although most species of livestock were kept including sheep and cattle, they preferred to keep large numbers of goats, camels and donkeys since they were considered hardy and can withstand adverse impacts of drought and specially camel give high productivity.

4.6. Government and Non-government Responses in Mitigating Impacts of Drought (2016)

With regard to government interventions, 95% of respondents indicated that the government intervened only by providing emergency food aid, while only 5% of respondents indicated that they received development aid. Community key informants pointed out that the government intervention is only through provision of relief food supplies (Table 4.17). Similarly, the key informants from food security and risk preparedness office stated that the government has responded majorly through provision of emergency relief food aid to pastoralists in the study area and particularly to households which lost large numbers of livestock and also for small children, pregnant and lactating mothers are provided with supplementary foods (Table 4.17). They further mentioned that beneficiaries of the relief food supplies are households registered by the Assistant Chief of the area. To address malnutrition, government in conjunction with the World Food Program supplied highly nutritive unmixed, soya bean flour and plum nuts. The Liben woreda food security and risk preparedness office with the kebeles administration distributed these foods to households with most vulnerable groups in the distribution center. This program has been ongoing until the onset of rainfall in March 2016. The interviewee further stated that monthly mobile clinics were set-up in pastoralists' settlement areas including the study area where people were treated of water and poor-sanitation related ailments. The main challenge during 2016 drought event was include insufficient budgetary allocation, inadequate logistical support and personnel, lack of infrastructure like road. Other government intervention measures were in taken (Table 4.17).

Table 4.17. Government intervention measures following the 2016 drought in the woreda

N^o	Types of food distributed.	Amount in.	Amount they received.	Remark
1	Cereals crops(Wheat, maize)	34,724 quintal	15kg/month or 500gm/day/p.	-
2	Pulses(bean)	3,111 quintal	-	-
3	Supplement food	3,698 quintal	-	For Children old aged and pageant
4	Oil	3,800litter	0.5kg/month/p	
5	Fodder for livestock	39,600 bells of grasses	-	For breeding animals only
6	Water	756,000cm ³	-	-
7	Drug/Vaccination	-	-	-

Sources: Liben woreda risk and preparedness, water mineral energy, and pastoralist offices in 2019

Key informants and respondents from focus group discussion were asked of their opinions on the usefulness and adequacy of the government support through relief food aid. This question elicited mixed responses. Few respondents mentioned that this support is very useful since it prevents starvation, somewhat it prevent to sale our livestock to purchase food stuff, reduce human migration but decried its adequacy in terms of quantity provided (example animals feed program covered only small segment of livestock population; only breeding animals were beneficiaries) and late delivery after animals and people have weak and migrate. Other respondents stated that the support is not useful and inadequate since it is not provided always, while a number of respondents said it perpetuates a culture of over-dependence. Most respondents concurred that more interventions to support their livelihood are required. These include water resource development, restocking, purchase of their livestock during drought at good prices

(destocking), need to expand the relief distribution center, and early intervention is needed.

CHAPTER FIVE

5. Summary of Major Findings, Conclusion and Recommendations

5.1. Summary of major findings and conclusion

The rain fall data collected from 1981-2016 shows that the study area received very low annual precipitation averaging 643.1mm with standered devation 181.8in the long term. Furthermore, there was a declining and a highly variable trend of precipitation received in the area.

From the analysis of rainfall anomalies there were more negative anomalies reordered as compared to positive ones. This shows that more periods insufficient precipitations were experienced in the study area. Moreover, negative rainfall anomalies indicated increased frequency and severity of droughts. This demonstrated by the periods when precipitation was consistently below the long term annual average, For instance, between 1984 and 1990, 1998 and 2000 the area was affected by frequent droughts. Similarly in the period between 2007 and 2016, the study area experienced precipitation below the long term mean. Severe drought occurred in 1991/1992, 1999/2000,2010 and 2016.These are periods when there were either total rainfall failure or very negligible precipitation .This accounts of rainfall anomalies are consistent with information on recalled period of drought by pastoralist studied. Their accounts of droughts in the past revealed that in the period from 1984 to 1990;1989to 2000;and 2007 to 2016,at least one severe drought hit in the study area the incidence of drought were common during winter season , the rainfall of the area is unreliable and erratic and the long dry season come next to autumn and also the partial failure of spring rain and almost complete failure of autumn rain (figure 4.2 and 4.3), this had negative impact on pasture condition, water supply and crop production.

Borena/Liben worda pastoralists have for decades been accustomed to droughts. However, they were less frequent in the past as opposed to present times. The Liben pastoralists studied largely perceived drought as a natural happening that leads to lack of rainfall for a season or more. From the study, key informants perceived drought as an ‘act

of God’, as a way of punishing people following disobedience of traditional religious practices, norms and values. Moreover, the findings revealed that only traditional sources were relied on for information on weather forecast. Findings on drought perceptions are illustrated in Table 4.5. Through practice of indigenous knowledge, the Liben/Borena pastoralists have for many years developed a system of drought prediction which had enabled them to respond appropriately particularly in the past. Although they still rely on traditional sources for weather forecast. All of them have been socially recognized and respect elders; who are in forecasting weather condition, political and socio-economical incidences to be futuristically happen in the area. Frequent droughts have adversely affected indigenous knowledge systems including precise predictions of droughts.

From the study, it was noted that almost all households were headed by males. There is also high illiteracy rate among the pastoral community studied. This was indicated by a lack of formal education on the part of adults and the presence of a large number of non-school going children in the households, during drought/stress events especially in winter there is high rate school drop-out. Furthermore, with most households averaging between 5-7 individuals, the household size implies that the area has high population growth.

Drought has adversely affected the livelihood of pastoralists in study area. The study revealed that major impacts included depletion of water and pasture; loss of livestock; poor human health and livestock, failure of crop; food insufficient; famine, and reduction of livestock prices.

The rangeland resource of the area was impoverished through repeated drought hits. The indigenous and quality species of grasses have extinct from the area and the permanent water points have dried up, absence of appropriate seeds variety. The typical and popular cattle breed of the area Borena Zebu is also on its phases of extinction from the area. Reliance on seasonal wells, coupled with absence of water and pasture preservation practices exacerbated the effects of drought on forage and pasture. This has consequently resulted in livestock deaths and reduction of livestock ownership, where more than 59% of households lost 6-10 cattle and the woreda lost 87.8% of crops and about 40 thousand livestock it cost 926,700,000ETB in the 2016 drought. Therefore, since livestock are the main source of livelihood to pastoralists, their decimation disrupts pastoral socio-economic existence.

The study also showed that drought lead to poor health of pastoral households. Cases of malnutrition increased during drought episodes owing to food insecurity. This mostly affected children under 5 years, suffered from acute malnutrition following the 2016 drought. In the same period, incidences of Measles, diarrhea and malnutrition were rampant. From the findings, drought in the year 2016 has resulted in drastic reduction of livestock prices.

The study result show that repeated drought is accelerating depletion of major used water called surface and ground water which constructed poorly by traditional knowledge and less modern skill use, this is accelerating the degree of vulnerability and cause high severity of not to meet the demand of water for livestock and human being with account below normal consumption of water for both.

The pastoralists in the study area considered mobility as their key strategy to cope with drought. They employed this strategy both in the past and in present times – as alluded to by community. Key informants in the study area could move to distances as far as Ghenale and Dawa riverbanks, and neighboring woreda to access pasture and water for their livestock. In recent times, however, mobility has been restricted to woreda or county level due to reduction of availability of few grazing reserves, reduction of livestock size in HHs level, and insecurity. Pastoralists studied place high preference on goats, and camels as like to cattle since from their experience; these livestock types adapt well in harsh arid environments, their high product (camel) and can withstand drought episodes. From the research findings, pastoralists in the study area have shifted to other livelihood option either as supplementation of pastoralism or as permanent shift away from pastoralism. Built rent house in the town, bee farming, gum production, fuel wood and charcoal trading activities were highly preferred as additional sources of income.

Government interventions have been largely through emergency response to drought when it reaches crisis level. For instance, emergency food aid and supplementary feeding for children is supplied when food insecurity and malnutrition becomes unbearable. Moreover, mobile clinics only cater for pastoral needs in the aftermath of drought situation. Cultural value and Lack of livestock markets in nearest area that makes it difficult for pastoralists to sell their livestock at appropriate time and at good prices. Poor physical infrastructure including poor road networks hampers livestock trade and

marketing, further exacerbating the adverse impacts of drought. Intervention measures by government and non-governmental organizations are piecemeal and done in a selective manner. For instance water related intervention was not sufficient and only implemented in specific location, livestock disease vaccination and supply of hay was only implemented in specific location and insufficient, and intervention was a delay in implementation. The pastoralists indicated that government interventions should support their livelihood through development of water resources, destocking, establishment of livestock market infrastructure and provision of livestock and human health services efficiently.

5.2. RECOMMENDATION

- **Promotion of Education**

Since education provides opportunities for future generation, the government should encourage parents to let their children to school, build boarding schools nearby the community and in some area areas movable schools should be settled and school feeding program should be strengthening.

Government with NGOs should strive in community awareness creation, trainings and workshops to include the importance of education to the entire community in Borena.

MoE need to pay attention to the school curriculum since it should be geared with pastoral way of life and need not be similar to the highland or sub-highland type; school calendars should fit the pastoral calendars and hence closing time shifted to stress months(winter).

- **Water Point Development**

The government should develop permanent water source to cope with drought in a sustainable way through diversion of rivers such as Genale and Dawa rivers, which are adequate and good quality for livestock, range land rehabilitation and human use. Water point development; including artificial lake, and should be integrated with natural resource management, the water supplies in the range lands should developed regarding the grazing capacity of the area.

- **Improvement of Livestock Health Services**

The government should provide and improve livestock health services by conducting livestock disease surveillance, vaccination, enough drugs and at kebeles level .moreover, pastoral community members i.e. community animal health workers should be identified and trained on livestock disease identification and treatment.

- **Improvement of Human Health**

More health post should be constructed to care for presentation of human diseases. Mobile clinics should set up in different pastoral settings and pastoral communities should be trained on proper hygiene and sanitation. Community health workers should be deployed in all pastoral areas.

- **Family Planning**

Population explosion is treat facing the rangeland of the study area .The following intervention should be follow; awareness-raising and behavioral change through well-designed campaign and sensitization on the need for family planning, and community based contraceptive distribution and implementing counseling services in the education system to reduce high attribution rate of female.

- **Integration of Indigenous Knowledge Systems into weather monitoring**

The indigenous knowledge systems used in crisis anticipation and response to droughts are very important in safeguarding the lives of the pastoral communities. Therefore, they should be incorporated into conventional weather monitoring systems. Indigenous knowledge has actually sustained pastoral communities' lives, and their continued usage shows how much trust has been invested in them. Indigenous knowledge therefore cannot be ignored in any study of the emergence of drought-related crises. Policies should therefore, support research and extension that responds to the needs and interests of pastoralists, and which draws on their extensive indigenous knowledge.

- **Communicating Weather Predictions**

From the findings, it was evident that the pastoral group studied does not have access to weather information. The government should put in place a communication channels, either through the local administration for the purposes of relaying weather information to pastoralists in areas where they occupy.

- **Destocking and Restocking program**

The stakeholder should practice commercial and slaughter destocking programs and restocking program. Destocking as a means to both save their remaining livestock and contribute to herd building. Restocking program help them to replace their lost animals

- **Herd diversification**

Camels and goat are adopting well harsh arid environments and can withstand adverse impacts of drought. Especially came give high products, so that, household can secure food demand. Thus stakeholders should encourage the study area community's shift towards keeping camels as oppose to large cattle herd.

- **Community fodder bank/Hay making (grazing reserves)**

Pastoral communities increase reserve private enclosures in the communal grazing lands, so the practice of communal grazing shall encouraged and strengthened by PAS registering the fodder banks, and the local kebeles administrative should know about them. Using fodder banks help to improve range management and in controlling land use. The communities could practice selective .This practice, if done properly, may control private enclosures and ranches for developing through grabbing. Concerned bodies should be encouraged and expand to the established communal fodders owned by village groups.

- **Improve farming**

The government should distribute drought resistance seeds and high yield varieties and also should promote the formation of local rural institutional and farmers groups. This will help in educating farmers on fertilizers, seed varieties and crop diversification. The government and both the local and international NGOs should put in place various measures to mitigate drought in the area by enhancing opportunities for small scale irrigation, water harvesting, and dam constriction. The concerned body must give more attention to keep saving the Borena Zebu cattle breeds from extinction or highbred.

- **Financial and logistical support**

Inadequate financial and logistical support to different government and non-government has curtailed implementation of different intervention measures. The government should increase financial support provide adequate logistic support to various departments relevant for drought management in the woreda.

- **Livelihood Diversification**

Livelihood diversification is one of the alternative of livelihood option to reduce the impact of drought, the study area have high potential of different resources such as; minerals, been colony (bee farming), charcoal, and gums production is use a multiple purpose drought resistance acacia trees (extensive bushes) farming. The concerned bodies should be giving more attention to use these resources as alternative sources of income.

- **Drought should be mainstreamed in to development planning**

Drought is a development issue not an emergency. Development plans should in corporate anticipates the occurrence of drought and should therefore plan to minimize the negative impact of drought on pastoral livelihood.

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Appendix 1
DILLA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

Department of:-Geography and environmental Studies

Dear respondent.

The purpose of this questionnaire is to collect necessary information about the Impact of drought on the socio-economic development of the pastoralist people in Liben woreda for the partial fulfillment of post graduate research.

Your honest, short, and precise response is highly appreciated in order to make the research more accurate, alive, and attractive. Hence you are kindly requested to devote your time and effort to fill the questionnaires.

For open questions write your idea, opinion and facts available.

- I. Interview prepared for livestock owner (pastoralist) and agro-pastoralist on the impact of drought on the socio-economic development of Liben woreda.

Background information/ Household Characteristics

1. Sex:_____

2. Age:_____

3. Level of education:_____

4. Marital status:_____

5. Religious:_____

6. Number of your family or Household size:_____

7. Number of children in school:

Education level	Girls	Boys
Primary		
Secondary		
Collage		

8. Is there school near to your village?

☐ Yes ☐ No

9. If question number 7 is yes how far it (approximately)_____

10. Do you have veterinary services in your kebele?

☐ Yes ☐ No

11. If question number 10 is yes how far_____

12. What kind of agriculture do you practice?

☐ Livestock rearing ☐ Crop production ☐ Both

13. What are the major constraints to your family well-being?

☐ Drought ☐ Human diseases ☐ Livestock diseases ☐ Poverty

Other (specify)_____

14. What types of livestock do you keep?

Animal species	Caws	Oxen	Camel	Sheep	Goat	Horse	Mule	Donkey	Poultry

15. Are you volunteers to tell the total number of animals owned?

Animal species	Caws	Oxen	Camel	Sheep	Goat	Horse	Mule	Donkey	Poultry
Livestock/HH S									

16. What problems do you usually encounter with regard to livestock keeping? Tick where appropriate

☐ Livestock diseases

☐ Shortage of water and pasture

☐ Lack of market

☐ Livestock rustling

Any other (specify) _____

17. What measures have you put in place to address the above mentioned problems? Tick Where appropriate

☐ Migration in search of water and pasture

☐ Use of traditional herbal treatment ☐ Restocking through traditional systems

☐ Sale of livestock during drought ☐ Accessing livestock veterinary services

18. What is the main source of water for the livestock? Tick where appropriate

☐ River/spring/stream

☐ Water pans or dams

☐ Motorized/solar pump water

☐ Wells/Boreholes

19. Is the water source constant or seasonal?

☐ Constant

☐ Seasonal

20. Who manages the water source? Tick where appropriate

☐ No management

☐ Community

☐ Individually owned

Other (specify)_____.

21. How much km takes from home to water point?_____.

22. How many animals have you sold in the last year?

Animal species	Cows	Oxen	Camel	Sheep	Goat	Horse	Mule	Donkey	Poultry
No of animals sold									

23. Why did you sell the animals?

☐ Income generation

☐ Sale during drought

☐ Restocking

Other(specify)_____

24. What are the causes of drought?

a._____ b._____ c._____

26. What are the effects of drought? Tick where appropriate

☐ Drying of water sources

☐ Poor health of animals

☐ Depletion of pasture

☐ Famine

☐ Loss of livestock

☐ Poor health of humans

☐ Increase in food prices

☐ Decline in livestock prices

Other (specify)_____

27. How many animals did you lost due to drought and related cause in the last drought events(2016)

Animal species	Cattle	Camel	Sheep	Goat	Horse	Mule	Donkey	Poultry
Number animals lost								

28. What are the major decreasing agents of livestock population in your area the last 10 years? (Put in rank)

Livestock species	Drought/mortality	Distressed sale(emergency sale)	Disease	Diversification Sale	Other(specify)
Cattle					
Camel					
Sheep					
Goat					
Horse					
Mule					
Donkey					
Poultry					

29. What are the critical problems during the drought?

☐ The prevalence of disease ☐ Shortage of water ☐ Shortage of pasture
 Other (specify) _____

30. How does drought impact on your livelihood? _____

31. How do you get the information on weather forecasts?

☐ Radio/TV ☐ Government agents ☐ Traditional sources ☐ Other (specify)_____

32. What measures do you put in place to safeguard yourself against a coming drought?

☐ Livestock management adjustments (changes in feed, water, grazing land use)

☐ Mobility

☐ Income diversification

☐ livestock insurance use of savings

Other (specify)_____

33. Considering the source of livelihood in 12, do you seek additional sources of income when anticipating drought?

☐ Yes

☐ No

34. If question number 33 is yes, which are these additional sources of income?

1.-----2.-----3.-----4.-----

35. Do you reserve water for use during the drought? ☐ Yes ☐ No

36. Do you reserve pasture for use during the drought? ☐ Yes ☐ No

37. What is the main source of water and pasture of the household during the drought season? (More than one answer allowed)

☐ Permanent water source nearby grazing reserve nearby

☐ Other grazing and water points within the County

☐ Other grazing and water points outside the County

Other (specify)_____

38. During drought, how do you cope with food shortages?

☐ Liquidating productive assets e.g. livestock ☐ Relying on charity

☐ Permanent or seasonal migration ☐ Shift to other livelihood options

☐ Relying on public relief programmers

Other (specify)_____

39. What are the practices for using and conserving natural resources such as pasture, forests, water etc?

☐ Having drought reserve grazing ☐ Protection of specific plant species or areas

☐ Having individual or communal user rights for water/grazing points

40. What livelihood options do you have, apart from pastoralist?

☐ None

☐ Other specify_____

41. Did you sell any livestock during drought period? ☐ Yes ☐ No

42. If yes, what was the main reason for selling livestock?

1. _____ 2. _____ 3. _____ 4. _____

43. What type of support do you get from the government in the event of drought?

☐ Information ☐ Emergency aid ☐ Development aid

☐ Financial assistance ☐ Development of water sources ☐ Restocking

Other (specify) _____

44. How did you find your total grazing area over the last 10 years?

☐ .Decreasing ☐ .Increasing ☐ .Constant/no change.

45. If you answer is decreasing, what do you think the reasons for the decreasing grazing land?

1. _____ 2. _____ 3. _____ 4. _____

Thank you very much for your cooperation.

Appendix2: Interview Guide for Interviews with Community Key Informants

Interview questions

1. In your opinion, do you think government intervention, if any, has been helpful?

2. How do you establish your own weather forecast?

3. How do you respond to weather forecasts?

4. In your opinion, what shows that the drought has occurred?

5. What are the impacts of drought on?

I. Livestock population and market

II. Human and livestock health?

III. Agriculture and food security?

IV. Water resources and Range land

V. Indigenous knowledge system?

VI. Formal education?

6. How did the community of this area cope with drought in the past?

7. How did the community of this area cope with recent droughts?

8. What other livelihood options do people have in the event of severe drought?

Thank you!!!

Appendix3: Interview Guide for Interviews with Government/Non-government Departments / Development offices

Background information

Profession _____

Education status_____

1. What do you think the main cause of drought occurrence in the woreda?
3. In which season /months drought occurrence most frequents in the woreda?
4. Why these /this season (s) is /is favorable for drought occurrence?
5. What are the impacts of recent drought on livestock development and marketing and crop production?
6. What has the government done to improve socioeconomic situation of pastoralists of through livestock development and marketing?
7. What are the impacts of recent drought events on the livelihoods of the pastoral communities In Leben woreda?
8. What has the government done to address these impacts?
9. In addressing socioeconomic issues attributed to drought, what challenges have the local provincial administration faced?

Thank you!!!

Appendix 4: Interview Guide for Interviews with Government Health Practitioners

Government health practitioners

1. What are the drought-related health challenges that affected the pastoralists group in the recent drought year (2016)?
2. Which are the most vulnerable groups in terms of gender and age that were affected by these health challenges?
3. Why are they so much vulnerable?
4. How did you intervene in such circumstances?
5. Do you have any suggestion or additional remarks?

Appendix 5: Interview Guide for Interviews with Primary School head/education sector

1. How has the recent drought affected the enrolment rate of children from pastoral groups?
2. Are there incidences where drought is attributed to dropping-out of children from school?

If there are incidences why is that so?

3. What measures is the school putting in place to keep children in school and avoid escalation of drop-out rates attributable to drought?

Thank you!!

Appendix 6: Meteorological data of precipitation of Liben woreda,from NB station

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total RF in mm
1981	0	24.8	519.9	368.5	68.6	0	3.5	8.4	59.4	220.5	35	0	1308.6
1982	0	57.2	29.2	323.8	247	0	2.2	0	26.7	233.6	85		1004.7
1983	0	28.1	3.5	157.5	123.3	32.9	3.1		31.8	128	166.5	0	674.7
1984	0		8.8	176.4	121.1	0	0.9	0	65.5	99	27.4	23.3	522.4
1985	0.1	0	71.7	192	116.8	1.7	0.3	2.5	26	168	68.3	10.9	658.3
1986	0	0	16.9	379.3	120.9	39.6	3	0.1	63.6	46.7	43.5	4.2	717.8
1987		14.9	80.3	175	296	22	0	1.3	19	107	98		813.5
1988	0	2.6	33.3	295.6	51.8	0	7.7	0	15.3	119.8	0		526.1
1989	12.4	0	202	160	88.6	0	22.8	0	58.6	132	12.6	12.2	701.2
1990	2.7	78	140.1	271.1	59.4	1.6							552.9
1991							0						0
1992												36.1	36.1
1993	9.3	61.2	2.2	244.5	191.2	8.8	6.6	0	0	135.8	3	5.9	668.5
1994	0	0	30.7	146.7	207.6	1.4	16.8	2.2	48.1	131	30.3	8.6	623.4
1995	0	24.4	98.1	289.8	52.5	10.7	9.1	5.9	54.1	145.6	48.7	0	738.9
1996	1.8	0.8	146.8	274.5	75.8	7.5	4.4	0.1	26.2	182	54.4	0.6	774.9
1997	0.2	0	33.9	96.3	42.2	43.6	3.3	0	67.3	203.8	106.1	27.3	624
1998	60.7		11.5	114	130.3	22.8	13.4	5.1	1.4	68.4	20	6.5	454.1
1999	0	0	105.5	27.1	64.7	2	2.6	1.1	6.6	135.5	12	1.7	358.8
2000	0.8	0	0	105.1	134.8	0.3	2.2	6	4.5	169.4	66.1	23.1	512.3
2001	0	9.7	76.4	213.3	94.2	2.9	3.2	5.4	49.7	112.3	37.6	2.2	606.9
2002	4.9	0	119.7	67.9	93.5	0.9	1.7	2.5	68.2	206.4	6.2	119.6	691.5
2003	9.7	0	25.3	242.3	192.9	2.1	2.9	17.9	7.1	50.5	21.2	43.5	615.4
2004	49.8	9.5	27.4	225.7	56	5.1	0	0.3	19.3	138.1	127	5.2	663.4
2005	33.9	7.5		225.3	339.7	4.6	5.8	1	2.7	100.2	54.6	0	775.3
2006	0	25.2	119	301.8	102.6	1.3	3.3	23.6	5.1	149.2	45.4	15.9	792.4
2007		2.5	45.6	171.8	109.1	17.3	11.6	8	18.7	98.1	23.3		506
2008	0	0	27.1	198.7	85.8	3.6	6.9	2.7	43.9	309.2	98.8	0	776.7
2009	14.4		31.8	127.2	131.6		1.1	0	46	129	35.1	12.9	529.1
2010	3.2	24.9	121.2	116.5	41.3	0.8	3.7	7.7	30.6	128	25.2	0	503.1
2011	0	1.2	0.5	62	148.9	2.2	5.5	1.1	19.8	120.9	257.9	19.6	639.6
2012	0	0	0	206.9	62.3	1	2.4	5.2	52.8	128.4		4.6	463.6
2013	1.5			174.1		39.9	1.2		44.9	155.5	116.1	0	533.2
2014	0	5.9		167	81.5	8.4	39.1	32.9	24.9	159.5			519.2
2015		0	24	191.8	144	11	0					1.1	371.9
2016								7					7
2017							2	10.3	32.8				45.1

Appendix 7: Meteorological data of maximum Temperature of Liben woreda, from NB station

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean max T°
1981	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1
1982	28.8	30.1	30.1	25.5	24.6	23.1	22.5	24.6	27.4	24.9	25.6	27.1	26.19
1983	29.1	29.3	31.3	26.8	24.9	22.9	23.9	24.3	25.3	25.1	25.8	27.5	26.35
1984	28.6	29.2	29.2	27.5	24.1	23.4	22.7	23.7	25.4	25.5	25.8	27.1	26.01
1985	28.2	29.6	28.2	24.5	22.8	21	21.5	22.7	25.2	24.6	25	27.1	25.03
1986	28.6	29.2	29.1	24.7	23.4	20.9	21.1	24.3	25.4	25.5	26.4	27.7	25.52
1987	28.5	29	29.1	25.8	24.1	22.3	23	24.2	27.1	25.8	25.8	28	26.05
1988	29.5		29.8	26.3	24.6	24.3	23.1	25.1	25.6			27.3	26.17
1989	28.8	28.9	28.3	24.4		21.7	21.1	23.4	25.6	24.1	25.3	26.5	25.28
1990	30.5	30	28.3	25.3		23.2							27.46
1991							28.5						28.5
1992											26.3	26.4	26.35
1993	27.4	27.7	30	26.8	24	22	21.4	23.6	26	25.3	26.7	28.4	25.77
1994	29.6	30.9	30.1	26.2	24.1	23.5	23.6	25	26.7	25.1	26.4	28	26.6
1995	29.9	30.4	27.1	25.6	25.9	25	24	24	26.1	24.8	25.6	27.8	26.35
1996	29		28.4	25.6	24.1	22.4	22.4	24.8	26.7	25.3	26.1	28.1	25.71
1997	29.8	30.6	30.2	25.5	25.5	25.4	24.4	26.4	27.6	24	24.8	25.3	26.62
1998	26.5	28.3	29.6	28.3	24.6	23.4	21.7	23.8	26.4	26	26.8	28.7	26.17
1999	29.5	30.6	26.6	25.6	24.4	24	23	25.3	26.8	25.3	26.3	28.1	26.29
2000	29.5	30.7	30.9	27.6	24	23.3	23.4	24.8	26.8	25	25.7	28	26.64
2001	29.6	30.7	29.6	25.9	24	23.5	23.7	25.5	27.3	25.8	25.8	28.3	26.64
2002	29.6	30.7	28.5	27	25.1	24	24.8	25.1	26.6	24.3	26.9	26.6	26.6
2003	28.3	31	30.5	27.4	24.4	22.6	22.6	24.3	26.8	27	27.3	27.2	26.61
2004	28.6	30.1	30.4	25.3	24.8	23.6	24.6	25.3	27.6	25.9	25.7	28	26.65
2005	29.1	30.8		27.9	24.4	22.5	22.9	25	26.8	25.5	26.2	28.6	26.33
2006	29.6	30.1	28.9	25.8	25	24.9	23.4	24.8	26.3	24.7	25.9	27.6	26.41
2007		31.2	30.6	27.5	25.5	23.8	24.4	25	26.9	25.7	27.3		26.79
2008	29.7	30.3	30.5	26.6	25.3	23.8	23	25.3	27.9	25.6	26	28.6	26.88
2009	29.4		30.9	26.4	25.3	25.5	24.6	25.9	27.2	25.5	27.5	28.4	26.96
2010	29.8	29.9	27.8	27.8	25.4	24.9	23.9	25.1	27.2	26.3	27.5	29.2	27.06
2011	30.1	31.1	31.4	30.1	26.1	25.8	25.9	26.1	27.2	26.6	25.4	26.9	27.72
2012	29.5	30.7	31.7	26.8	25.5	25.2	24.7	26.9	27.2	26		28.6	27.52
2013	30.7	31.9	31.9	29.7	26.1	24.6	24.1		28.1	25.7	26.4	29	28.01
2014	30.7	31.4	30.4	27.6	26.2	25.5	24.8	26	26.7	25.4			27.47
2015		32.2	30.9	27.7	25.8	26.5	25.9				27	29.8	28.22
2016		32.6						27.5	28.7				29.6
2017							27	27.1	28.8				27.63

Appendix 8: Meteorological data of minimum Temperature of Liben woreda, from NB station

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean min T°
1981	11.3	12.4	14.8	15.4	14.7	13.2	12.8	13	13.4	13.1	11.1	10.4	12.96
1982	11.8	12.9	13.4	15.1	14.9	13.7	12.1	12.4	12.3	13.8	13	11.3	13.05
1983	10.5	13.9	14.3	15.6	15.2				13.2	13.5	11.4	10.4	13.11
1984	10.6	10.9	13	15.1	14.7	13.4	13.3	12.8	13.4	12.8	12.3	12.4	12.89
1985			13.1	14.1	15	13.2	12.9	12.7	13.1	13.9	12.5	11.7	13.22
1986	10.7	12	12.8	13.1	15.2	13.8	12.4	11.6	13.1	12.9	12.8	12.1	12.70
1987	11.5	12.8	14.6	14.1	15	14	12.8	12	13.1	14	12.9	12.1	13.24
1988	16.1	15.9	16.1	16	15.8	15.7	15.1	15.6	15.8	15.6	15.6	16	15.77
1989	11.3	12.5	13.5	14		12.7	12.7	12.2	13.7	13.5	13.4	13.4	12.99
1990	15.3	16.3	15.5	14.9	14.9	13.2							15.01
1991	15.5	14.5	15.7	15.9	15	15.2	12.2	15.2	16.2	14.8	14.4	16.1	15.05
1992	15.8	15.1	16	16.9	15	15.2	18.1	15.8	18.9	15.3	15.4		16.13
1993	16.3	16.5	17.1	17.2	16.3	15.2	14	14.1	14.8	16.1	15.4	15.5	15.70
1994	15.7	16.8	17.7	17	16.5	14.8	14.9	15.2	15.8	16	15.5	14.8	15.89
1995	15.6	16.7	17.1	16.9	16.6	14.9	15	14.8	15.7	15.9	15.6	15.4	15.85
1996	16.4	17	17.4	16.6	16.3	15.1	14.1	14.3	15.3	15.5	15	14.8	15.65
1997	16.2	16.4	18.1	16.7	16	15.5	15	15	16.1	16.1	16.1	15.6	16.06
1998	16.1	17.1	17.7	17.8	16.7	15.1	14.5	15.1	15.2	16.4	15.2	15.2	16.00
1999	16	16.8	13.8	12.5	13.6	14.8	14.2	14.8	15.4	15.9	15.4	15.2	14.86
2000	15.9	16.9	17.7	17.5	16.3	15.1	14.5	15.1	15.6	16.3	15.4	15.7	16
2001	16.5	17.1	18.2	16.9	16.3	14.9	14.7	14.9	15.9	16.3	15.3	16.3	16.10
2002	16.9	17	18	17.2	16.4	15.1	14.8	15.3	16	16.3	15.8	16.4	16.26
2003	16.3	17.8	18	17.1	16.8	15.6	14.7	15	15.7	16.4	16.1	15.2	16.22
2004	17	17.4	17.9	17.2	16.3	14.8	14.6	15.3	15.9	16.3	16.2	16	16.24
2005	15.9	17.1	18.5	18	16.6	15.4	14.6	14.9	16.2	16.3	15.4	14.7	16.13
2006	16.6	17.5	17.5	16.5	16.6	15.8	14.9	15.3	15.9	16.4	15.5	16.1	16.21
2007		18.1	17.9	17.5	16.9	15.7	15.2	15.6	16.6	15.8	15.4		16.47
2008	16.4	17.1	17.9	16.5	16.1	15.1	15.1	15.6	16.9	16.4	15.3	15.7	16.17
2009	16.3		18.4	17.1	16.5	15.8	15	15.8	16.6	16.6	15.9	17.1	16.46
2010	17.1	19.1	17.4	17.4	17.4	16.3	15.2	15.6	16.4	16.9	15.8	15.6	16.68
2011	16.1	17.6	18.4	18.8	17.3	16.7	16.2	16.4	17	16.7	16.7	15.2	16.925
2012	16.1	17	17.9	16.9	16.5	15.5	15.5	16	16.6	16.7		16.8	16.5
2013	17	17.8	17.8	18.1	17	16.4	14.2		16.4	16.6	16	15.3	16.6
2014	16.5	17.8	17.9	17	16.9	15.8	15.5	15.9	16.2	17.1			16.66
2015		17.4	17.9	17.1	17.1	16.2	15.6				16.6	16.7	16.82
2016		18						15.5	15.7				16.4
2017							16.4	16.5	17				16.6