



**SCHOOL OF GRADUATE STUDIES
COLLEGE OF SOCIAL SCIENCES
DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES**

**THE IMPACT OF CLIMATE VARIABILITY ON FOOD SECURITY:
*THE CASE OF LEMO WOREDA HADIYA ZONE SNNPR ETHIOPIA***

BY

LONSEKO DEBEBE DADDE

**JUNE 2020
ADDIS ABABA ETHIOPIA**

ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

COLLEGE OF SOCIAL SCIENCES

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

***THE IMPACT OF CLIMATE VARIABILITY ON FOOD SECURITY THE CASE OF
LEMO WOREDA, HADIYA ZONE SNNPR, ETHIOPIA***

***A THESIS SUBMITTED TO DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL
STUDIES OF ADDIS ABABA UNIVERSITY, IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF ART (CLIMATE CHANGE AND
ADAPTATION)***

BY: LONSEKO DEBEBE

ADVISER: YOHANNES G/MICHAEL (PHD)

JULY2020

ADDIS ABABA ETHIOPIA

DECLARATION

I, Lonseko Debebe Dadde, do hereby declare that this thesis is a product of my original research work, and it has not been submitted to any other university for any academic degree. Materials and information other than those of another are dually acknowledged.

Name: Lonseko Debebe Dadde

Signature: _____

Addis Ababa University
School of Graduate Studies
College of Social Sciences
Department of Geography and Environmental Studies
THE IMPACT OF CLIMATE VARIABILITY ON FOOD SECURITY:
THE CASE OF LEMO WOREDA, HADIYA ZONE SNNPR ETHIOPIA
BY
LONSEKO DEBEBE DADDE

This is to certify that the thesis is prepared by Lonseko Debebe, Dadde entitled: The Impact of Climate Variability on Food Security and submitted in partial fulfillment of the requirements for the Degree of Master of Arts (Geography and Environmental Studies, Specialization: in Climate Change and Adaptation) complies with the regulations of the university and meets the accepted standards with respect to originality and quality.

Approved by the examining committee:

Advisor _____ Signature _____ Date _____

Internal Examiner _____ Signature _____ Date _____

External Examiner _____ Signature _____ Date _____

Chair of Department or Graduate Program Coordinator

Acknowledgement

Firstly Above all, I would like to thanks the Almighty God without whose blessing power it would have been possible all my wishes and dreams to come in to reality.

Next and for the most I am deeply indebted to my advisor Yohannes G/Michael (PhD) for his earnest guidance, critical comment, encouragement and timely suggestion that made this research success.

Thirdly my thanks go to AAU, Department of Geography and Environmental Studies, CSA Hosaina branch, NMA Addis Ababa branch , Anlemo woreda education office ,Lemo woreda agricultural development office Lemo woreda finance & development office, K.N.Singh (PhD), Muluneh Woldetsedik (PhD,&farmers of the three sample kebeles ,

My special thanks to ,Eyob and Yosef from Lemo woreda agricultural development office agents Yohannes Abega, Tagesech (mishame) &Girma Abebe,Mathewos and Girma Debebe ,Abebe desalegn ,my lovely Father and Mother Arase (Amarech Nunishe), and all my brathers , sisters & class mates I have no words to thank and appreciate for their their hospitality and patience to answer the questionnaire and their contribution on data collection.

Finally, I would like to express my heartfelt gratitude to my beloved wife, Wana Sajin Birkinesh Abebe (Yelibe) & my childrens(Waito, lomboro, malala and masame) for their continuous encouragement and support throughout this study.

ABSTRACT

This study examined climate variability impact on food security and household coping mechanisms in Lemo Woreda ,Hadiya Zone SNNPR. The study aimed at assessing the climate variability condition and its impact on household food security. It assessed essential information and perception of local people on impact of climate variability on food security, and household coping mechanisms and adaptation strategies. The study utilized semi-structured questioner, key informant interviews, focus group discussions and discussion with government officials in collecting primary and secondary data sources from three sample kebeles and agro-ecological zones based on mixed research design and qualitative and quantitative studies were employed in data analysis..It was increased un predicatively and damage crop production in harvesting time. Also the Physical, socioeconomic, technological factors, late rain in autumn is the determinant factors to agricultural productivity in the study area. The result of the study analysis that climate variability affect food security by declined in food production, livestock rearing , increased in food item prices and decreased in food item availability in a market condition. There are three groups of population in the study area Such as severely food insecure, moderately food insecure & food secure based on food sufficiency within monthly income totally in a year. The means of strengthening adaptation and coping strategies diversifying off-farm, tracing, assuring residence security, , increasing livestock sub- sector productivity ,pleasing to the eye environmental protection, digging deep water holes and ponds to improving irrigation schemes must receive policy attention to enhance agricultural productivity and to promoting establishment of household market networking to minimize climate variability impact on food security in the study area.

Keywords; *Households, Climate variability, Agriculturalpractices, Adaptation &Food security*

Mvx

Acronyms

CSA	Central Statistical Agency
CFSVA	Comprehensive Food Security and Vulnerability Analysis
EAS	Ethiopian Academy of Sciences
EIA	Environment Impact Analysis
EPACC	Ethiopia's Program of Adaptation to Climate Change
FAO	Food and Agricultural Organization
FGD	Focus Group Discussion
GHF	Global Humanitarian Forum
GHG	Greenhouse Gases
HFIAS:	Household's food insecurity access score
HHs:	Households
MoFED	Minister of Finance and Economic Development
NAPA	National Adaptation Program for Action
NMA	National Meteorology Agency
PCI	Precipitation concentration index
RSA	Republic of South Africa
SEA	Strategic Environmental Assessment
SNNPRS	Southern Nations Nationalities and People's Regional States
SPSS	Statistical Package for Social Sciences
UNDP	United Nations Development Program
UNEPA	United Nations Environmental Program
UNESCO	United Nations Educational Scientific and Cultural Organizations
USAID	United States Agency for International Development
WFP	World Food Program
WGII	Working Groups Two.

Table of Contents

Contents	Page
Acknowledgement	i
<i>ABSTRACT</i>	ii
Acronyms	iii
Table of Contents	iv
List of Figure	viii
List of Table.....	x
INTRODUCTION	1
1.1 Background of the Study	1
1.2 Concepts and Definitions.....	3
1.3 Statement of the Problem	8
1.4 Objectives of the Study	9
1.4.1 General Objective.....	9
1.4.2 Specific Objectives:.....	9
1.5 Research Questions	9
1.6 Significance of the Study.....	9
1.7 Scope of the Study.....	10
1.8 Limitation of the Study.....	10
1.9 Organization of Paper.....	10
LITERATURE REVIEW.....	11
2.1 Climate variability	11
2.1.1 Climate variability and General Overview of Food Insecurity Situation in Ethiopia	12
2.1.2 Poverty, Vulnerability and Food Insecurity in Ethiopia	13
2.1.3 The food security program of Ethiopia.....	14

2.2 Conceptual Framework	14
METHODOLOGY.....	18
3.1 Description of the study area	18
3.1.1 Lemo Woreda.....	18
3.1.2 Physical Environment of the Lemo woreda.....	19
3.1.2.1 Relief.....	19
3.1.2.2 Agro-Ecological Zones	20
3.1.2.3 Climate Condition Of The Woreda	21
3. 1.2.4 Land use and land cover pattern.....	24
3.2 Method of Data Collection	24
3. 2.1 Research Design:	24
3.2.2 Sample and Sample Size.....	25
3.2.3 Data Sources	27
3.2.4 Household Survey	27
3.2.5 Focus Croup Discussion	28
3.2. Key Informant Interview	28
3.2.7 Field Observation	29
3.2.8 Sources Secondary data	29
3.2.9 Data analysis	29
RESULTS AND DISCUSSIONS.....	30
4.1 Demographic and Socioeconomic Profiles.....	30
4.1.1 Profile of the respondents house hold	30
4.2 Metrological analysis of the lemo woreda.....	32
4.2.1 Assessing the trend analysis of CV and change situation of the study area	32
4.2.1. 1 Trends of temperature and rainfall	32
4.2.1.2 Temperature trend analysis of lemo woreda	35

4.2.1.4 Rainfall: Amounts, trends, variability and seasonal concentration	40
4.2.1.5 Monthly Rainfall Amount Trend and Seasonal Concentration in decades.....	41
4.2.1.6 Seasonal Rainfall Pattern in lemo Woreda	41
4.2.1.7 winter rainfall trends.....	42
4.2.1.8 Belg rainfall trends	43
4.2.1.9 Summer rainfall trends	44
4.2.1.11 Pluviometric Coefficient.....	47
4.2 Climate change contribution to vulnerability in food insecurity	48
4.2.1 The causes of climate variability in Lemo woreda.....	48
4.2.1.1 Drainage.....	50
4.2.1.2 Soil Types on the base of agriculture	51
4.2.1.3 Natural Vegetation.....	52
4.3 Assessing the impacts of CV/CC on food security in the study area.....	54
4.3.1 Physical Factors;	56
4.3.1.1 Factors Affecting Crop Production in the study area	56
4.3.1.2 Land holding	57
4.3.1.3 Economic Factors	58
4.3.1.4 Technological Factor	58
4.3.2 Analysis of Household Food Insecurity	59
4.3.2.1 Food Availability and Crop Production in lemo Woreda.....	59
4.3.2.2 Crop production.....	60
4.3.2.3 Description of Livestock.....	62
4.3.3 Household Income Sources.....	65
4.3.3.1 Household Access to Food.....	65
4.3.3.2 Assets	65
4.3.3.3 Aspect of Food Utilization.....	66

4.3.3.4 Strategies on time of specific food shortage problems	69
4.3.3.4 Vulnerability to Food Insecurity	69
4.3.3. 5 External support	71
4.4 Community Response to the climate change induced food security problem.....	72
4.4.1 Coping strategies practiced by the people in the study area.	72
4.4.1.1 Local Adaptive strategies.....	72
4.4.4.1.2 Grass strip	76
4.4.4.1.4 Soil bund	77
4.4.4.1.5 FanyaJuu	77
4.4.4.1.6 Cutoff drains.....	78
4.4.4.1.7 Stone bunds	78
4.4.4.1.9Planting trees.....	79
CONCLUSIONS AND RECOMMENDATIONS	80
5.1 CONCLUSIONS.....	80
5.2 RECOMMENDATIONS.....	82
REFERENCE	85
APPENDIX I:.....	89
APPENDIX II:.....	96
<u>APPENDIX III:</u>	97

Mvx

Mvx

Mvx

List of Figure

Figure 1 conceptual frame work	17
Figure 2 Figure 2 Map of Lemo Woreda and the Sample kebeles in Lemo woreda	19
Figure 3 Agro-ecological Zones and Climate condition of the lemo woreda	21
Figure 4 mean maximum, minimum and Average Temperature of Lemo Woreda	23
Figure 5 Focus group Discussion.....	28
Figure 6 Key Informant Interview	29
Figure 7 autumn temperature trend	36
Figure 8 summer temperature pattern	37
Figure 9 Winter temperature trends	38
Figure 10 Belg temperature trends	39
Figure 11 annual rain fall trends	41
Figure 12 Winter/bega average rainfall pattern	43
Figure 13 .Average belg/spring rainfall pattern.....	44
Figure 14 Average summer/keremt rainfall patterns	45
Figure 15 Total Autumn/tsedal rainfall pattern	46
Figure 16 drainage pattern of lemo woreda.....	50
Figure 17 soil types of lemo woreda.	52
Figure 18 Sample Afforested forest tree of Lemo	53
Figure 19 average wheat annual productions in lemo Woreda	60
Figure 20 average wheat annual single price in lemo Woreda.....	61

Figure 21	Enset crop production that affected by climate variability	71
Figure 22	Planting trees nursery area in sample kebele	72
Figure 23	Grass stripping	77
Figure 24	. Soil bund embankment	78
Figure 25	Stone bunds embankments and Cutoff drains.....	79
Figure 27	planting places are presented in digiba and Lisana qusa kebele.	79

List of Table

Table 1 : Seasonal division of lemo woreda.....	22
Table 2 maximum, minimum and Average Temperature of Lemo Woreda (1985-2017)...	23
Table 3 :Agricultural land use in hectare	24
Table 4 population size by Sample kebele	27
Table 5 Characteristic of the household survey respondents	32
Table 6 : Responses about climate variability/change from respondents	34
Table 7 Maximum, Minimum andAverage Seasonal Temperature trend by Decades,	35
Table 8 Autumn/tseday temperature trend	36
Table 9 Summer seasonal temperature trend.....	37
Table 10 Winter temperature trends.....	38
Table 11 Belg temperature trend.....	39
Table 12 Total annual rainfall.....	40
Table 13 Total seasonal rainfall	41
Table 14 Total seasonal rainfall data in decades.	42
Table 15 Winter rainfall	42
Table 16 Belg rainfall trend.....	43
Table 17 summer rainfall.....	45
Table 18 Autumn rainfall	46
Table 19 Computation of PCI value and pluviometric coefficient.	48
Table 20 Responses about causes of climate variability/change from respondents	49
Table 21 Responses about water access from respondents	51
Table 22 Responses about climate variability/change factors from respondents	53
Table 23 PSNP beneficiaries 27 kebeles of lemo woreda.....	56
Table 24 average wheat annual productions in Lemo Woreda,.....	59
Table 25 Sum of wheat production in each year	60
Table 26 average wheat annual single price in lemo Woreda,	61
Table 27 Average total price (Birr) of wheat sold in one quintal in year 2005-/2011 Years..	62
Table 28 Production in quintal and Average single price in each quintal.....	62
Table 29 Livestock trend in the study area.....	63
Table 30 Average Monthly income Sources of the sample households	65
Table 31 Household perception of causes of disease and food shortages.....	66
Table 32 Household perception of about causes of disease and food shortages	68

Table 33 Strategies on shortage of specific food problems.....	69
Table 34 .Households perception of causes of food insecurity	70
Table 35 : Farmers' Coping strategies to climate variability	73
Table 36 : Farmers' Coping Mechanism to climate variability	75

INTRODUCTION

1.1 Background of the Study

In coming decades the global climate variability may have an adverse overall effect on agricultural production and thus bringing several regions of the world on the dangerous thresholds in many regions. Areas currently suffering from food insecurity are expected to experience disproportionately negative effects. To reduce the effect of climate change on food supplies, livelihood and economies, we must greatly increase adaptive capacity in agriculture –both on long term climatic trends and to increasing variability as an urgent policy. This problem is more serious in developing countries as they lack adaptive capacity. On the other hand Meeting the dual challenge of achieving food security and other developmental benefits on the one hand and mitigating and adaptation to climate change on the other hand requires political commitment at the highest level (Bedding ton *et al.*, 2011)..

The impacts of climate change, and the vulnerability of communities to climate change, though vary in degree from region to region, is superimposed on existing vulnerabilities. Climate change will severely impose a real threat to food security; further reduce access to drinking water; negatively affect the health of people and disturbing the social lives of communities in many developing countries mainly in Africa, Asia, and Latin America. In some areas where livelihood choices are limited and mostly based on primary economic activities such as agriculture, decreasing in crop yields has been widely exhibited and food insecurity experienced often according to (UNEP, 2009).

The macroeconomic costs of the impacts of climate change are highly uncertain, but very likely have the potential to threaten development in many countries (Christopher *et al.*, 2008) According to Negatu in developed and developing countries all over the world, farmers and indigenous and local communities have traditional knowledge, expertise, skills, and practices related to food security, agricultural production, diversity and adaptation. Food security is a global challenge closely linked to poverty. The global lobby for Global Development has indicated food security is Goal number one. There has been progress in reducing global hunger (protein-energy malnutrition) from about 1 billion people in 1990-1992 to about 870 million in 2010-2012 (Negatu, 2016).

The climate related disasters pose a serious threat to the poverty reduction and sustainable development in Africa continent. As one of the most vulnerable regions in the world to the

projected impact of climate change, Africa faces many challenges at theoretical juncture. Traditionally, national development plan, poverty reduction strategy and sectoral strategies in climate sensitive sectors have paid little attention. The impact of climate change will fall disproportionately on the world's poorest countries, many of them here in Africa. Poor people already live on the front lines of pollution, disaster, and the degradation of the resources and land. For them, adaptation is a matter of sheer survival. Sufficient evidence shows that the average temperature rise in Africa is faster than the global average and is likely to persist in the future (Hassan *et al.* 2006).

Ethiopia is one of the horns of African countries which are highly vulnerable to climate variability. Recurring drought is the single most important climate related natural hazard impacting the country from time to time. also showed that rainfall decreases 'significantly' in June-July-August (JJA) over parts of the Horn of Africa which is the main crop cultivation season in Ethiopia. Ethiopia has experienced major droughts which resulted in famine (Hulme *et al.*, 2000).

The study also depicts that, means of adaptation and coping mechanisms of the local people vary and the millions of Ethiopians often face harsh food scarcity (MCKeej.2008). Also broad area of Ethiopian history is interrupted and affected by drought and famine, covering country hundreds of thousands of square kilometers, and millions of households (Kaur, 2013), The degree of climate change effect varies from region to region with the ability of different societal and environmental system to adapt changes and sharing idea, about climate variability needs flexibility in resources use (grasping opportunity and coping with shortages) also high degrees of adaptability to repeatedly change situation (Yohannes 2010).

In general Ethiopian history is punctuated by drought and famine which affected large parts of the country covering hundreds of thousands of square kilometers, and millions of households, (MCKeej.2008). particularly the eastern and northern parts of the country are the most vulnerable and have the highest food insecurity. Two factors critical to assuring food security, at the local as well as global level, is increasing crop productivity with available water resource and increasing access to sustainable water supplies. These factors are also vital to the efficient economic performance of agriculture, which is particularly important in Ethiopia that the sector accounts for about 41 percent of the country's gross domestic product (GDP), produces 80 percent of its exports, employs 80 percent of the labor force, and is a

major source of income and subsistence for the nation's poor (You, G. J.-Y., and C. Ringer, 2010).

These situations indicate that Ethiopia is vulnerable to the impacts of climate change in Africa. Some thesis reviewed also indicated that climate irregularities affecting Ethiopian agriculture .in developed and developing countries all over the world, farmers and indigenous and local communities have traditional knowledge, expertise, skills, and practices related to food security, agricultural production, diversity and adaptation (Negatu 2016).

1 .2Concepts and Definitions

For this study the major variables are expected to have influence on the impacts of food security and farmers adaptation practices are categorized under household head characteristics (family size, Age and sex); socio economic characteristics(Livestock, level of education, farming status, total income, maternal status);physical and institutional factors:(land size and access to extension services) environmental factors: (precipitation, drought, flood and temperature); technological factors(access to appropriate farm equipment and tools, adequate farm input) are defined.

Climate; -is average state of the atmosphere observed over a long period of time? It represents the accumulation of daily and seasonal weather events over a long period of time (Ahrens, 2007). Weather; - is a condition of the atmosphere at a particular place and time. It is a day to day state of atmosphere (Ahrens, 2012: Muluneh, 2010).

Climate change: Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcing such as modulations of the solar cycles, volcanic eruptions, and persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that the Framework Convention on Climate Change (UNFCCC), in its Article 1, defines climate change as: 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.' The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition, and climate variability attributable to natural causes.

Climate variability: refers to the year to year variations of atmospheric conditions around the mean states (WMO, 1992). It is natural climate variation on astronomical/ geological time scales as distinct from human-induced climate change cmvx

(Killmann 2008). Key weather variables for crop prediction are rainfall, temperature, solar radiation, humidity and wind speed that play great role. Its shocks directly impact house hold economies, but also often aggravate other stresses such as disease burden (Sivakumar, 2005). Climate change, and increasing climate variability, as well as other environmental issues, such as land degradation, loss of biological diversity and stratospheric ozone depletion, threatens our ability to meet the basic human needs inadequate food, water and energy, safe shelter and a healthy environment (Sivakumar, 2005).

Adaptation: refers to a response to climate related disasters that are not prevented by mitigation efforts. It is coping with those climate change effects that we cannot, will not; prevent. It is already happening as a response to climate change along with climate variability and other no climate factors. It is the principal way to deal with the impacts of a changing climate. It involves taking practical actions to manage risks from climate impacts, protect communities and strengthen the resilience of the economy (Goodwin, 2008; Burton et al., 1993; SERA, 2000; IPCC 2015).

Impacts: Effects on natural and human systems. It is generally refers to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system. This is also referred to as consequences and outcomes. The impacts of climate change on geophysical systems, including floods, droughts, and sea-level rise, are a subset of impacts called physical impacts (WGII, 2014).

Vulnerability;- is defined as the degree to which a system is susceptible and unable to cope with adverse effects of climate change including climate variability and extremes (IPCC, 2001).It is also defined as the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt (WGII, 2014). Limited national scientific, technological, financial and institutional capacity and arrangements and poor infrastructure collectively heightened Ethiopia's vulnerability to the impacts of climate change. Major floods occurred in different parts of the country in 1988, 1993, 1994, 1995,

1996, and 2006 and overall, periodic drought in Ethiopia causes severe reductions in food availability, putting government expenditures on food aid and emergency drought relief to swell during these periods. In recent years, the Ethiopian government has maintained records of expenditures on vulnerability and food security, which have typically increased during extreme drought (e.g., 1999–2000 and 2003–2004), (EPCC, 2015).

Risk: The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values (WGII, 2014).

Hazard: The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources (WGII, 2014).

Mitigation: refers to efforts to prevent climate change. It is an action or a series of actions taken to reverse or to stop an adverse situation. It comprises conservation and, the development and employment of alternative energy sources. It consists of a component of technology and behavior change (Goodwin, 2008).

Resilience: The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation (WGII, 2014).

Exposure can be defined as the nature and degree to which the income generating assets of a household are located in places where they are subject to droughts and other shocks. (Cervigni *et al* 2016).

Sensitivity is the degree to which a household is affected by droughts and other shocks. For a given level of exposure, a household that derives a large share of its income from drought affected activities (Cervigni *et al.*, 2016).

Coping capacity refers to the ability of a household to mitigate the impact of drought and other shocks after they occur according to (Cervigni *et al.*, 2016).

Food: is any substance consumed to provide nutritional support for the body. (<https://en.wikipedia.org/wiki/Food>.) Food systems: encompass (i) activities related to the production, processing, distribution, preparation and consumption of food; and (ii) the

outcomes of these activities contributing to food security (food availability, with elements related to production, distribution and exchange; food access, with elements related to affordability, allocation and preference; and food use, with elements related to nutritional value, social value and food safety). The outcomes also contribute to environmental and other securities (e.g. income). Interactions between and within bio geophysical and human environments influence both the activities and the outcomes (Killmann, 2008).

Food security: is the state at which all people at all times has physical and economic access to sufficient , safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (world food summit,1996)” (EPCC, 2015; Negra, 2013).

Food insecurity: is defined as lack of access by people to enough food for an active and healthy life. It describes the phenomenon of food deficit in the household and the community level (Balcha, 2001).

Food access: a household's ability to acquire adequate amounts of food, through a combination of home production and stocks, purchases, gifts, borrowing and aid (Killmann, 2008; WFP, 2014).

Food utilization: a household's consumption of the food it has access to and the individuals' ability to absorb and metabolize the nutrients. Indicators could include physiological development quality and safety of food, including nutrition aspects (WFP, 2014).

Food stability: the condition where food is regularly and periodically available and affordable so that it contributes to nutritional security. (Killmann, 2008; WFP, 2014).

Age of household (AGEHH): It is Discrete variables measured by numbers of years of the household head. The age of a farmer is important characteristic of a farmer that affects adoption of technology in the practice of climate smart agriculture (Abebe, 2000).

Family size (FAMS):The size of the household has been identified to positively influence the rate of fertilizer adoption in Eastern Oromia, Ethiopia (Bezabih, 2000) and the probability of adopting of improved fallow in Zambia (Keil, 2001). Some previous findings indicated that availability of labor associated with adoption of soil and water conservation practices (Tesfaye, 2001; Bekele and Holden, 1998).

Educational level (EDUL): Many studies indicated that educational attainment affects conservation measures adoption decision positively found that education was significantly

related to conservation efforts. According to them, farmers, who are more educated, are more likely to use contouring, minimum tillage and hay or pasture rotation to control soil loss. (Ervin and Ervin 1982)

Access to extension service (ACES): it is a dummy variables which focus for household heads access to extension service 1 and 0 if not. Efficiency of extension service depend on the frequency that extension agent visit of a given household in a specific crop year. According to (Kidane and Degnet 2001) high frequency of extension contact accelerates effective dissemination of information that enhances adoption of new agricultural technologies.

Farm size (FAMS): it is a continuous variable which is measured by hectares. Farm size affects the practices of conservation structures because large farm size, the more likely the land will be exposed to erosion. Large farm size is the symbol of wealth in the farming community as it is the sources of income. Research reports indicated that farmers with large farm size had more cash to hire labor and to undertake investment on land management (Bekele and Holden, 1998).

Livestock (TLU): serves as an important source of cash. As it confirmed in many studies farmers who have better livestock ownership status are likely to adopt improved agricultural technologies like desho technology; because, livestock can provide cash through sales of products which enables farmers to purchase different agricultural input (Storket *al.*, 1991).

The general results of the above study clearly indicate that both rainfall and temperature attributes significantly determine the annual agricultural outputs causing food insecurity in the Lemo woreda. Basically there are three group of peoples in my study area .these include severely food in secured, moderately food secured and food secured based on food sufficiency within a year.

Thus, the local people particularly, those ecologically live in Digiba and, Lisanaqusa kebeles are moist and dry woinadega respectively and Anabalesa is dega .Those which dry woinadega as are significantly affected, and their adaptive capacity is low than moist woinadega and dega even though they used various adaptive and coping strategies. Therefore, this study values for policy makers to adjust additional remedies to problem and helps as baseline for those interested to study on similar issues in LemoWoreda.

1.3 Statement of the Problem

Lemo woreda has a narrow range of agro-ecological conditions, and it is ideal or representative for mid, high and lowland areas where mixed farming exists. Nowadays crop and livestock production has decreased and the woreda has become a hotspot for impacts of climate change/variability. In addition to this there is change in the cropping pattern of the study area. According to study that conducted by Markos Ethiopia is endowed with varieties of natural resources suitable to produce wide range of crops, it is frequently challenged by shortage of food and its insecurity, due to unpredictability of climatic elements especially rainfall. Particularly, since 1959, the domestic production of food has never been sufficient to meet the food requirements of the national population. Indeed, since the 1960s, the number of food insecure households has been increasing, and per capita food availability has been decreasing. The per capita food availability was, on an average, 128.08kg for the period 1961- 1974, and it declined to 119.99kg in 1975-1991)

Though average per capita food availability increased to 125.41kg during 1992-2001, still it remained far below the recommended average per capita daily requirement of calorie intake of 2100kcal set by the Ethiopian government. It is equivalent to 225kg of grain per annum per head (Markos, 1997).It can be justified by the increasing frequencies of drought in Tigray and Wollo (1965,1974, 1983, 1984, 1987, 1990, 1991, 1999, 2000, and 2002) and recent flooding in Somali region, South Omo and Dire Dawa (1997 and 2006) leads to negative effects on food security (Abebe, 2013).

A study conducted by YisakBekele in lemo woreda refers that before the implementation of PSNP in the study area, the Woreda was relief recipient and food insecure, but after the implementation of PSNP. There is improvement in food consumption, food quality, and frequency of meal per day and asset status of households. Though the stated improvements certain that the food security situation of the study area was relatively changed just after the implementation of the program; Based on above elaborated researches. There are many studies conducted related to impacts of climate variability and change on food security in global, national and regional level they are concluded drought and flooding are contributes to food in security (YisakBekele 2011).

Therefore, this study has assessed the pattern of rainfall and temperature of the study area. At the same time impacts of climate change and variability on the Household of the rural population of the woreda is assessed. to analyzed and their contribution to agricultural productivity and food security. In so doing the climate variability, food security and farmers

adaptation strategies where been assessed, against the rain feed agricultural practices at community level surveyed in study area.

1.4 Objectives of the Study

1.4.1 General Objective

The General objective of this study is to assess the impacts of climate variability on farmers' food security and adaptation strategies in the Lemo woreda Hadiya zone SNNPR Ethiopia.

1.4.2 Specific Objectives:

The specific objectives of the study are to:

- ✓ assess the trends of climate variability situation of food security in the Lemo woreda.
- ✓ identify the causes of climate variability in Lemo woreda.
- ✓ assess the impacts of climate variability/change on food security in Lemo woreda.
- ✓ identify the adaptation strategies practiced by the people in Lemo woreda.

1.5 Research Questions

Based on the Objectives of the study and related literature, the following research questions were sated.

Research questions are:-

- ✓ What are the major impacts of climate variability on food security?
- ✓ What are the causes of climate variability in the Lemo woreda
- ✓ What are constraints that make worse farmers' vulnerability to food insecure?
- ✓ What are the local adaptation and copping strategies to against climate variability impacts on food security in the Lemo woreda

1.6 Significance of the Study

The study offers on the area significant evidence about trends and patterns of climate variability and change that provides possibilities for the impact induced to vulnerability by climate variability and it contributes a better consideration of predicted impacts of climate variability on agricultural products and food security. This research may also be essential so as to fight food insecurity with right adaptation strategies of climate change/variability and to enhance resilience Green economy, It also serves as base line information to facilitate and exchange of ideas among local community, researchers, policy makers, development actors etc. at different institutional level by creating awareness on how to keep up local knowledge and use it as input for further studies under threat of climatic variability and change.

1.7 Scope of the Study

The study focused on assessing the impact of climatic variability on food security in rural households from three selected sample kebeles of lemo woreda in Hadiya zone, SNNPR. These three sample kebeles are selected from dry woina dega, moist woinadega and dega – Lisane kusa, digiba and anabalesa respectively from both agro-ecological zones of the lemo Woreda. And, study focused more on farming dependent segment of population rather than engaged in various works. The study area is selected purposely based on the researcher's previous and current knowledge for the woreda and the sample kebeles were selected randomly.

1.8 Limitation of the Study

This study had limitation in relation to number of sample size this is because of time and financial constraints. Some households and experts were not willing to fill questionnaires and to participate on FGD. The other problems that the researcher faced was clash of programs held with developmental agents to use the enumerators and key informants with that of woredas seasonal trainings, community based on tafasas (rebuilding the environment by tracing program) and individual works. However, it was adjusted by postponing the held program to appropriate days. In all this ups and downs, the abovementioned money constraint played a great role in travelling and buying stationeries, Shortage of adequate secondary source of data in woreda and zone biro was also another problem. But to fulfill this problem different measures are taken.

1.9 Organization of Paper

The thesis has five chapters. The first chapter deals with background of the study, Statement of problem, research objectives, research questions, significance of the study, scope of the study and limitation of the study. Chapter two is all about review of related literature. Chapter three presents the description of study area and the approaches and methods applied in the analysis. Chapter four presents the results and discussions that start with analysis of the pattern and trend of climate variability in the study area and the last chapter five concludes the major findings of the study while recommending some potential measures that should be undertaken by the different stakeholders in the study area in the future.

LITERATURE REVIEW

2.1 Climate variability

The Earth's climate has changed throughout history. Just in the last 650,000 years there have been seven cycles of glacial advance and retreat, with the abrupt end of the last ice age about 7,000 years ago marking the beginning of the modern climate era-and of human civilization. Most of these changes are attributed to very small changes in the Earth's orbit changing the amount of solar energy the Earth receives. The current warming trend is of particular significance because most of it is very likely human induced and proceeding at a rate that is unprecedented in the past 1,300 years. The climate of a place or region has changed over an extended period (typically decades or longer). There is a statistically significant change in measurements of either the mean state or variability of the climate for that place or region. Changes in climate may be due to natural processes or persistent anthropogenic factors that caused in atmosphere or in land use systems (UNFCCC, 2006). One of the most significant effects of climate change is the impact on the global food system as it changes rainfall patterns, reduces agricultural yields and affects food security. Developing countries across Asia, Africa and Latin America are forecast to see reductions in agricultural productivity of between 9 and 21 per cent by the 2080s due to climate change. In some places, the effects will be felt much sooner than that. By 2020, rising temperatures and variable precipitation are likely to reduce the production of staple foods by up to 50 percent in some African countries, leading to declining yields and the abilities of families to feed themselves.

Furthermore, the Intergovernmental Panel on Climate Change's (IPCC) (Assessment Report 2007) highlighted that agricultural production and access to food in many African countries is projected to be severely compromised by 2020. This would further adversely affect food systems and exacerbate malnutrition. The IPCC went as far to state that "malnutrition linked to extreme-climatic events may be one of the most important consequences of climate change." Climate change is also increasing the frequency and severity of natural disasters. We know that children are hit hardest during natural disasters such as floods and droughts. These disasters also damage food production, killing livestock, destroying crops and forcing people to abandon their land, less food and higher food prices increase the risk of children going hungry and becoming malnourished.

The effects of climate change on livelihoods can be sudden, such as droughts and floods, or slower but cumulative, such as changing long-term rainfall patterns. This cumulative effect is particularly notable in the case of food security and nutrition. Figures quoted by the Stern

Review suggest that, with temperature increases of 2°C, up to 200 million people will be placed at risk of hunger across the world, rising to as many as 550 million with warming of 3°C in the next 50 years. By the end of this century, climate change is likely to double the frequency of extreme droughts and increase their average duration six-fold.

The projected levels of greenhouse gas emissions and lack of action to reduce emissions through international action, indicates that these impacts will intensify to have a more profound and severe impact on the world's food system than the scenarios currently predicted. Urgent action is therefore needed by governments to ensure that children are able to withstand the impact that climate change is having on the food system so that it does not negatively impact on their chance at a future (unicef.org.uk/ climate change) For climate variables such as rainfall, soil moisture, temperature and radiation, crops have thresholds beyond which growth and yield are compromised. For example, cereals and fruit tree yields can be damaged by a few days of temperatures above or below a certain threshold (Wheeler *et al.*, 2000).

Factors like deep rooted poverty, illiteracy and lack of skills, weak institutions, limited infrastructure, lack of technology and information, low levels of primary education and health care, poor access to resources, low management capabilities and armed conflicts have contributed and will continue to negatively effecting the developing countries' ability to cope with climate change. The overexploitation of land resources including forests, increases in population, desertification and land degradation pose additional threats. Africa is already a continent under pressure from climate change stresses and is highly vulnerable to the impacts of climate change. Many areas in Africa are recognized as having climates that are among the most variable in the world on seasonal and decadal time scales (UNFCCC, 2007).

In the European heat wave of 2003, when temperatures were 6 °C above long-term means, crop yields dropped significantly, such as by 36 percent for maize in Italy, and by 25 percent for fruit and 30 percent for forage in France (IPCC, 2007c). Increased intensity and frequency of storms, altered hydrological cycles, and precipitation variance also have long-term implications on the viability of current world agro ecosystems and future food availability.

2.1.1 Climate variability and General Overview of Food Insecurity Situation in Ethiopia

According to (Devereux 2000), food insecurity and poverty are conceptually and empirically distinct; in Ethiopia the overlap between the two is greater than in most countries. Real GDP grew at just 1.9% during the 1980, which, given population growth of 3.1% produced a

negative per capita growth rate of -1.2%. Agricultural growth at 2% per annum in four years of drought during the decade was insufficient to maintain per capita food consumption. Food poverty incidence in Ethiopia is about 50% at national level, 37% in urban areas and 52% in rural areas. Ethiopia needs massive and all round efforts to totally eliminate seasonal food insecurity the recent (2002/3) food crisis that affected about 22% of the population explicitly shows the extent of the problem.

At present the population of chronically food insecure people is slightly more than eight million the Ethiopian government therefore has recently adopted PSNP beside others as strategic means of addressing the food insecurity situation prevailing in the country state that Ethiopia's food insecure people to be around 40-50% of the total population. Similarly (Government of Ethiopia 1999 Cited in Devereux 2000) Stated that using a 'national minimum consumption basket', the welfare monitoring unit founds that 50% of the population is living in 'food poverty', 52% rural and 36% of urban Ethiopians.

The cause of food insecurity in Ethiopia is a complex product of shocks (drought, war) plus low resilience (due to poverty, weak infrastructure and institutions, a constraining rather than enabling policy environment).

2.1.2 Poverty, Vulnerability and Food Insecurity in Ethiopia

Poverty in Ethiopia is not only widespread, but also deep and chronic. Nearly one third of the population is chronically poor and chronically food insecure in a sense that the income they earn (40 cents per adult per day) simply will not sustain them year round. As a whole 22.5% of the households belong to the category of extremely poor households, which are virtually on the verge of starvation or destitution. Moreover, poverty is a major determinant of food insecurity and vulnerability to famine.

The poor in Ethiopia face the most severe constraints in their own food production and in their access to food from the markets which makes them vulnerable to food insecurity crisis (Subbaro and Smith, 2003). Ethiopia is one of the food insecure countries in the world, and recent studies showed that Ethiopia's poor continue to become poorer and poorer and the livelihood of greater number of them sinking into destitution is ever increasing. The worst aspect of the food insecurity situation is the number one of chronically food insecure households is increasing from year to year. In recent years the problem of food insecurity has worsened with around 14 million people requiring emergency food aids clearly states the

existing poverty and food insecurity situation of Ethiopia and its coverage showing the degree of the problem.

Food in security has become one of the defining features of rural poverty in Ethiopia, particularly in drought prone rural areas. Poverty is widespread in both rural and urban areas, however the magnitude is much greater in drought prone and flood prone rural than in urban areas. On the whole 45% of the Ethiopian population is living in absolute poverty, with a relative coverage of 47% and 33% of the rural and urban population respectively for Rapid population growth, diminishing land holdings and livestock, and rapidly diminishing communal for standing razing lands contributed in no small measure to the food insecurity, and very high levels of poverty and vulnerability (Subbaro and Smith, 2003)

2.1.3 The food security program of Ethiopia

Since moisture deficit areas known for their food insecurity problems, the implementation of the food security program (FSP) has started to yield results. Based on experiences gained the program will continue. In this program there are parts that are inclusive and teeing one to the other. These are household asset building, safety net, and settlement programs, as well as off-farm income generating activities. The safety Net program will be implemented jointly with household asset building program .Since it is also a program that can solve the natural resources degradation problem, which in turn is also the cause of the food insecurity problem, and since it can enable to build community asset, efforts will be to effectively implement the program and meet its objective. By targeting those safety net beneficiaries who are involved in the household asset building component, by giving them support for business plan preparation. Training, technology supply, credit and extension they will be able to ensure them food security. In the household asset building component, packages that are based on the food security strategy will be formulated. The packages will be inclusive of those which are suitable for moisture deficit areas, water harvesting, and that can lead to result in low moisture and small area in order to ensure food security (FORE GTP 2010).

2.2 Conceptual Framework

Climate change has far-reaching consequences for agriculture that affect the poor disproportionately. Greater risks of crop failures and livestock deaths are already imposing economic losses and undermining food security and they are likely to get far more severe as global warming continues. Agriculture is important for food security in two ways: it produces the food people eat; and it provides the primary source of livelihood for 36 percent of the

world's total workforce so agriculture is at the core of food security. In turn climate is also the most decisive factor for agriculture (FAO, 2008).

Food systems exist in the biosphere, along with all other manifestations of human activity. Some of the significant changes in the biosphere that are expected to result from global warming will occur in the more distant future, as a consequence of changes in average weather conditions. The most likely scenarios of climate change indicate that increases in weather variability and the incidence of extreme weather events will be particularly significant now and in the immediate future. The projected increases in mean temperatures and precipitation will not manifest through constant gradual changes, but will instead be experienced as increased frequency, duration and intensity of hot spells and precipitation events. Whereas the annual occurrence of hot days and maximum temperatures are expected to increase in all parts of the globe, the mean global increase in precipitation is not expected to be uniformly distributed around the world. In general, it is projected that wet regions will become wetter and dry regions dryer (FAO, 2008).

In the long run, the climatic change could affect agriculture in several ways: productivity, agricultural practice environmental effect, soil erosion reduction of crop productivity etc. (http://en.wikipedia.org/wiki/Climate_change_and_agriculture). Weather-related disasters, crop failure, flood, and drought which resulted from extreme weather events will increase in frequency. As the result of this the livelihoods and food security status of millions of people in disaster-prone areas will be adversely affected. In countries with severe resource constraints, farmers will not be able to adapt to climate change without outside help and thus the poor will need additional help in adapting. As it is shown in figure 1, the climate change and variability components are interrelated and their impact, directly or indirectly, feels by the food security. (Kenneth M, 1995) reported that the continued addition of green house gases in to the atmosphere will alter global climate, increasing temperature and changing the rain fall and other weather patterns. Conceptual framework on the concepts climate change and food security (FAO, 2008) is modified and used in this study.

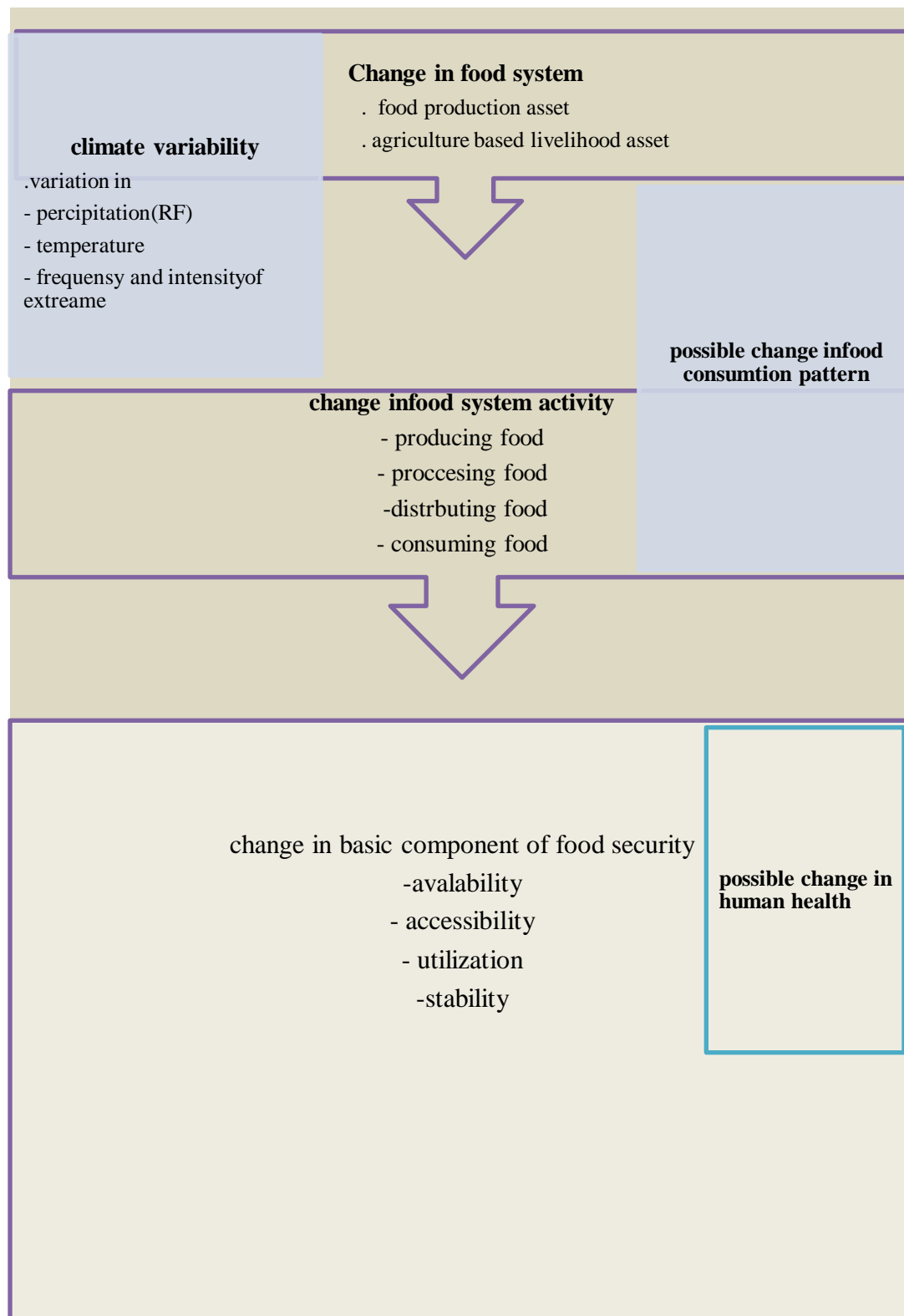
The framework shows climate change and food security outcomes on the three components of food security – food availability, food accessibility and food utilization. For the poor - agricultural production is both are a source of food and a source of income; climate change affects three pillars of food security in various direct and indirect ways. Availability of agricultural product is affected by climate change directly through its impacts on crop yields,

crop pests and diseases, and soil fertility and water-holding properties. Physical and economic access to food would be affected negatively by climate change as agricultural production declines, food prices rise, and purchasing power decreases.

This is due to poor infrastructure and low utilization of modern technology that climate change and variability cause. More frequent and more intense extreme weather events (droughts and floods) and increasing irregularities in seasonal rainfall patterns are already having immediate impacts on not only food production, but also infrastructure, incidence of food emergencies, livelihood assets and human health. Finally climate change poses threats to food utilization through effects on quantity and quality of water and human health. Widely climate change has an impact in the overall livelihood system of the vulnerable societies, as they are highly dependent on rain-fed climate sensitive economic activities and overall household food consumption pattern changed.

Generally this conceptual framework recognizes that a household's food security situation is subject to change and fluctuates. Capacities to withstand shocks such as floods, high food prices and droughts depend on many factors, including a solid asset base, the ease with which households are able to alternate between and rely on the incomes from different livelihoods, the health and physical strength of individual household members and the political environment. The framework considers change in food system assets, change in food system activities and change in basic component of food to be the final outcome or the manifestation of insufficient food intake and/or disease at the individual level. These two immediate determinants of malnutrition and mortality are in turn determined by the household's ability to access food, the care practices used, and the wider health and hygiene environment in which the household lives.

Figure 1 conceptual frame work



Source: computed by researcher adapted from FAO.2008

METHODOLOGY

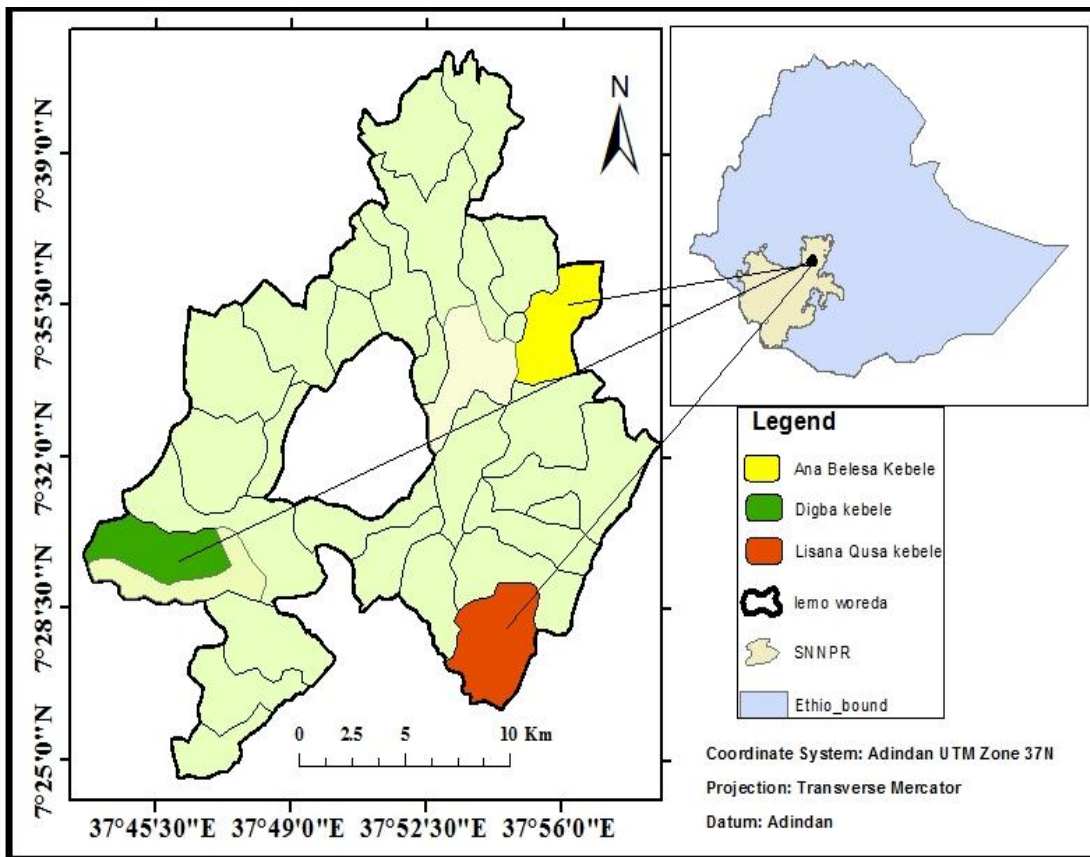
3.1 Description of the study area

3.1.1 Lemo Woreda

Lemo woreda is Astronomically located between 7°25' 00"-7°39 '00"N latitude and 37°45' 30" 37°59'30"E longitude and Based on figures published by the Central Statistical Agency in 2007, this woreda has an estimated total population of 118,578 of whom 58,663 were males and 59,915 were females and 3% of its population are urban dwellers, which is less than the Region and Zone average of 10.28% and 8.1% respectively And an area coverage covers 34973 hectare. Of which 2240.22 is taken as my three sample size kebeles. Lemo has an estimated population density of 437.1 people per square kilometer, which is greater than the Zone average of 378.7 and the Region average of 133.9 people per square kilometer.

The Woreda has an estimated population density of 440.5 persons per km² of arable land and the average arable land holding is 0.98 hectares per household, varying from 0.25 ha to 2.0 hectares. More than 85% of households own less than one hectare of farmland (Limo Woreda office of agriculture, 2011). The woreda is found surrounded in hosanna the capital of Hadiya zone and its office is sated on it . Hosanna town(the office of Lemo woreda), which is located 232 kms away from South west of Addis Ababa and 168 kms from Hawasa SNNPR administration city under Alaba damboya road. Lemo woreda is bordered with Silte Zone in the North, Misha woreda in North west, Ana Lemo woreda of Hadiya Zone in the North East, KembataTembaro Zone in the South, Soroworedain South West, Shashogo woreda of Hadiya Zone in the East.and Gombora woreda of Hadiya Zone in the West.

The Three study kebeles: Digiba located about 14kms south west of Hosanna , Lisanaqusa 16km in the East of Hosanna, and Balesa located about 8kms in the North East from Hosanna town.(see Fig 2) Lemo is one of from 13 woradas/ districts of Hadiya zone and It have 32kebeles and three legally administrated towns (lisana town ,balesa town and jawe town) , according to CSA(census) the Woreda has currently both Urban and Rural about 118594 total population. From this figure male households, 58,666 and female 59,928 populations. Population land ratio of 4 person /hec. This indicated that extreme shortage of land when we compared with population. According to experts of (Limo Woreda office of finance, 2011).Lemo Woreda .land is not sufficient even for subsistence farming in such area where rural people is high.



Source; computed by author from (ARK GIS 2018)

Figure 2 Map of Lemo Woreda and the Sample kebeles in Lemo woreda

3.1.2 Physical Environment of the Lemo woreda

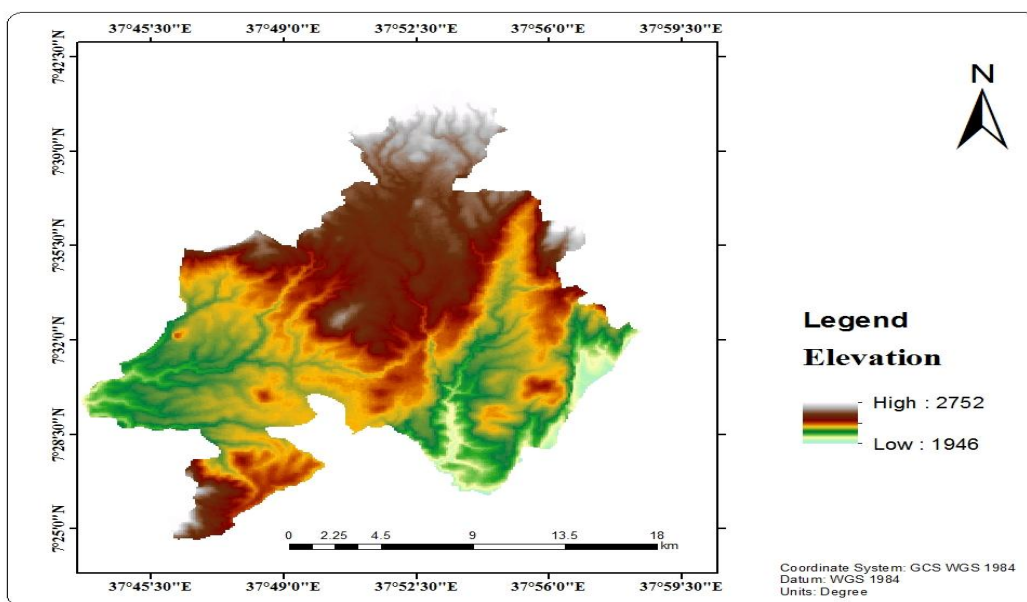
This is to refer those observable characteristics that constitute land escape. These include relief, rivers that cross the Woreda, the soil type and character and the land structure and etc.

3.1.2.1 Relief

The dominant land feature in LemoWoreda is gentle slope and some hills are found like Damala hill,, kubaegahill ,jawe hill,goratume hill and omoshora hill. From this the highest peak is 2752m and the lowest 1946 above sea level. Other parts characterized by plain areas. There is little portion of ups and downs in western, eastern, north eastern, southern edges of the Woreda. The modest conclusion of the land expells in LemoWoreda suggests that the land features of plain land or gentle slope takes 35%, hills 45% and rugged land constitute the total area of 20%The gentle slope is not good land feature for agricultural production. This feature is not disposed for erosion and the subsequent reduction in organic minerals from the soil and it reduced in its productivity from time to time. Agro ecologically the woreda was 76 % covers woina-dega and moderately rising and falling land and 24% is dega or high

altitude areas . Currently, there is a growing usage the rugged land for the shortage of arable (agricultural) land.

The tendency to use rugged land is resulted from high population growth. The plots hold by households has now become insufficient to be shared among themselves to Brings and as a result new generation began to plough mountainous and some grazing lands. Plough over the rugged land is a tire some activity. Farmers use different sort of terraces to prevent soil degradation as result of erosion. There are considerable cases that indicate devastation products of before maturity because or high erosion. Plough or tilling over rugged land is time consuming and costly as compared to plough in plain areas. please see Figure 2 bellow.

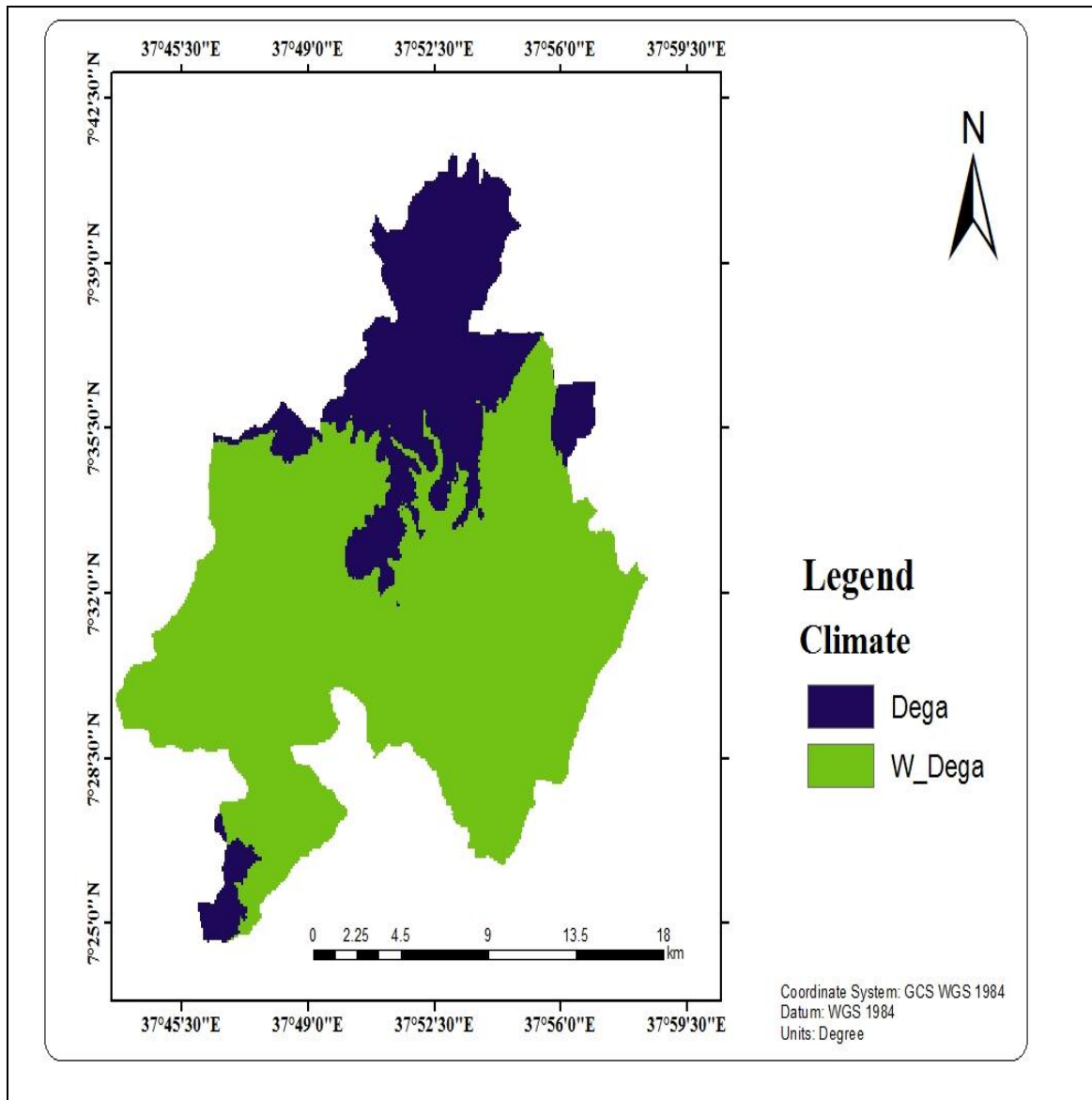


Source computed by author from ARK GIS 10.

Figure 3 Relief and Natural Resource of Lemo woreda

3.1.2.2 Agro-Ecological Zones

The topography of Lemo woreda contains two main traditional divisions; woinadega (1946-2300 meters above sea level) with relatively moderated rainfall and temperature, and Dega (2400-2752 meters above sea level) highlands with somewhat higher rainfall and cool temperature. (see fig 3 at below).



Source computed by author from ARK GIS 10.3

Figure 4 Agro-ecological Zones and Climate condition of the lemo woreda

3.1.2.3 Climate Condition Of The Woreda

The climate condition of the region is direct reflection of its altitude. The four climatic periods i.e. autumn, spring, winter and summer with the average unequal Number of months that characterize in Lemo Woreda. The table1 below indicates the months and the climatic periods.

Table 1: Seasonal division of lemo woreda

No	Climatic period	Months
1	Autumn (Qarraaxxo)	March-May
2	Winter (Bile)	December-February
3	Spring (Fiitte and so'o muura)	October –November
4	Summer (haagayye)	June-September

Source Lemo woreda Bureaus of agricultural and Finance and Economic Development, 2010

Based on above Table 1 Climate /seasonal division of The woreda recorded annual mean temperature of the region ranges from 15.1 - 20 °c and The highest rainfall in the region occurs during summer season which starts in the beginning of June and ends up in the end September. Rainfall distribution in the region is characterized by high temporal and spatial variability with annual precipitation ranging from 700-1226 mm (Ethiopian National Meteorology Agency, 2007). Rainfall, temperature, wind, humidity and sunshine are some of climatic elements which affect socio-economic activity and life condition of the people in a given spatial units.

In the agrarian society, changes in above climatic elements have impact on the agricultural production. Particularly changes in temperature and precipitation directly affect crop production and can even alter the distribution of agro-ecological zones. Woreda receives mean annual rainfall of about 1200 mm. The Woreda receive rain in three seasons such as Belg (autumn) season (March to May) and summer (kiramit) season (June to august). Spring (tseday) season (September to November) Bega (winter) season (December - February) is the driest season in the area. In the Woreda the highest rainfall amounts recorded in months of august, September and October and the lowest amount recorded in months of January and February.

Temperature is other climatic elements which influence agricultural activity. Similar to rainfall temperature also shows spatial variation. The temperature data from 1985-2017 indicates that the higher monthly mean maximum temperature was recorded in the Woreda during month of December to February where as the lowest monthly mean minimum temperature recorded during months of December and January. In these years (1985-2017) the recorded average mean maximum, minimum and average temperature were 26.2 0c, 21.01 0c and 24.1 0c, respectively. See the following table 2 and figure 4.

Table 2 maximum, minimum and Average Temperature of Lemo Woreda (1985-2017)

year	maximum, minimum and Average		
	Temperature in C ^o in five year interval		
	max	Min	average
1985-1989	24.9	21.5	23.7
1990-1994	25.9	21.5	23.6
1995-1999	26.8	23.1	24.3
2000-2004	26.5	22.3	24.4
2005-2009	26.8	22.3	24.6
2010-2017	26.5	15.4	24.2

Source: Computed by Author from NMA data

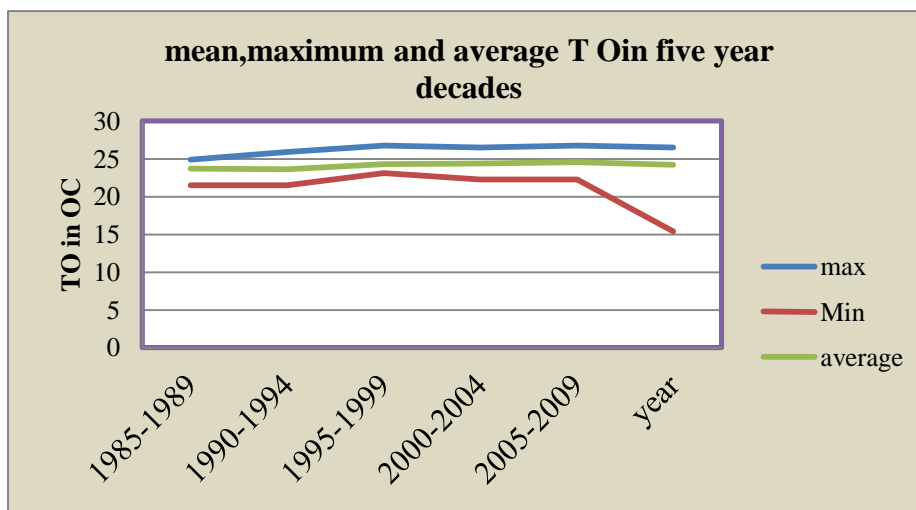


Figure 5 mean maximum, minimum and Average Temperature of Lemo Woreda (1985-2017)

Source: Computed by Author from NMA data

According to Lemo Woreda rural and agricultural office information, the average annual rainfall ranges between 700-1260mm, while is suitable for the production of cereal crops. The distribution of the rain is intensive where rainfall distribution is concentrated in summer i.e. between June-sep; relative good in Belg (March-May) and light for the rest of months. The limit condition in general and the rainfall in particular are highly changing. They are extremely becoming drier. These days the spring months are becoming drier to the extent of no variation with the winter. And as result of this, farmers suffer to reduce spring vegetables and crops such as potato, maize, cabbage, some of which are products of both winter and spring seasons.

3. 1.2.4 Land use and land cover pattern

According to CSA 1994 data the total land coverage in the woreda is 382 sq km .from this the below table 3 indicate land use land coverage. In table 3 cultivated land is dominant land use in areas of high population density followed by degraded and forest land .grazing land is the list one. The natural forest resource of the region is overexploited and covers only about 22.3% of the total land area. According to woreda Bureaus of agricultural and Finance and Economic Development, 2010 Report the woreda has 34973 hectares .among that the below table show their division of the land on the bases of their uses. Please see it.

Table 3: Agricultural land use in hectare

Agricultural Land use	In hectare	Percent (%)
Cultivated land	25218	72.1
To be Cultivated land	349	1.0
Miscellaneous land	859	2.3
Natural forest	519	1.5
Forest land	1559	4.5
Perennial	3744	10.7
Grass land	1079	3.1
Community forest	240	0.7
Private land	800	2.3
Institution	606	1.3
Total	34973	100

Source Computed by researcher data collected from (Lemo woreda Bureaus of agricultural and Finance and Economic Development, 2010)

3.2 Method of Data Collection

3. 2.1 Research Design:

This research is employed descriptive survey method_ As a result; it employed a combination of various methods of data collection to obtain both quantitative and qualitative types of data. And The researcher has used of both the qualitative and quantitative approaches. The mixing of the two is expected to enhance the overall strength of the study. To put it in a specific form, social survey design (cross sectional) was used as a research design and both qualitative and quantitative data collection method were employed.

Household survey, key informant interviews, focus group discussions and field observation methods were employed to collect primary data Moreover; narration was extracted from

focus group discussions and key informant interviews. The primary data were complemented with a review of secondary sources as triangulation of data sources has a number of advantages that no single data could have. Thus the rationale behind using a combination of various data sources and methods was just to overcome the limitation of one by another.

3.2.2 Sample and Sample Size

As mentioned earlier, selection of the district was based on the past record of food insecurity incidences. Study was conducted in three agro-ecological zones in which one representative kebele was selected for each ecological zone. Selection of the kebeles from each agro-ecological zone was done by using a district map in collaboration with district authorities that are familiar with location of the villages in the district. The population number and list of households for each village were obtained from the kebele register. Also the data analysis was taken by collecting information's regarding some, as far as possible, representative items, called the samples.

Lemo woreda have 35 kebeles. Using stratified random sampling technique, the 28 kebeles were stratified into two agro ecologic climatic zones that is moist woyna dega and dry woyinadaga seven (7) Keble's encompassing dega (taken one from each agro-ecology). Dry woynadega, weynadega, and dega. Digiba and Lisana qusa are selected from the moist and Dry woynadega (low lands) respectively and Anabalesa were from the dega (highland). Woynadega agro-ecology were selected for detailed of status of food security and roles of different factors so as to identify the predictions. In order to their importance three kebeles were selected randomly. Each kebele was shared proportionate sample size (probability proportion) based on their number of household. Accordingly, there are 1728 household heads are the members of three kebeles. Then to get the population proportion sample I use the following mathematical formula.

In Digiba kebele where 580 household heads then

$$\frac{580 \times 173}{1728} = 58$$

In Anabalesa kebele where 539

$$\frac{539 \times 173}{1728} 53.9$$

$$\sim 54$$

And In Lisana qusa kebele where 609

$$\frac{609 \times 173}{1728} = 60.9$$

~61 Household heads

In other way to get male and female household heads proportion I use the following mathematical formula

In Digiba kebele where 460 male household heads then

$$\frac{460 \times 173}{1728} = 46$$

In Digiba kebele where 120 female household heads then

$$\frac{120 \times 173}{1728} = 12$$

In Anabalesa kebele where 340 male household heads then

$$\frac{340 \times 173}{1728} = 34$$

In Anabalesa kebele where 199 female household heads then

$$\frac{199 \times 173}{1728} = 19.9 \sim 20 \text{ female household heads}$$

In Lisana qusa kebele where 360 male household heads then

$$\frac{360 \times 173}{1728} = 36$$

In Lisana qusa kebele where 249 female household heads then

$$\frac{249 \times 173}{1728} = 24.9 \sim 25 \text{ Female household heads}$$

In general from Digiba Anabales And Lisana qusa 58, 54 and 61 household heads were selected. Respectively for proportionate sample size . The table 4 refers full information about sample size

Table 4 population size by Sample kebele

Sample kebele	Elevation in (m)	Sample Households from each kebele			proportionate sample size from each kebele		
		MHH	FHH	Total	M	F	T
Digiba	1500-2500	465	115	580	36	22	58
Anabalesa	2500-3000	340	199	539	34	20	54
Lisana qusa	1500-2500	360	249	609	36	25	61
Total		1165	565	1728	106	67	173

Source computed by author from Lemo woreda.

For key informant interviews, six household heads (HHs) were selected (5(Five) HHs from each kebele). The purpose of the interview was to explore climate change/variability and its impacts, and their responses. Interview was also held with experts: five government officials from Woreda and two from zone representative in order to get relevant and reliable information. In addition to these, two group discussions consisting of 10 each from Digiba and Anabalesa 20 persons from Lisana qusa (one FGD from each agro-ecology) were conducted. One group discussion consisting 10 individuals was conducted at Kola Kebele and the second group discussion was conducted .The individuals who were participated the FGD.

3.2.3 Data Sources

The required input data for this study were generated from both primary and secondary sources. Primary sources include the administering of questionnaires to four groups of selected interviewees (sample households, key informants and FGD members).On the other hand, secondary data were generated by reviewing different relevant literature from books, research works, journals, published and unpublished documents, different activity reports from government and non-government institutions, and available rainfall and temperature records of NMA, maps ArcGis 10.3 and CSA.

3.2.4 Household Survey

A total of 173 households was interviewed using a structured- interview-questionnaire designed by the researcher. Primary data were obtained through structured and semi-structured questionnaires administered to various respondents. A structured survey questionnaire was used to gather primary household data at the village level. Primary data was also generated by interviewing local extension agents. In addition, direct field observations and a number of informal discussions with village elders, farmers groups, and

extension workers were conducted to cross-check and verify additional some information of interest to this study and the sample households were eligible to conduct the interview.

3.2.5 Focus Croup Discussion

To get access to valuable qualitative information with regard to the views of community, public work out puts, gender aspects in the public works and accessibility of package loans focus group discussions were held. Accordingly, the focus groups were formed in each sample kebeles. As such each focus group had from 10-20 participants in order to make the discussion manageable. Thus, a total of three focus group discussions were organized and conducted in the three selected study kebeles. The information obtained through this method often complemented the data collected through household survey & key informants' interview. Check lists were prepared for both focus group and key informants. Please see the following figure 6

Figure 6 Focus group Discussion



Source, field survey2019

3.2. Key Informant Interview

Interviews with selected key informants were another mechanism employed to obtain primary data. *It* was, used in order to overcome the limitations of household survey focus group discussion in addressing in- depth analysis of the issue under study. Interview with members of the food security ask fore at woreda and kebele level including DA's. Community leaders, and concerned officers from WARDO and other sect oral offices as required were purposely selected and interviewed. To this end, un structured-interview-guide was designed and administered by the researcher taking the respective role responsibility of each interview in consideration.



Source ,field survey2019

Figure 7 Key Informant Interview

3.2.7 Field Observation

The researcher will be employed a field observation to get some insights on activities related to the public works projects and status of the community assets created by the different projects. Here the researcher will attempted to draw partner's sense out of his own systematic and critical observation made during the field study. Accordingly, the information generated from field observation were presented and analyzed along with the rest of the data.

3.2.8 Sources Secondary data

Indication to the primary data sources, the study will be attempted to incorporate several secondary data sources related to the topic under review. These include official documents, photos, census data from statistical reports (CSA) data from NAMA, and PSNP progress reports found at the woreda and kebele level. Besides the research in context a reasonable size of scholarly literatures and empirical research works dealing with theme at hand were critically reviewed.

3.2.9 Data analysis

In this study both qualitative and quantitative tools of data was used to analysis were employed. The collected survey questionnaire was coded and entered into the computer for completion and analysis. Following this, SPSS used for the analysis of quantitative data collected through the survey. Finally, the result of the analysis were summarized and presented using simple statistical techniques such as tables and figures. The data obtained through open-ended interview-questionnaires, focus group discussions, key informant interviews and field observation were analyzed and discussed in qualitative manner.

RESULTS AND DISCUSSIONS

This chapter presents the findings of the study based on the data obtained on various fact of the sampled households, and historical rainfall and temperature records of the Lemo woreda. Five main subsections are discussed under this main chapter. The first subsection deals with the demographic and socio-economic profile of the sampled household that it linked with food security status of respondent. The second subsection is about the pattern/trends of local climate (The annual and seasonal rainfall, and temperature trends) and moisture condition of the study area are discussed in fact The Third sub-section is relating to perception of households on the causes of local climate variability/change impact on the production of crops and livestock and the general impact of climate variability/change on the food security of the study area is discussed. The Fourth sub-section is identifying the households food security status using HFBM and HFIAS, and also food utilization aspect of households is treated under this section. The Fifth subsection of the data analysis part discusses about the households' adaptation to climate variability/change and the major constraints of the adaptation strategies in the study area.

4.1 Demographic and Socioeconomic Profiles

4.1.1 Profile of the respondents house hold

In line with this research study shows the characteristics presented in this study were responses from household members from three Kebeles of Lemo Woreda. greater part of respondents were male (male headed HHs), constituting male account for 106 that holds 61.3% and female account for 67 that holds 38.7 respondents and female (female headed HHs) see (table 5). This means the livelihood out of the total respondents, greatest portion is covered by males and almost all were depend on crop production and mixed farming, (i.e., crop and livestock production), were based on others means of livelihoods like petty trade , daily labor and the majority of the respondents (94.6%) have depend on only crop production and mixed farming no additional income sources.

The remain 5.4% have additional income sources in which got additional income from trade, causal labor, foreign support and employee. On the other hand the Age is sensible from my sample size population. Most of the respondents were married and divorced that 76.9 % respondents account between 15 and 65 years, this figure shows the researcher get more important information about food problems from the productive age. Also the other age group

of respondents in the range 65 and above 65years old account for 23.1% they give more relevant information about the climate and food related problems.

The overall number of children in a family 51.4% and 34 % was accounts between in the range of 6-9 and 3-6 respectively .This indicate the highest percent of population is live in the worada and was doubled from time to time and the average family size was

The level of education years of schooling) of a rural household plays an important role in improving the productivity (both at individual and community level) by equipping people with the skills and knowledge to actively participate in the economic endeavors of the society, and in promoting entrepreneurship (Phillips 1994), In line with this research study shows the characteristics presented in this study were responses from household members from three Kebeles of Lemo Woreda. Regarding to education level the majority of the respondents had attained in no schooling . Among the respondents 74.6% were illiterate (not writing and reading) whereas, Regarding to Agro ecology from Dega 55 respondents accounts 31.8 % from woyina daga 58 respondents accounts 33.5 % from dry woinadaga 60 respondents accounts 34.7% are participated in my interview. see to all explanations in table 5.

Table 5, Characteristic of the household survey respondents

Characteristics		Number of households	Percent
gender of house hold	male	106	61.3
	Female	67	38.7
	Total	173	100
Ageof households	15-65	133	76.9
	>65	40	23.1
	Total	173	100
Educational status	no schooling	129	74.6
	Primary school	28	16.2
	Secondary school	16	9.2
	Total	173	100
Religion	orthodocs	25	14.5
	Muslim	34	19.7
	Protestant	114	65.9
	Total	173	100
Monthly income	< 500birr	116	67.1
	500-1500 birr	42	24.3
	1500-2500birr	15	8.7
	Total	173	100

Source, field survey2019

4.2 Metrological analysis of the lemo woreda

4.2.1 Assessing the trend analysis of CV and change situation of the study area

4.2.1. 1 Trends of temperature and rainfall

Trends of temperature and rainfall as to establish the change/variability of climate and moisture conditions in the area .The researcher planned to detect at climate change (temperature and rainfall) in addition to climate variability. The 33 years rainfall and temperature data was taken from NMA to see the climate variability and change in rainfall and temperature pattern interested to take data from durame, fonko, gimibichu and hosanna but the data from 1985-2017 was not fully recorded (no reliable data of temperature and rainfall in durame,fonko and gimibichu). To identify the second variable that climate change, the temperature data is not found in the durame,fonko and gimibichu meteorological station.

.Due to this throughout this presentation the researcher distinguish the variability and change of rainfall based on from hosanna meteorological station .Thus, I took the temperature and rain fall data of hosanna meteorological station was part of Lemoworeda that all administrative office of lemo wordas are located in Hadiya zone and it is very close and has similar natural condition, that its data of 33 years from 1985-2017. Therefore, both Rainfall and Temperature data were computed to see the variability throughout the discussion. And the presentation below considers Hosanna Meteorological station to represent the highlands and lowlands temperature condition of the study area respectively .The elevation of Hosanna Meteorological station is 2750 above sea level. Therefore, using the Hosanna Meteorological station data was used to represent my study area and It is fitting due to the reason given above of course with some limitations that missed data in a station used by taking average.

Table 6: Responses about climate variability/change from respondents

Variables	Respondents	Number of households	(%)
Is climate variability over 30 years in your locally ?	Yes it is occurred	104	60.1
	No it is not occurred	69	39.9
pattern of climate change in Temperature	Increase	77	44.5
	Extremely decrease	12	6.9
	No change	57	32.9
Fluctuation of rainfall	No idea	27	15.6
	Increase	67	34
	Extremely decrease	58	33.5
	No change	40	28.3
Drought	No idea	8	3.1
	Increase	75	43.4
Change of length in belg	Extremely increase	12	6.9
	Increase	173	100
Change of length in kiramit	Increase	77	44.5
	decrease	96	55.5
	Total	173	100
Frost	Increase	173	100
Wind	Extremely increase	173	100
Moisture	Increase	92	53.2
	Extremely increase	53	30.6
	Decrease	22	12.7
	Extremely decrease	6	3.5
	Total	173	100

Source, Field survey2019

In table 6 reveals the responses of households about the temperature variability in the study area indicates that varied from time to time. Also on the base of question climate variability/change over 30 years about 60.1% respondents were yes and 39.9% No .this indicate the trend of climate variability/change within 30 years is occurred and the life of Households is varied from time to time. on other hand in above table the opinion is clearly

refers on the base of the pattern of climate change of temperature , snow fall , change of length in belig, change of length in kiramit , drought, wind and moisture is increase from time to time .all the respondents agrees that change of length in belg is increase and on the base of the change of length in kiramit increase 44.5% decrease55.5% this indicate the variation of this variable change the situation of food stability in the life of all households. The researcher also tried to see the trend of temperature with data obtained from national meteorological agency Hosanna station. Accordingly, the seasonal maximum, minimum and average temperature distributions are shown in detail as follows.

4.2.1.2 Temperature trend analysis of lemo woreda

Table 7 Maximum, Minimum and average Seasonal Temperature trend by Decades, 1985-2019

year	Seasonal max,min ,average Temperature in °C											
	Kiramit(haggayye)			Tsedal(fiitte)			Bega(bille)			Belig (qaraxxo)		
	Jun-Aug			Sep-Nov			Dec-Feb			Mar-May		
	max	min	aver	max	min	aver	max	min	aver	max	min	ave
1985-1989	21.1	18.2	19.5	24	5.1	20	24.9	21.5	23.7	25.8	21.1	23.1
1990-1994	21.6	18.2	19.6	23.7	20	22	25.9	21.5	23.6	26.2	22.2	23.6
1995-1999	22.1	18.7	19.9	24.6	20.9	22.2	26.8	23.1	24.3	27.3	21.7	23.8
2000-2004	21.6	18.9	20	24.6	20.9	22.5	26.5	22.3	24.4	25.9	22.1	23.9
2005-2009	23.3	19.2	20.7	23.8	20.9	22.2	26.8	22.3	24.6	26.9	22.7	24.7
2010-2017	23.4	18.7	20.8	24.6	20.9	22.6	26.5	15.4	24.2	27	22.7	24.4

Source: that Computed based on the raw data obtained from NMA

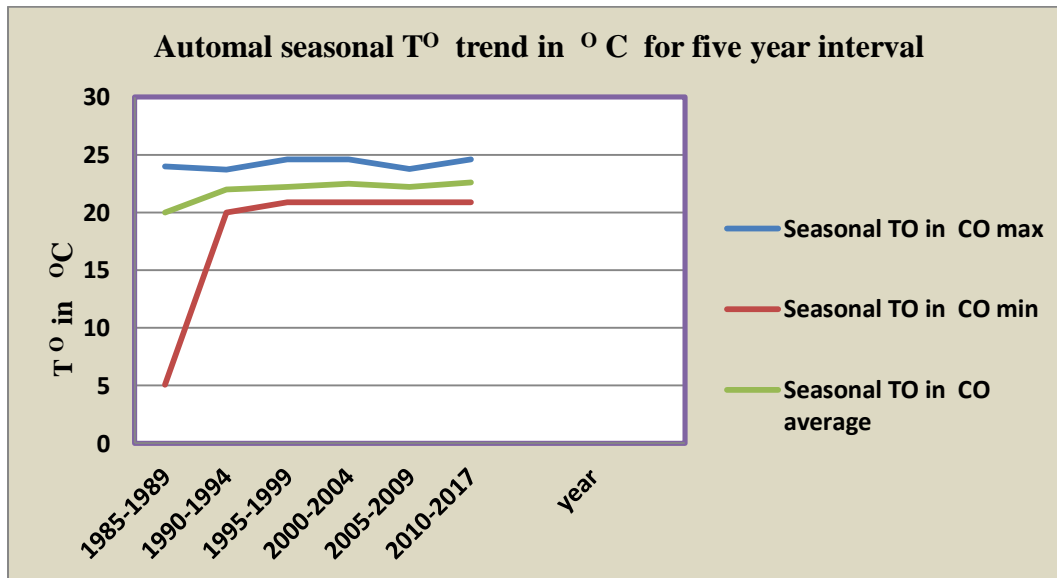
In table 7 computed that Seasonal temperature max 27.3 in 1995-1999, min 5 in 1985-1989, average 23.9 from 1985-2017 trend of temperature in °C is that increasing from year to year in the Lemo woreda. The seasonal maximum temperature recorded in 1995-1999 March 27.3 0c and in 2005-2017 February 26.8 0c and the seasonal minimum temperature recorded in 1985-1989 and 1990-1994 2.2 in year. this indicate the Temperature was varied within five and ten years .it is also recycled and fluctuated in autumn season .it affect the general situation on winter season climatic condition and finally declining the spring crop production situation and loss of expected yield in the area.

4.2.1.3 Seasonal temperature trend analyses of Lemo woreda

Table 8, Autumn/tuesday temperature trend

year	Autumn Seasonal T ^o in °C		
	max	min	average
1985-1989	24	5.1	20
1990-1994	23.7	20	22
1995-1999	24.6	20.9	22.2
2000-2004	24.6	20.9	22.5
2005-2009	23.8	20.9	22.2
2010-2017	24.6	20.9	22.6

Source: that Computed based on the raw data obtained from NMA



Source: that Computed based on the raw data obtained from NMA

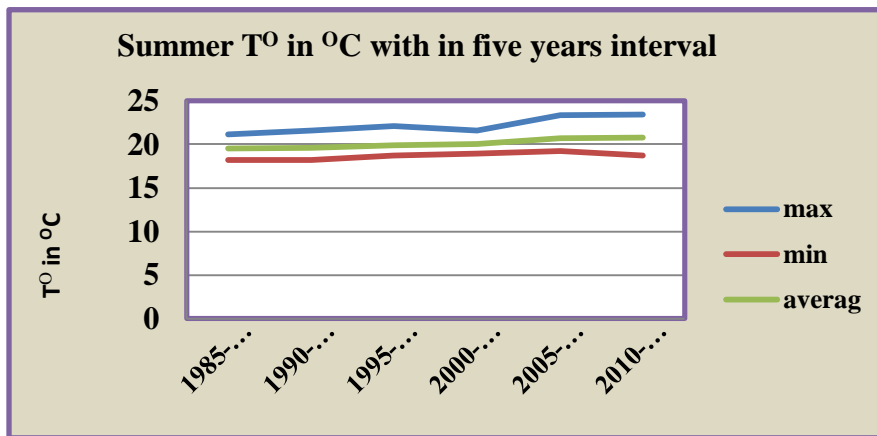
Figure 8, autumn temperature trend

The autumn temperature trend analyses of Lemo woreda indicates the maximum temperature of autumn season was 24.60c was occurred from year 1995-2004, and its minimum temperature recorded 20.0 0c in year 1990-1994. Generally, as the study objective is to identify causes of climate variability trend and to assess the impact of climate variability on food security, the temperature fluctuation is a main cause to low yield and it results to minimize the yield and occurred food insecurity in the study area. These study also brief with (Balcha, 2001) states as extremely high temperature in the low lands affect agricultural productivity and food security.

Table 9 Summer seasonal temperature trend

year	Summer seasonal T ^o trend in °C		
	max	min	averag
1985-1989	21.1	18.2	19.5
1990-1994	21.6	18.2	19.6
1995-1999	22.1	18.7	19.9
2000-2004	21.6	18.9	20.0
2005-2009	23.3	19.2	20.7
2010-2017	23.4	18.7	20.8

Source ,:That Computed based on the raw data obtained from NMA



Source ,:That Computed based on the raw data obtained from NMA

Figure 9,summer temperature pattern

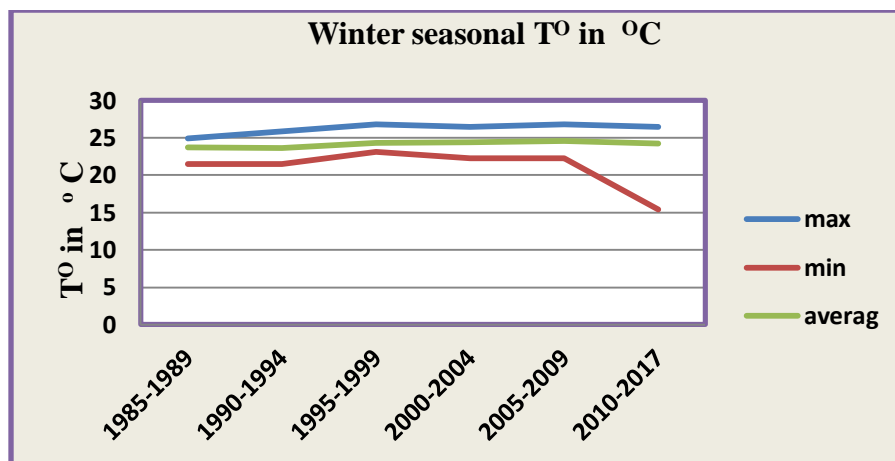
The maximum temperature of summer season was 23.4 0c in 2010-2017 and its minimum temperature recorded was 18.20c from 1985-1994. As depicted in figure 9 above it reveal increment of temperature on summer season by0.05,0.02,0.030c and decreasing in 0.05.0c 1990-1994,1995-1999,2000-2004,2005-2009 and 2010-2017 respectively(that means the average temperature was fluctuated from 19.0-20.80c in the same season .

Table 10 Winter temperature trends

Winter temperature trends in °C within five year intervals			
Year	Max	Min	Average
1985-1989	24.9	21.5	23.7
1990-1994	25.9	21.5	23.6
1995-1999	26.8	23.1	24.3
2000-2004	26.5	22.3	24.4
2005-2009	26.8	22.3	24.6
2010-2017	26.5	15.4	24.2

Source: that Computed based on the raw data obtained from NMA

Figure 10 Winter temperature trends



Source: that Computed based on the raw data obtained from NMA

Here the maximum temperature, 26.80c occurred in year 1995-1999 and 2005-2009 and the minimum temperature 15.40c was occurred in 2010-2017. As depicted above in figure 10, it reveals increase of winter season 1.0 0c (that means the average temperature in 1990-1994 was 23.6 0c. in the same season in 2005-2009 was 24.60c, so within these years it revealed increment of 1.0 0c.

“As the one FGD member informed in bega /locally bille season rain fall is expected insufficient. The quantity and quality of animals was decreasing. This is due to the lack of forage and the scarcity of water and the prevalence of animal diseases resulted from increasing temperature variability. Thus, the quality and the quantity of animal product also

deteriorated. The Annual average temperature distribution of the study area was characterized by a general trend of increasing annual variability.”

Table 11 Belg temperature trend.

Year	Belg temperature trend in °C within five years intervals		
	max	min	average
1985-1989	25.8	21.1	23.1
1990-1994	26.2	22.2	23.6
1995-1999	27.3	21.7	23.8
2000-2004	25.9	22.1	23.9
2005-2009	26.9	22.7	24.7
2010-2017	27	22.7	24.4

Source: that Computed based on the raw data obtained from NMA

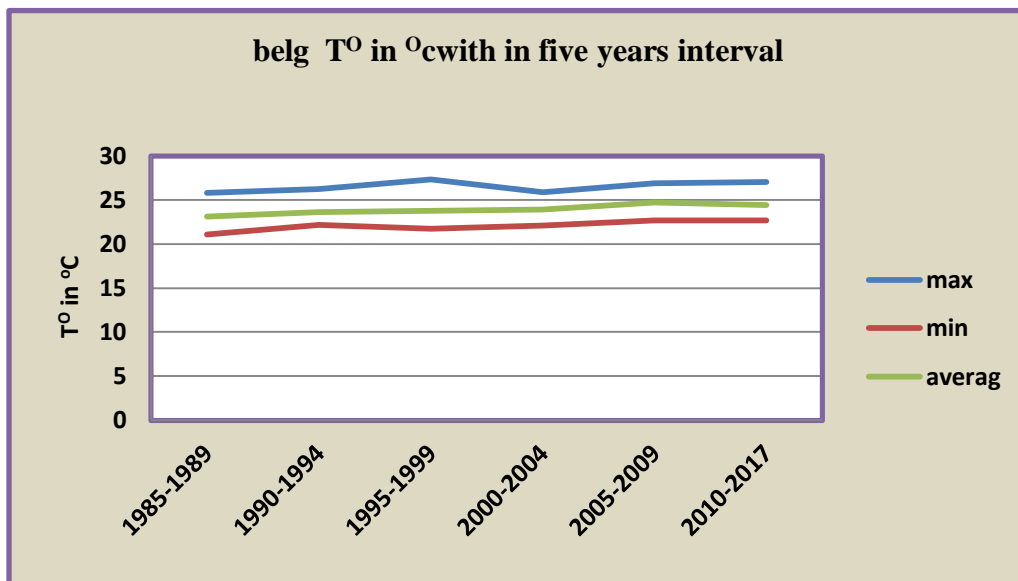


Figure 11 Belg temperature trends

Source: that Computed based on the raw data obtained from NMA

As shown in figure11 above in belg season, general trend of temperature was increased but relatively with decreasing rate. Specifically, the highest temperature recorded was 27.3 0c in 1995-1999. And the lowest temperature was recorded as 21.10c in 1985-1989. So, belg average temperature difference with in 32 years in the study area reveals 6.20c. This season is the main production months particularly maize barley enset and potato in both agro ecological zones to the households as well as a time of good access to livestock fodder in

lemono Woreda but it is drying up with the average increasing of annual and seasonal temperature specially in may.

4.2.1.4 Rainfall: Amounts, trends, variability and seasonal concentration

The long-term (1985-2017) annual average rainfall at Hosanna Meteorological Station (located in Hosanna closer to Lemo Woreda) is computed to be about 1180mm.see table 12and fig 12.

Table 12 Total annual rainfall

Year	TRF	Year	TRF	Year	TRF	Year	TRF	Year	TRF	Year	TRF
1985	981.4	1991	1006.8	1997	1442.5	2003	1124.2	2009	1184.1	2015	527.7
1986	1417.9	1992	1387.2	1998	1556	2004	1121.8	2010	1121.5	2016	1428.6
1987	1280.5	1993	1413.6	1999	1011.3	2005	1179	2011	1094.1	2017	1072.4
1988	1216.2	1994	946.5	2000	991.9	2006	1201.7	2012	981.6		
1989	1199.7	1995	1160.8	2001	1145.5	2007	1098.8	2013	1220		
1990	1058.9	1996	1168.7	2002	1346.4	2008	1202.8	2014	1439.9		

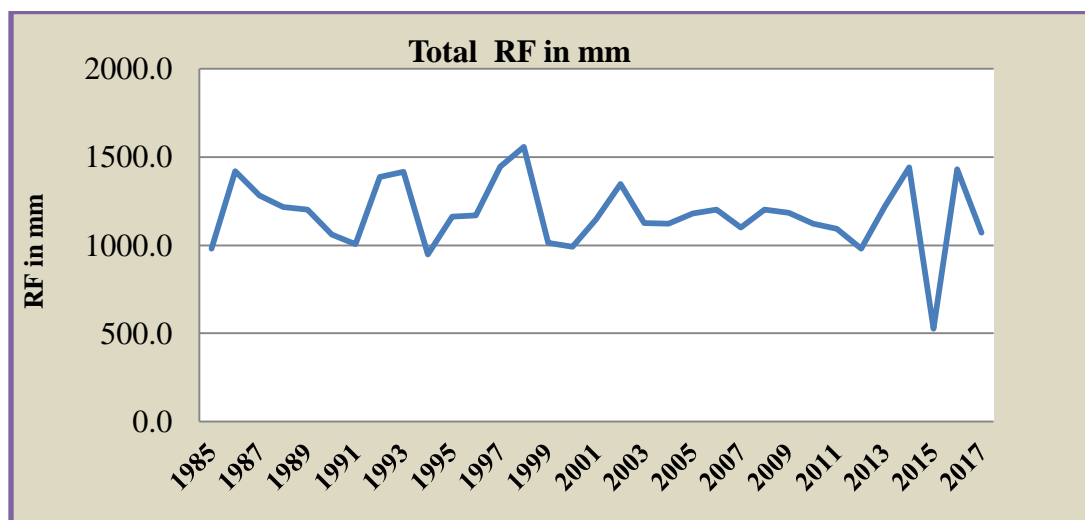
Source: that Computed based on the raw data obtained from NMA

The annual total rainfall is somehow increasing and decreasing over the years in the study area. mostly 1991 up to 2003 was the abnormal years with a total amount rainfall fluctuated. The inconsistent year is 2015when the total annual rainfall was only about 527.7mm The maximum annual amount of rain fall received in1997and1998 accounting for 1447.4mm and 1556.4 respectively. At this stage, one can raise a question in relation to rainfall which is the critical problem in this woreda. The problem is the amount and variability of rain in lowland areas and not the amount rather the sequential variability in highland areas. see the graph bellow.

The other problem of rainfall distribution was more related to the temporal variability or concentration within a few seasons. In other words, the variation in onset and preservation of rainfall should be given a outstanding attention Thus, the months of December, January, February have very small concentration of rainfall, and March, April and May have medium concentration of rainfall (dry) while June, July, August has small amount of rainfall concentration. On the other hand high concentration of rainfall was recorded in the month of September, October and November.

Generally, highland parts of the Woreda receives sufficient amount of total annual rainfall in view of the characteristics of most Ethiopian highlands.

Figure 12 annual rain fall trends



Source: that Computed based on the raw data obtained from NMA

4.2.1.5 Monthly Rainfall Amount Trend and Seasonal Concentration in decades

Monthly rainfall amount trend and seasonal concentration in decades are presented in table 13 in general .see table 13.

Table 13 Total seasonal rainfall

Year	Summer /hagaaye			Tsadel/fiitte			Kiramit /biille			Mehtar/qaraaxxo		
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1985-1989	67.8	420.7	493	760.1	874.4	178	744.5	906.9	780.3	320.8	0.9	1.5
1990-1994	144	385.6	534	641.1	742.9	600	736.8	919.3	635.3	333.8	69.8	71.1
1995-1999	195	143.7	468	848.2	677.6	666	882.8	768.8	789.4	681.6	119	98.9
2000-2004	221	195.6	559	728.7	596.1	558	556.1	992.8	799.1	248.6	57.7	217
2005-2009	110	78.7	549	624	753.3	665	904.9	765.7	756.8	402.9	195	61.4
2010-2017	147	328.9	778	890.7	1358	1077	1276	1180	1155	235.8	257	203

Source: that Computed based on the raw data obtained from NMA

4.2.1.6 Seasonal Rainfall Pattern in lemo Woreda

The total seasonal rainfall and average data was computed on each season and decades are presented in table 14.see table 14.

Table 14 Total seasonal rainfall data in decades.

Year	bille	qaraxxo	hagaye	fitte	average rain fall
1985-1989	2431.7	323.2	980.8	1812.8	1219.5
1990-1994	2291.4	474.7	1063.5	1984	1162.7
1995-1999	2441	899.7	806.5	2191.8	1267.8
2000-2004	2348	523.1	975.5	1882.1	1146
2005-2009	2427.4	659.6	737.7	2323.2	1173.3
2010-2017	3610	696	1253.9	3325.7	1110.7

Source: that Computed based on the raw data obtained from NMA

4.2.1.7 winter rainfall trends

Based on NMA meteorological data that recorded in Hosanna metrological station 2019Bega (locally known as „Bille“) is the driest season which receives a maximum rainfall 3610mm during period 2010-2017and which receives a minimum rainfall 2291.4mm during period 1990-1994. It ranges from 0 .0mm to 299.1mm which indicates variability is very high. For example, in the year 1998, 2006, 2015, and 2017 rainfall was very little computed with the station.

Table 15 Winter rainfall

Year	Kiramit /biille		
	Dec	Jan	Feb
1985-1989	744.5	906.9	780.3
1990-1994	737	919.3	635.3
1995-1999	883	768.8	789.4
2000-2004	556	992.8	799.1
2005-2009	905	765.7	756.8
2010-2017	1276	1180	1155

Source: that Computed based on the raw data obtained from NMA

The scarcity of rain water was cause for the shortage of animals“ forage and water, resulting animal disease. Thus, the quality and the quantity of animal product also deteriorated, even according to lemo woreda agricultural office information in the year 2015 more than 400 animals, particularly cattle were died and highly affected specially in dry woyinadaga areas see fig 13.

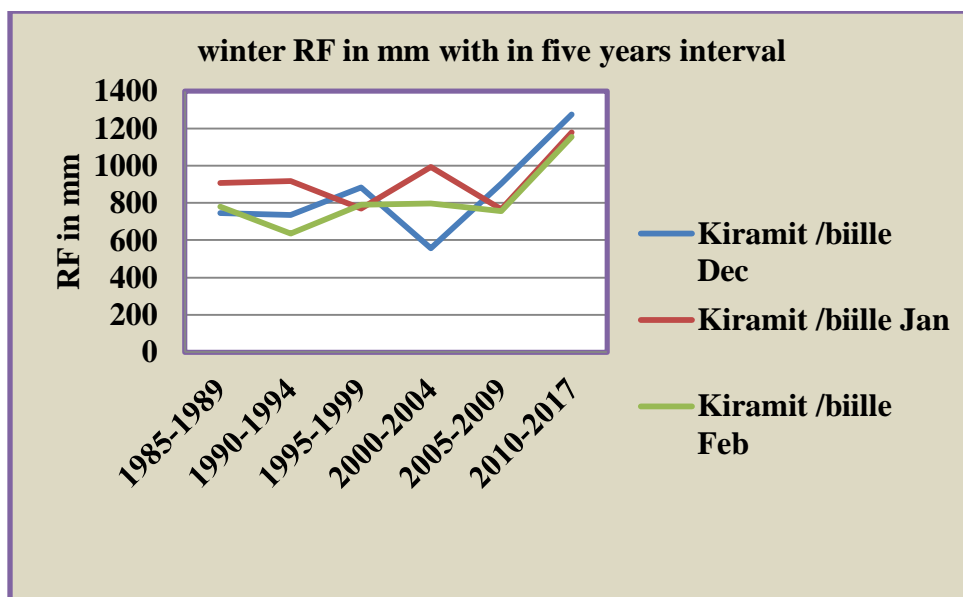


Figure 13 Winter/bega average rainfall pattern

Source: that Computed based on the raw data obtained from NMA

4.2.1.8 Belg rainfall trends

Based on NMA meteorological data that recorded in Hosanna metrological station 2019Belg (locally known as “Qaraaxxo”) rainfall is the crucial but the most variable and which receives a total of 3576.3mm rainfall during the period of1985-2017. As it shown in figure 14 the average 596.05mm and the mean total belg rainfall ranges from 323.2 to 899.7mm which implies variability was increased. For example, in 1985,-1987, 1990, 1994,1995,2002,2011 and 2012 rainfall amount was small. See table 16.

Table 16 Belg rainfall trend.

year	Mehtar/qaraaxxo		
	Mar	Apr	May
1985-1989	321	0.9	177.5
1990-1994	334	69.8	71.1
1995-1999	682	119.2	98.9
2000-2004	249	57.7	216.8
2005-2009	403	195.3	61.4
2010-2017	236	257.4	202.8

Source: Computed based on the raw data obtained from NMA

The highest amount of rainfall was registered in the years 1997, 2004, 2008 and 2009. Sometimes the belg rainfall brings highest or maximum rainfall which may cover the time to seeds with to farmers to prepare and sow their seeds to the next planting season. On the contrary; it may be dry or minimal to prepare the farm and plant crops. Thus, farmers lost their seeds owing to the unreliable nature of belg rainfall. In these season farmers in both agro-ecology produces maize, Berly, potato and other vegetables are produced. There is relatively a good access to forage- livestock got to fed relatively good grasses to revenge the scarcity that occurred in bega season. Also unexpected decreasing rainfall in April that caused many damage on households farm production and their life in the study area.see fig 14

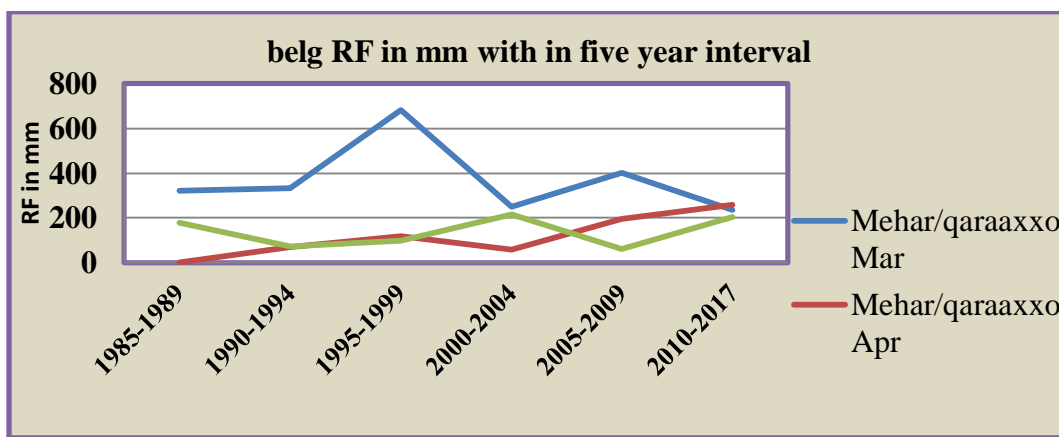


Figure 34. Average belg/spring rainfall pattern

Source: Computed based on the raw data obtained from NMA, 2019.

4.2.1.9 Summer rainfall trends

Based on NMA meteorological data that recorded in Hosanna metrological station 2019As shown in Table 19 summer (locally known as Haggayye“) revealed rainfall abnormal distribution trend generally throughout the season and particularly small amount of rain that received based on time of duration in1985,1988,1991,1995,1999,2000,2008,2009,2015,2016 and 2017 and its amount has shown a range of 187.7 mm in1987 and 188.3mm in 2013.The total rainfall concentration during this season from 1985-2017 is about 5080.2 mm. The effect of flooding devastates the planted crops which are sown during belg and summer rain in both agro-ecological zones of lemo Woreda. However, in the last 32 years unpredictable belgrainfall and the secession of summer (keremt) decreasing rainfall those negatively influence crop production in the woreda. In these season farmers in both agro-ecology produces Teff, Wheat, Bean,Pea,Berly and moist woinadega produces potato and other vegetables. There is relatively a good access to forage- livestock fed. In this season some

adaptation practices and planting trees individually and in different associations took place. the scarcity of expected rainfall in this season that caused many damage on households farm production in the study area. See table 17.

Table 17 summer rainfall

year	Summer/hagaaye		
	Jun	Jul	Aug
1985-1989	67.8	420.7	493
1990-1994	144	385.6	534
1995-1999	195	143.7	467.9
2000-2004	221	195.6	559.4
2005-2009	110	78.7	549.1
2010-2017	147	328.9	778.1

Source: that Computed based on the raw data obtained from NMA

“As the one FGD member informed in bega season rain fall is scanty. The quality of animals was decreasing. This is due to the lack of forage and the scarcity of water and the prevalence of animal diseases resulted from high temperature variability. Thus, the quality and the quantity of animal product also deteriorated, even in the year 2015 more than 200 cattle”s died, particularly larger animals are highly affected (KII &FGD,2016). Annual average temperature distribution of the study area characterized by a general trend of increasing annual variability.see fig 15

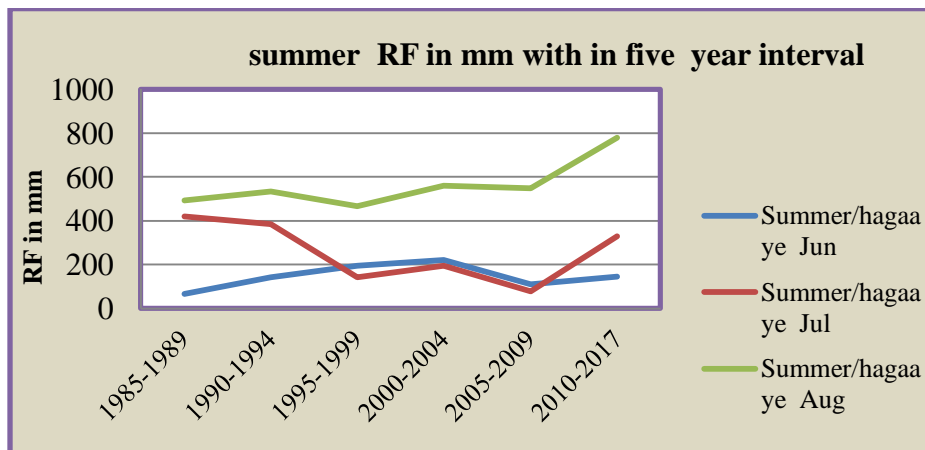


Figure 45. Average summer/keremt rainfall patterns

Source: that Computed based on the raw data obtained from NMA 2019.

4.2.1.10 autumn rainfall trends

Based on NMA meteorological data that recorded in Hosanna metrological station 2019The autumn/tseday (locally known as „Fitte“) rainfall receives minimum 1812.5mm from 1985-1989 and highest 3325.7mm from 2010-2017.It plays significant role in agricultural production. That means the high amount of rain was received in this season and the time is no more need of rain because plants are ready to bear their seeds and almost it is a time of harvesting .However as it is indicated on figure 16 the amount of rainfall has shown fluctuating and high variability trend. If the autumn rainfall becomes heavy, it may devastate the crops which are already to be harvested. See table 18

Table 18 Autumn rainfall

year	Tsadel/fiitte		
	Sep	Oct	Nov
1985-1989	760	874.4	548.8
1990-1994	641	742.9	599.8
1995-1999	848	677.6	666.3
2000-2004	729	596.1	558.2
2005-2009	624	753.3	664.8
2010-2017	891	1358	1077

Source: that Computed based on the raw data obtained from NMA

On the other hand, if the amount of rainfall is scarce in this period particularly in the dry woinadega agro-ecological zone the cropland highly devastate the crops. Rainfall starts at the beginning of March (belg) rain and continue till the end of November (tseday).in the worda. See fig 16.

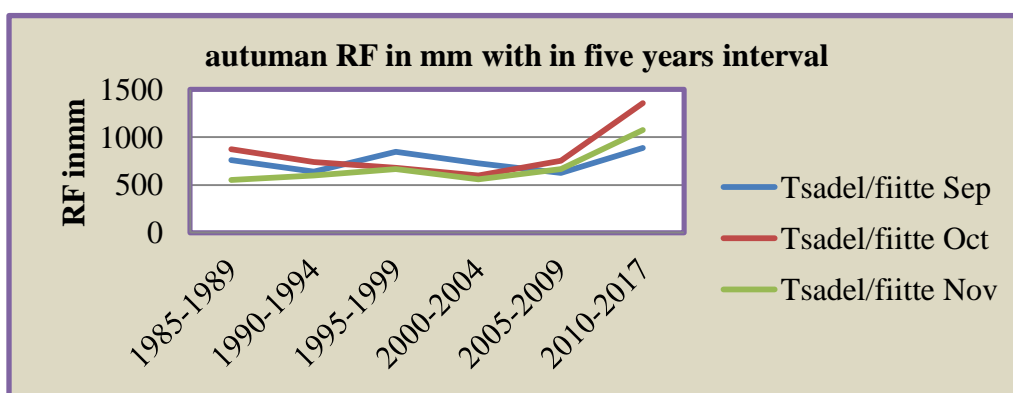


Figure 16 Total Autumn/tsedal rainfall pattern

Source: that Computed based on the raw data obtained from NMA in HMS 2019

4.2.1.11 Pluviometric Coefficient

As shown on the table 16 the precipitation concentration index (PCI) value of lemo Woreda is about 11.03. According to Oliver 1980 as cited in (Woldamlak 2009), value of PCI less than 10 indicate uniform monthly distribution while values between 11 and 20 signify high rainfall concentration and value greater than 20 represents very high concentration of seasonal rainfall distribution. More precisely, (Monkhouse and Wilkinson 1971), using pluviometric coefficient signifies values between 0.6 and 1 show low concentration, values 1 to 2 indicate medium concentration while values 2 to 3 show high concentration and the value greater than 3 represents very high concentration of attribute. Pluviometric coefficient for Averageannual rain fall of Hosanna metrological stationwas calculates any month at a given weather station the ratio of the monthly normal precipitation to one-twelfth of the annual normal precipitation.Seetable 19

Table 19 Computation of PCI value and pluviometric coefficient.

Months	Long-term monthly rain mm(pi)	mean rain fallin	Pi ²	Rainfall coefficient (pluviometric coefficient)
Dec	154.57		23891.8849	0.15457
Jan	167.67		28113.2	0.16767
Feb	148.96		22189.0816	
Mar	67.38		4540.06	0.06738
Apr	21.22		450.2884	0.02122
May	20.18		407.2324	0.02018
Jun	26.8		718.24	0.0268
Jul	47		2209	0.047
Aug	102.45		10496.0025	0.10245
Sep	136.4		18605	0.1364
Oct	151.64		22994.6896	
Nov	113.45		12870.9	0.11345

$$\sum p_i = 1157.72$$

$$(\sum p_i^2) = 13403.1559 \quad (\sum p_i)^2 = 147485.5752$$

$$PCI = 100 * [(\sum p_i^2) / (\sum p_i)^2]$$

$$\sum p_i^2 = 147485.5752$$

$$= 147485.5752 \quad = 13403.1559$$

$$= \underline{11.03}$$

Source computed from NAMA

4.2 Climate change contribution to vulnerability in food insecurity

4.2.1 The causes of climate variability in Lemo woreda

The major causes of climate variability earned in a food insecurity in the lemo woreda is topographic factors and un expected rain fall are the basic problems that responded by respondents and the farmers to perceive cultivated field from their home is near, moderated and far from their home respectively. Also the farmers get the land have currently through kebele allocating, share cropping ,renting how do you perceive the crop production in previous six year was decreasing and which the type of crop that more affected by climate variability is cereals .the effect on crop production is seemed by reducing yield and productivity by crop dieses and pests. The house hold healthy status is sometimes or

occasionally sick the lack of continuously drained drainage pattern leads to none productive thinking in irrigation and lack of any production without rain feed agriculture. please follow it table 20 .

Table 20 Responses about causes of climate variability/change from respondents

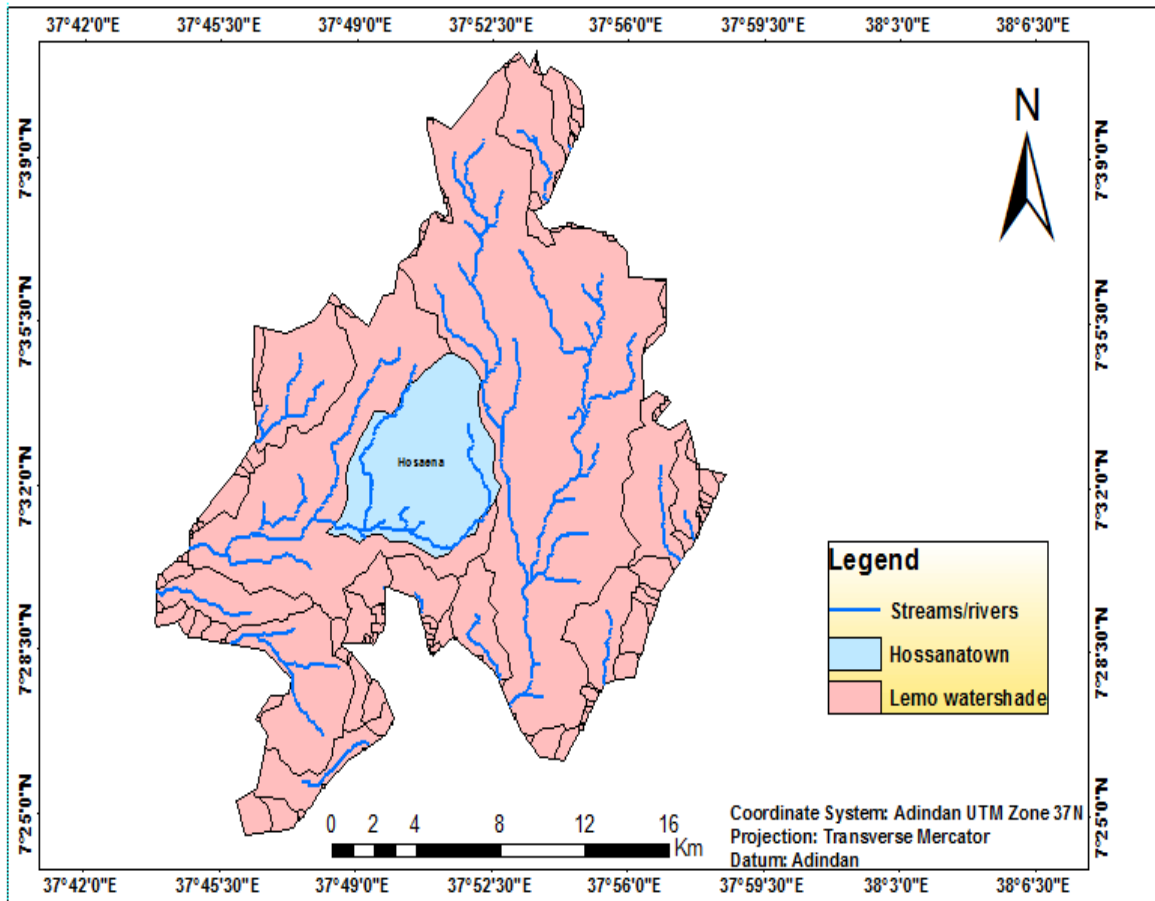
issue	Characteristics	Frequ	Percent
is their cv causes to food	Yes it is	75	43.4
insecurity	No isn't	98	56.6
major causes of climate	topographic	20	11.6
earned problem in	earth quake	4	2.3
a food security	un expected rain fall	4	2.3
	choice 1& 5 are causes	145	83.8
how do you perceive	Near	92	53.2
cultivated field from	Moderate	53	30.6
your home	Far	22	12.7
	Very far	6	3.5
how did you get the	Through renting	38	22
land you have currently	Through share cropping	46	26.6
Production in previous six year	Kebebele allocating	89	51.4
	Decrease	173	100
By climate variability	Cereals	173	100
what are the effect on crop	Reducing productivity	78	45.1
production	and crop yield		
	Crop disease and pests	95	54.9
environmental aspect	NO	8	4.6
how is your house	Fully healthy	21	12.1
hold healthy status	Some times (occasionally	152	87.9
	become) sick		

Source field survey2019

Environmental Sanitation problem results Nutritional problems Food shortage ,Malnutrition& Nutritional problems results Poor access to health care What are the causes of disease in your family mostly? (Put in order of severity) .Do the household get sufficient water for the whole years? 2hr In dry season<1hr During wet season unprotected spring.

4.2.1.1 Drainage

There are two major river streams that include Gombora and Gudar river stream .Gombora River tributaries include river Ajo, Abara, Marduncho and finally flow to Ommo River at the west of lemo worda. And Gudar river streams/ tributaries include river Shilansha, and batena flow to Blate River East of lemo worda. See figure 17.



Source author compute from ARK GIS 10.3

Figure 57 drainage pattern of lemo worda.

Table 21 Responses about water access from respondents

issue	Characteristics	Frequency	Percent
What are the causes of disease in your Family mostly? (Put in order of severity)	Environmental Sanitation problem results Nutritional problems	3	1.7
	Food shortage ,Malnutrition, & Nutritional problems results Poor access to health care	62	35.8
	No idea	108	62.4
Do the household get sufficient Water for the whole years?	yes	25	14.5
	no	148	85.5
From where the house Hold gets water?	unprotected spring	30	17.3
	protected spring	75	43.4
	hand dug well	68	39.3
The walking distance in Time to water source is _hr.	2hr In dry season	63	36.4
	<1hr During wet season	110	63.6

Source field survey 2019

4.2.1.2 Soil Types on the base of agriculture

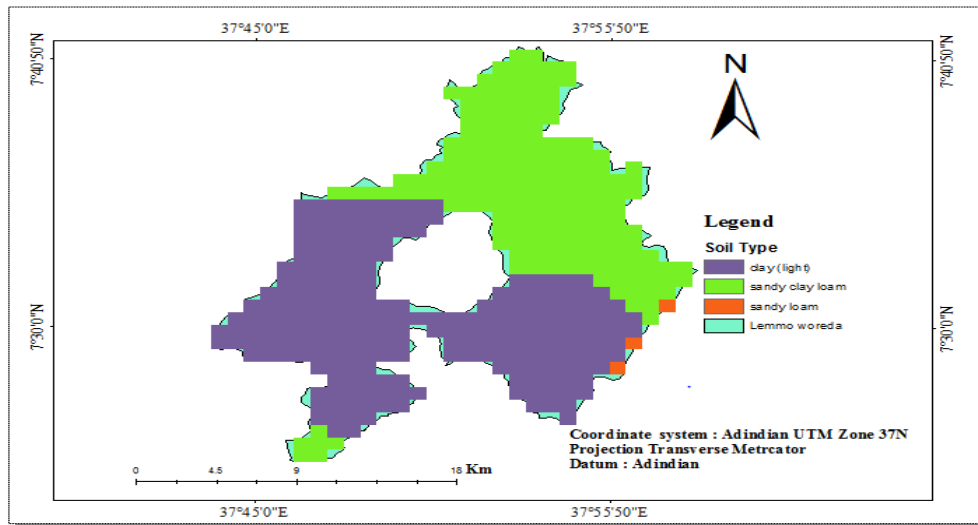
According to <http://soils4teachers.org/physical-properties> the areas where dominated by sandy clay loam and clay soil (see figure 19 below). The types of soil and its characters:

Sandy Loam: Sandy loam soils have a high concentration of sand that gives them a gritty feel. In gardens and lawns, sandy loam soils are capable of quickly draining excess water but cannot hold significant amounts of water or nutrients for your plants. Plants grown in this type of soil will require more frequent irrigation and fertilization.

Clay Loam: A fine-textured soil that breaks into clods or lumps that are hard when dry. When the moist soil is pinched between the thumb and finger, it will form a thin ribbon that will break readily, barely sustaining its own weight where as

Clay: Clay soil is composed of tiny particles that are hard and able to become easily compacted. This compaction makes it difficult to plant or even shovel within the soil. While clay soil can be difficult to work with, it can be beneficial to the growth of certain plants. It is

able to hold onto the roots of plants better and provide a more stable environment than many other types of soil



Source author compute from ARK GIS 10.3

Figure 18 soil types of lemo woreda.

4.2.1.3 Natural Vegetation

Since according to Lemo Woreda agricultural officials, because of high densely population it is difficult to produce a clear description of the vegetation types and their distribution. However, what is clear is that due to the human interaction, the vegetation types had registered significant changes. According to (Eyasu, 2002) In the past, highland areas were dominated by Wanza (*cordial Africana*), Tid (*Juniperus procera*), Weira (*Olea europea*), Bisana (*Croton macro stachys*) and Korch (*Erythrina Abyssinia*) Nowadays, the area is almost bare with little vegetation coverage dominated by eucalyptus tree and above listed. There are only a few remnants of these indigenous forests in some Government and Private Institutions, Church compounds, along banks of stream and in other sacred places access to which is very difficult. The vegetation in the lowlands is naturally dominated by acacia tree, grass and tsetse infested thorny bushes. see the following figures.



Figure 19 Sample Afforested forest tree of Acacia, Eucalyptus tree and thorny bushes in Lemo
Source field survey 2019

Table 22 Responses about climate variability/change factors from respondents

issue	Characteristics	Frequency	Percent
are you vulnerable to cc related problems	Yes of course	117	67.6
	no	56	32.4
what happen to rain fall on set and season 20years	rain fall amount decrease	3	1.7
	rain fall amount increased	4	2.3
	time of onset become late	92	53.2
	choice 1,3,5 are cases	74	42.8
which factor affect your lie based on severity	drought ,shortage of water supply and ,food in adequacy	75	43.4
	shortage animals feed ,poor grazing land, flood and migration	98	56.6
what problem faces climate change	increase and decrease of temperature and fluctuation of rain fall	1	0.6
	drought and disease incidence like malaria	172	99.4

Source field survey 2019

The responses to what happen to rain fall on set and season 20years rain fall amount decrease rain fall amount increased time of onset become late which factor affect your lie based on

severity drought, shortage of water supply and, food inadequacy, shortage of animal feed, poor grazing land, flood and migration. What problem faces climate change: increase and decrease of temperature and fluctuation of rainfall, drought and disease incidence like malaria. The basic problems in the sample kebebles.

4.3 Assessing the impacts of CV/CC on food security in the study area.

The study population involved both beneficiary households from the public works component and direct support component of the program. Hence, the unit of analysis for the study to collect information about the food insecurity in the study area. The existence of climate change in the study area is clearly seen from the analyses done in the above section. This climate change/variation has a range of impacts on physical and socioeconomic conditions including on the food security situation of the area. The degree or severity of climate change impacts depends on the extent and frequency of drought occurred. In this regard, all household survey respondents indicated that a vivid drought occurred and resulted in low agricultural production and productivity.

The interviewed farmers who reported drought in the area within 3-4 years, 5-6 years and 1-2 years account for 70%, 20% and 10%, respectively. The respondents also reported that besides the low agricultural production the drought has been adversely influencing on-farm and off-farm activities, social services like education and health, and some other social affairs. Key informants also explained that as the area has experienced multi climate change induced challenges such as: poor education service and high students' dropouts due to food and water shortage, poor health services deliveries due to lack of water in health institutions, high turnover of teachers and health personnel because of shortage of basic services like potable water in the area.

During FGDs, participants stressed on and raised as unemployment is the other socioeconomic problem of the area. They mentioned as it is common to see groups of people mainly youth sit inactive and chewing "chat". Climate change affected food security in different ways. It affected food production, availability and prices of food items. Almost all HH survey respondents reported, as it affected/reduced food production. Of the HH survey, respondents those who reported increase in food items' price and decline of food items availability in the market due to the climate change were 50% and 20%, respectively.

One of FGDs members stated "our land is fertile, during good season farmers produce different crops like Teff, Wheat, Barley, Chickpea, Pea, Beans Drought resistant crops (maize,

sorghum and enset&soya /beans crops are common. In such seasons, in the area market became full of various food crops, traders from Lemo woreda and other place used to come and purchased our products to resell in other markets. But what always surprises me is that during drought seasons/years when intense crop failure occurred, no enough crops available in local market and no trends of brining food crops from other market to our market. Because of this, we have been forced travel to Lemo woreda or other far markets to buy food crops which exposed us for high costs.’’ In turn food insecurity condition has a number of problems. FGD participants and interviewed farmers have identified some major problems occurred in the area due to food insecurity such as: malnutrition, physical weakness, various human diseases, students’ dropout, migration and human death.

Food insecurity problem has affected all community groups. But the degree of the effect is varies from group to group. As FGDs participants explained and interview respondents reported, children, elders and women are the highly affected groups in order of importance. According to Lemo woreda (RIC) report currently, there are Totaly 9284 M 4708 Female 4576 beneficiary households in 27 selected rural kebeles of the study woreda, which encompasses a total of 35 kebeles. Of which 8255households are under public works component while the rest 1029 are under the direct support component.

The total number of households under the three sample kebeles public works and direct support component of the sample kebeles was 1097. The required sample size for the study was 173. The sample size required for this study was determined by a mathematical method developed by Carvalho (1984). According to him, the proposed sample sizes are determined as low, medium and high for homogeneous, medium and heterogeneous populations, respectively, which are categorizes under specific ranges of a given population. As per Carvalho’s sample size determination table, the size of the survey population of this study (1097) falls under the fifth category (501-1200).

However, despite the presence of significant elements of homogeneity in the survey population, a high sample size (173) was preferred by the researcher, as opposed to carvalho's assumption of low sample size (35) will be on the safer side. Also my sample study areas are purposely included under the 27 kebeles that was indicated in table.23

Table 23 PSNP beneficiaries 27 kebeles of lemo woreda

Name of kebele	Direct beneficiated m	f	Total	Name of kebeles	Direct beneficiated m	f	Total
Ajo taisa	233	182	415	Lereba	82	96	178
Am/gode	114	133	247	Lambuda	154	96	250
Ajo taisa	233	182	415	Lereba	82	96	178
Am/gode	114	133	247	Lisana kusa	313	256	569
Anabalesa	149	130	279	Lisana sena	201	192	393
Ashe/kubaega	140	146	286	Omoshora 1	134	126	260
Ashebuquna	148	146	294	Omoshora 2	149	138	287
dabubbalesa	148	143	291	Sedama	212	214	426
Digiba	120	129	249	Lay kode	271	257	528
Dijodamala	107	102	209	Semen balesa	194	192	386
Dubancho	79	77	156	Shacha oroma	128	117	245
Hayse	101	114	215	Shurmo dacho	167	181	348
G oratume	216	219	435	Shurmo wit bira	125	125	250
Kalish	79	62	141	Tach ambicho	150	147	297
Laygana	159	124	283	Tach kode	201	225	426
Lambuda	154	96	250				
Total	2140	2118	4258		2568	2458	5126
Sub total	4708	4576	9284				

Source Lemo woreda (RIC)2019

4.3.1 Physical Factors;

Crop production was affected by physical, economic and technological factors. The perception /opinions of respondents are shown as following tables.

4.3.1.1 Factors Affecting Crop Production in the study area

Such as unpredictable rainfall, temperature fluctuation erosion/ land degradation was posing major adverse impact than socioeconomic and technological factors. Also from all variables responded by respondents, rainfall fluctuation is serious than others. Generally, when rainfall became insufficient, onset and late or early affected crop production and animals rising of the farmers in the study community rather than other factors. In addition to survey, woreda disaster and risk management also mentioned that the shortage and unpredictable rainfall is

the prominent physical factor that causes the failure of crop production which ultimately results in the chronic food security.

The crop production of barley, potato, maize and groundnut affected by late belg rain fall in all agro ecological zones of the woreda. When, the belg rain terminates early Most of the crops in dry woinadega agro ecological zones are attacked by pests. Moreover, following the less availability of rainfall in bega and belg seasons leads to shortage of animal forage and the prevalence of livestock disease is the other challenge of food security mainly in dry woinadega. Also rainfall terminates; during tuesday season pest infestation occurs and also increasing temperature makes crop species less able to adapt the changing conditions and plants are more susceptible to attacked by pests in august and September months. Following the termination of increasing rainfall in tuesday season was the other physical factor that affects crop production in woinadega and dga agro ecology kebeles.

In general erosion and land degradation is the other natural factor that affects crop production and the challenge of food security. Land degradation indicates that, one or more loss of soil, water, vegetation; cleared air, climate and relief have changed for the worse.

4.3.1.2 Land holding

From the respondents from 173 sample respondents 63 of 36.4% have < 0.5 hec 58 of 33.5% are they have 0.5 hec and 52 of 30.1 % have their 1 hec of their own land and 173 of 100% are agree it was Decreased in crop yield and crop growth computing with the amount of agricultural production before a decade and know a time it was caused by Drought and Expansion of settlement (Pop. Growth). See table 24

Table 24 land use related cases

Issue / perception Variable	Characteristics	Freq	%
Do you have your own land? If yes, how many hectares do you have?	< 0.5 hec	58	33.5
	0.5 hec	63	36.4
	1 hec	52	30.1
How was/is the amount of agricultural production before a decade compared with this time?	Decreased in crop yield d crop growth	173	100.0
How was/is the amount of agricultural production in five years	Declining	173	100.0
How many time you grow crops in year2005/2006	. 2time	173	100.
How do you describe the trend of animal feed?	Declining	173	100.0
If it is declining, why is that?	Drought	91	52.6
	Expansionofsettleme nt (Pop. Growth)	82	47.4

Source field survey 2019

4.3.1.3 Economic Factors

Such as farm land shortage and poor access to chemical fertilizers were, considered as second level factor that affected the households of the study area. Under subsistence agriculture the size of agricultural land determines the amount of production on farm households. As mentioned in table 24 respondents that 36.4% have < 0.5 hectare land 58 respondents that of 33.5% are they have 0.5 hec farm land and 52 respondents that 30.1 % have 1 hec of their own land of the respondents in the sample kebeles reported that they have shortage of land. Where the agricultural products are declining time to time because of lack of Agricultural input, chemical fertilizer improves the fertility of the soil and plays great role to maximize crop production, and however the small size of agricultural land and shortage of necessary agricultural inputs have negative consequences on agricultural production and food security This implies that, the economic status of households were very low to sustain their living condition.

4.3 .1.4 Technological Factor

Here as a variable traditional farming method used and those respondents are affected by lack of modern technological access and information that they were practicing traditional method of farming. Education is fundamental for the implementation and use of proper agricultural inputs including farming system either it is modern or basic.

Generally, it is assumed modern technology with improved seed and use of fertilizer may increase yield production. But, many poor farmers including women headed households were vulnerable due to low purchasing power and labor shortage.

4.3.2 Analysis of Household Food Insecurity

In this part, households' food was analyzed by four pillars or components of food security; which is food availability, access to food, and food stability and food utilization with their indicators because it is a challenge to analyze food insecurity using specific or single indicator. In other words, household food security is multi-dimensional and has complex interaction with various indicators.

Table 24 average wheat annual productions in Lemo Woreda,

Percent Variable	How many quintal of wheat production in Years 2005-/2011											
	2005/06		2006/07		2007/08		2008/09		2009/10		2010/11	
Production in quintal	FR	%	FR	%	FR	%	FRQ	%	FRQ	%	FR	%
	Q		Q		Q						Q	
Nopt			3	1.7	5	2.9					6	3.5
i												
<1			24	13.9	27	15.6	10	5.8	10	5.8	40	23.1
1-3			28	16.2	34	19.7	24	13.9	25	14.5	65	37.6
3-6	91	52.	23	13.3	25	14.5	15	8.7	15	8.7	44	25.4
6-9		6	82	47.	31	17.9	25	14.5	47	27.2	47	27.2
9-12		4			37	21.4	31	17.9	47	27.2	47	27.2
>12					37	21.4	31	17.9	47	27.2	47	27.2
			27	15.6	26	15.0	30	17.3	29	16.8	9	5.2

Source field survey 2019

4.3.2.1 Food Availability and Crop Production in lemo Woreda

To assess food shortage, it is crucial to gather the amount of production of woreda level and of household level. The Woreda Agriculture Office reported the seven years agricultural yield from 2005- 2011 E.C was decreased in quintals. The following Table shows average annual crop productions in lemo Woreda, during seven years with CV.

4.3.2.2 Crop production

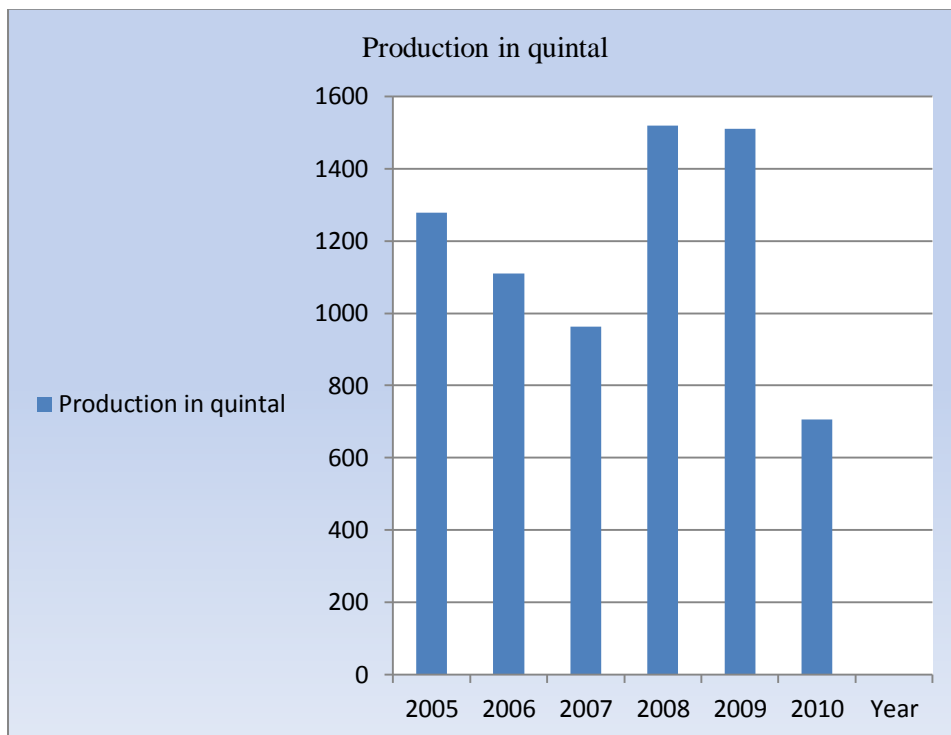
Table 25 indicate that in each year reducing the yield of weat production .this indicate the variation of production refers that the variation of climate induced problems bears decreasing of crop yield in each year. Please see table 26, 27, 28 and fig 20, 21.

Table 25 Sum of wheat production in each year

Year	Production in quintal
2005	1279
2006	1110
2007	963
2008	1519
2009	1510
2010	706

Source field survey 2019

Figure 20 average wheat annual productions in lemo Woreda



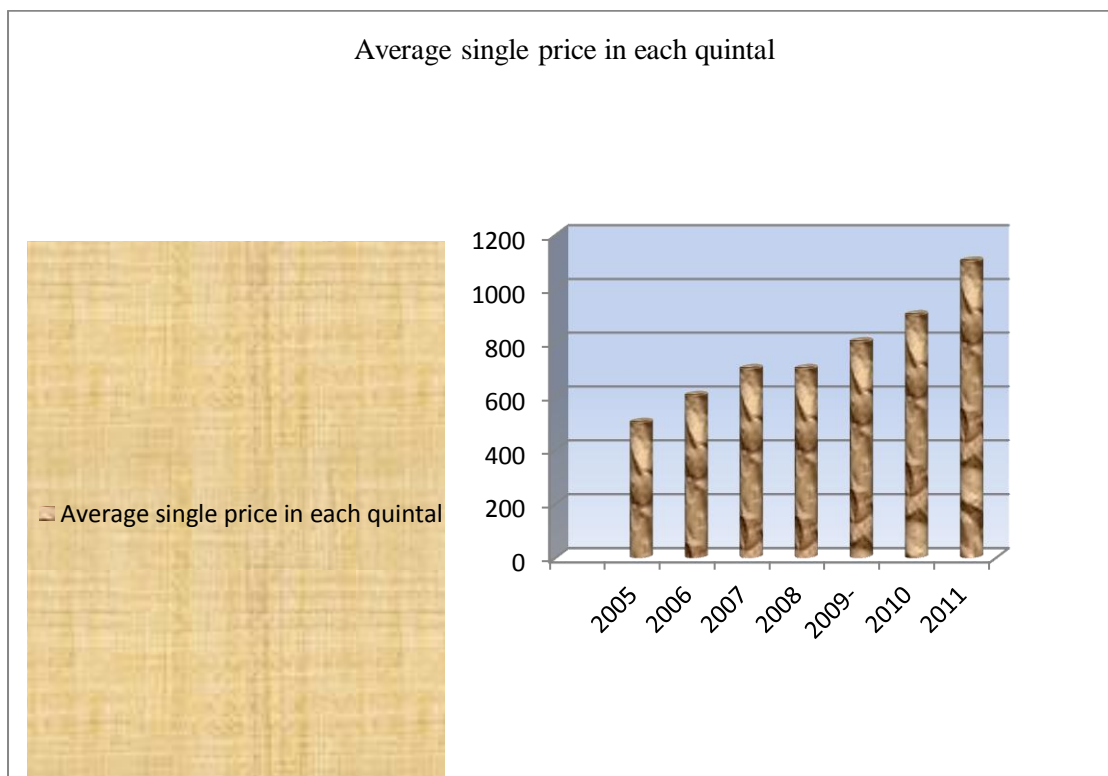
Source field survey 2019

Table 26 average wheat annual single price in lemo Woreda,

Perception Variable	Average single price of wheat in quintal in Years 2005-/2011											
	2005/06		2006/07		2007/08		2008/09		2009/10		2010/11	
Production quintal	FRQ	%	FR	%	FR	%	FRQ	%	FR	%	FR	%
< 500	173	100					2	1				
500							20	12				
600			173	100			3	2				
700					173	100	134	78				
>700							14	8	173	100	173	100
Toa												

Source field survey 2019

Figure 21 average wheat annual single price in lemo Woreda



Source field survey 2019

Table 27 Average total price (Birr) of wheat sold in one quintal in year 2005-/2011Years

Perception Variable Production quintal	Average total price of wheat sold in quintal in year 2005-/2011Years											
	2005/06		2006/07		2007/08		2008/09		2009/10		2010/11	
	FRQ	%	FR	%	FR	%	FRQ	%	FR	%	FR	%
No			3	1.7	5	2.9	8	4.6	10	6	6	4
1000			23	13.4	27	15.6	34	19.7	33	19	38	22
2000	56	32	27	15.7	34	19.7	51	29.5	52	30	65	38
3000	11.7	68	24	14.0	24	13.9	80	46.2	78	45	44	25
>3000			95	55.2	83	48.0					20	12
Total												

Source field survey 2019

In table 28 table that indicate in each year crop production was seriously decrease and the price is rapidly increase in each year .for instance the collecting data from households refer in year 2009 and 2008crop production in yield refer 1510 and 1519 respectively .incase the average single price is raised 700 to 800and again in year 2011 unfortunately the crop yield is decrease and average single price is increase up to1100birr.See table 29

Table 28 Production in quintal and Average single price in each quintal

Year	Production in quintal	Average single price in each quintal
2005	1279	500
2006	1110	600
2007	963	700
2008	1519	700
2009	1510	800
2010	706	900
2011	701	1100

Source field survey 2019

4.3.2.3 Description of Livestock

Access to sale or income from livestock is the other parameters of household either to be food in secure or not. In all kebeles have very low income from their livestock sale .Therefore, if

their agricultural production fluctuates because of the effects of climatic variability and change or the effect of natural disasters, income from livestock could not support their food access. However, comparatively the households in Lisana qusa (dry woinadega) earned better income from livestock than digiba (moist woinadega) and ana balesa in (dega). Thus, such amount of income is not enough to support their life.

However, income from livestock is insufficient because of certain constraints that briefly explained in above. The absence of rainfall during bega season and the unreliable rainfall in belg season makes limited quantity of animals' pasture and drinking water. Moreover, during these seasons animals' diseases also highly affect livestock production. Livestock disease highly devastates in dry agro-climatic zone and particularly in moist woinadega. For example, animal disease likes Abagorba (Muuraato), Abasenga (Ellinchcho), Aftaegir (Xinnxichcho), Lobbaxxa and Anjichcho are locally known cattle disease in both climatic zones. Thus, this constraint leads the sample households to be food insecurity.

Table 29 Livestock trend in the study area

live stock	Type	Average Number before 10 years		Av/ single Price before 10 years	Average Number Now a day		Av/ single Price now a day
		total	Average		total	Average	
Cattle	Oxen	304	1.8	2000	198	1.1	6000
	Cows	252	1.5	6000	162	1	4000
Small	Sheep	190	1.1	400	91	0.5	1100
remnant	Goats	110	0.6	500	101	0.5	1300
Pack	Donkey	320	1.8	1500	220	1.3	4000
animals	& hors						
Poultry		365	2.1	50	420	2.4	180

Source: Own survey, 2019

More importantly, HHs asked to report their livestock both in type and in number that they had before 10 years and this time. In the above Table 30 the researcher asked as, how many of the following livestock did you have before 10 years and nowadays to know its trend. The distribution of livestock is not uniform throughout the household. As respondents, oxen average number before 10 years ago was 1.8 but nowadays its average has decreased to 1.1. Similarly the average numbers of Cow reduced from 1.5 to 1, sheep from 1.1 to 0.5, goat from 0.6 to 0.5, Donkeys horse from 1.8 to 1.3, poultry from 2.1 to 2.4.

On other hand Oxen are the most important one than the other livestock for households, who engaged on crop production. Cow is the second biggest animal next to oxen, because it provides milk and milk products that support in a season of hardship. When both environments compared, dry woinadega (lisana qusa) has relatively better concentration of livestock than digiba (moist woinadega) and anabalesa (dega) of due to relative presence of forage (grasses) and relatively the absence of animal diseases. Before two decades, bee hives is considered as one of the best sources of income but now a day it is rare because of clearing of forests by deforestation and to fill the increasing demand of agricultural land. Donkeys help to petty trade and for the transportation of yields to the market center. It is common more in dry woinadega agro-ecology of the study area.

Generally, the number of livestock has decreased within the previous two decades as 98.7% of respondents even if 1.3% responded as no change at all. Hence, the study result briefly related with the study of WFP (2014) which states as households that rely on rain-fed agriculture as the main source of livelihood, unfavorable climate conditions such as drought can be experienced as a main shock and may well lead to food insecurity.

The Households perception about constraints of livestock raising are Lack of pasture ,Stock disease , Poor stock management and Water scarcity are the major challenges and constraints to livestock rearing in the study area. In second level lack of pasture is also a serious constraint to livestock production. Currently, the number of livestock in each agro-ecological zone has decreased than before a decade. Livestock are highly exposed and attacked by diseases if the long Kermit/bega is occurred and when the late onset belg rainfall starts. Generally, the shortage of rainfall which causes scarce availability of feed and water, and the presence of livestock diseases were the significant problem. Households' perception on the reason to declining animal feed is the expansion of farm land/ fragmentation of farm land size, High population growth, population pressure and drought are still now the leading causes / factors.

Generally, even if climate variability poses a major challenge to animal rising and its forages and the above variables have its own factor. Therefore, their forages limited to crop residue, increasing its cost and declining individual grazing field are the major challenge to animal rising to respondents. Also the decreasing amount of animals rising also lead to minimize the feeding system of human life. This means if problems occurred in animal raising that reverses the limitation of food system .please see table 32.

4.3.3 Household Income Sources

4.3.3.1 Household Access to Food

Is a household's ability to acquire adequate amounts of food, through a combination of home production and stocks, purchases, gifts, borrowing and aid? It is preceded in table 31.

Table 30 Average Monthly income Sources of the sample households

Issue / perception	Variable	Characteristics	Frequency	%
What are the main sources of income for the house hold?		.Crop production	125	72.3
		Daily laborer	48	27.7
How much money you earn per-year (approximately?)		1000	19	11.0
		More than 1000	93	53.8
		less than 1000	61	35.3
How your household income source Is sustains households annual living cost?		Enough	62	35.8
		.More than enough	2	1.2
		Not enough	109	63.0

Source field survey 2019

Including livestock use and other household resources were considered to assess the economic status of the respondents. In this research the annual household income is classified into three based on the response of the households and calculated in monthly income. These are poor with monthly income less than 1000 birr per month, monthly income (1000 birr) relatively better and the average monthly income is more than 1000 were relatively wealthy. The main sources of income for the house hold is Crop production and Daily laborer that 125 respondents' 72.3% and 48 of 27.7% respectively. Each of sample respondents are give the following response based on their life experiences. They earn money approximately per-year 1000birr 19 respondents 11% more than 1000 birr 93 respondents 53.8% and less than 1000birr 61 respondents 35.3% and on the base of income source enough 62respondants 35.8%, 2 respondents more than enough 1.2% and 109respondants not enough 63%.

4.3.3.2 Assets

The available assets can indicate the wealth of the respondents. One of the major assets that indicate the wealth of households in many countries is how much as house is worth (Oxfam, 2008). Therefore, the respondents estimate the cost of their house in birr as shown below.

Housing is the predominant component of wealth for the typical household in many countries. Thus, table 18 briefly indicated that the cost of houses that we estimate the status of the wealth of the respondents, about 35.3 % of the respondents consist the highest percentage that estimated their house was worth less than 1000 birr. The majority of the houses were categorized between birr 1000 and 2000 birr. Building materials and house types were the major parameter for relative financial status and trend to correlate the household's economic strength. The size of the houses and the types of materials which houses made indicate the economic status of the households. Comparatively, houses in moist woinadega (digiba) are better constructed than dry woinadega (lisana qusa) because they built their houses relatively with expensive materials and roof than (lisana qusa).

Generally, researcher concluded that since the objective of the study is to determine the status of food security in the study area, their asset (livestock as well as houses) value and monthly income was very low for majority of households to fit any challenges that imposed on their livelihood. So that 45% of households have no access to food and but only 6% of households have enough access to food and 49% have medium access to food in the study area.

4.3.3.3 Aspect of Food Utilization

Food Utilization is a household uses of food and is determined by such factors as households' access to drinking water, adequate sanitation, food storage and processing techniques and knowledge. Access to safe drinking water and sanitation are vital indicators on key health and nutrition. Hence the scarcity of food and the frequent presence of epidemic disease like malaria, typhoid and typhus's are the direct and indirect consequences of climate change in the study area.

Table 31 Household perception of causes of disease and food shortages

Perception Variables	Frequency	Percent
Poor access to health care	13	7.5
Sanitation problem	23	13.3
Nutritional	33	19.6
Malnutrition	25	14.5
Food shortage	35	20.0
Environmental problem	45	26.0
Total	173	100

Source: Own survey, 2019

The well-known causes of repeated disease in the study area as shown on Table 32 include; poor access to health care 7.5%, poor sanitation 13.3%, nutritional problem 19%, malnutrition 14.5%, food shortage 20%, Environmental problem including climate change 26%, and of the respondents with order of decreasing severity. Therefore, in the study area prevalence of disease that associated with food shortage, environmental problems, and disproportional health center distribution has significant impact in study community. But, still now the severe challenge is environmental that associated with climate variability. comparatively, more vulnerable societies were *lisana qusa* of dry *woinadega* zones. As seen below in Table xxx majority of households 37.5% walk to the health center about to 1hr, 52% of the households walk to 2hrs mostly this is in the dry *woinadega* environment and more than 2hr like 10% of respondents. So that in the study area the aspect of food utilization is very poor that requires improvements all most in all aspects.

Table 32 Household perception of respondent required about causes of disease and food shortages

Respondent Required about Perception /Variables	Frequ	Percent	
causes of disease and food shortages	ency		
how is your house hold healthy status	Fully healthy Sometimes sick	21 152	12.1 87.9
What are the causes of disease in your family mostly? (Put in order of severity)	Environmental & Sanitation problem results Nutritional problems Food shortage, Malnutrition,& Nutritional problems results Poor access to health care	111 62	64.1 35.9
Distances health center compared hour	1hr 2hr >2hr	65 90 18	37.5 52 10
Do the household get sufficient water for the whole years?	yes no	25 148	14.5 85.5
From where the house hold get water?	unprotected spring protected spring hand dug well	30 75 68	17.3 43.4 39.3
The walking distance in time to water source is _hr?	2hr In dry season <1hr During wet season	110 63	63.6 36.4
How far is the nearest market in your village? in hour to walk	1km	173	100

Source field survey 2019

In Table 33 for the question to assess water access, some respondents 63.6% walk less than 2hr In dry season to get water. Next to 36.4% walk about <1hr during wet season get water within 1km to 1.5km long distance. Generally, in both kebeles the respondents do not have better access of safe drinking water. The majority of the households“ fetches drinking water from unprotected sources. But the rest fetch from unprotected springs and open wells are not too safe for drinking. But relatively moist woinadega is better concerning to distance to water

sources. In access to livestock water dry and moist woinadega is better than moist woinadega due to the presence of Guder River and Gombora River respectively even if it is dry up in winter season.

4.3.3.4 Strategies on time of specific food shortage problems

Table 33 Strategies on shortage of specific food problems

Issue / perception Variable	Characteristics	Frequency	%
Is there a time of a year when your households encounter a shortage of specific food?	yes	73	42.2
	no	100	57.8
If your response is yes, how often it happens?	Sometimes.	173	100.0
In which months your households encounter a shortage of specific food	March, April, may	173	100.0
	,July, august		
How do you see your income last year (2010/11 E.C)?	As usual	37	21.4
	Below the average	136	78.6
Which Strategy Do you use to food consumption related coping mechanisms in times of food crises and How often did you cope using the following mechanism?	Eating food that were less preferred Everyday	173	100
How many times does your HHs normally eat every day?	4 meals	129	74.6
	1 meals	44	25.4
In times of famine caused by drought, who helps you best? Put in order	The government	173	100
Do you think the government services are adequate in minimizing your vulnerability and diversifying your livelihood?	yes	172	99.4
	no	1	.6
What type of aid do the government and other institutions give you?	Food aid		100
		173	

Source own survey

4.3.3.4 Vulnerability to Food Insecurity

The researcher tried to assess the major causes of food insecurity in the study area.

The perception of question to households that problems occurred when encounters a specific food shortage of households? Their response is “yes” and all at all agree in food shortage from them 73 respondents 42.2%responded Sometime and the remain 100 respondents 57.8% it happens in March, April, may, July and august 173 100%. Also the respondents

estimation about last year (2010/11 E.C) income comparing with their real life is 37responded of 21.4% As usual136 Below the average 78.6% and The use and food consumption related to coping mechanisms in times of food crises 129 of 74.6% HHs they do not normally eat every day and the remain 44 respondents 25.4% got 4 meals every day. When famine caused by drought, The government help best them order they think the government services are adequate to minimizing their vulnerability and diversifying their livelihood. By supporting Food aid. Accordingly, the households responded as follows in the table 35.pleaseseen table 35.

Table 34 .Households perception of causes of food insecurity

Perception/ Variables	Frequency	Percent
Early rain fall/Rainfall shortage	83	47.9
Land fragmentation	12	7.5
Low non-farm income	15	8.6
Poor access to modern farm input	10	5.7
Poor soil fertility cause decrease of crop production	10	5.7
Animal disease prevalence	27	15.6
Poor access to pesticides	3	1.7
Lack of government aid	13	7.5
Total	173	100

Source: Own survey, 2019

In table 35 above indicates that, about 47. % respondents the rain fall fluctuation attribute food insecurity to, 15.6 %responded as animal disease prevalence and 11.4% poor access to modern farm input attribute to, low non-farm income and Poor soil fertility cause decrease of crop production as 8.6%, Low non-farm income and as 7.5 % Land fragmentation and Lack of government aid each finally as the households reported the other serious cause is 1.7% Poor access to pesticides.

Generally, all factors reported in the Table above could have contributed to food insecurity. But as indicated in long term national meteorological data of NMA, and as this survey result the dominant factor is rain fall and temperature fluctuation and then high population growth and land fragmentation could have prominent effect on food security. Hence, the objective of the researcher's study is to Assessing the status of food security, about 96.5% of the respondents believed and added the existence of food insecurity in both kebeles. In case of

non-farm income practices moist woinadega (digiba) is relatively better than dry woinadega of lisana qusa kebele community. Because, they were involving in day to day income generating activities and were earning their livelihood in time of climate related risks. Most of the time females and Childs“ involve in small business. Relatively in of lisana qusa kebele community those victims to food insecurity simply wait for the support from government, NGOs and Safety Net program.



Figure 22 Enset crop production that affected by climate variability

Source field survey 2019

In figure 22 Enset crop is affected due to CV because of long Bega/winter t and that affect the food security in the study area means its product is more usable in the worda.

4.3.3. 5 External support

Moreover, the local community’s efforts, the government and international organization like World Bank provided support to community in respond to the climate change related challenges.

The government provided awareness raising education to local community on impacts of climate change, water and soil conservation (WSC) and other natural resource management intervention, and on income diversification and promoting saving and credit. The government also promoting and participating the community in tree planting and other WSC works to mitigate the climate change impact. Sea the following figure .



Figure 23 Planting trees nursery area in sample kebele

Source own survey 2019

In addition, the government and international organization (e.g., World Bank) provide food aid (for those who have chronic food shortage) and financial input as revolving fund for community members who can engaged in Income Generating Activities (IGAs).

4.4 Community Response to the climate change induced food security problem

4.4.1 Coping strategies practiced by the people in the study area.

4.4.1.1 Local Adaptive strategies

The major Local existed knowledge is one and important adaptive strategies in overcoming the challenges of climate variability and change. In the study, the researcher has assessed both the previous and currently existing the local community's adaptation strategies/mechanisms. In assessing the previous adaption mechanisms /measures for the question that presented in table local actions/coping strategies practiced, they use possible capacity to avert climate earn problems adapt to the impact of climate change by taking action in their locality, are not use irrigation because of lack of enough water access and also they Diversify income source. what you take to cope up the effect of climate change they Use multi-strategies to improve agricultural input and sale of livestock and use income source from Temporary migration & External support from relative and relief (food aid) to Use early matured crops to resistant Drough and Cropping problem crops (maize, sorghum and

enset? And use Early cropping Casual labor and petty trade Are the major questions that responded by respondents.

Table 35: Farmers' Coping strategies to CV when caused food security problem in the study area

Issue	Characteristics	Freq	Percent
What local actions/coping do you think and Possible in your capacity?	Soil and water conservation	72	41.6
	Change in cropping and Diversification of household's income	101	58.4
Do you think that is it possible to avert or adapt to the impact of climate change by action in your locality?	Yes	101	58.4
	no	72	41.6
Do you use irrigation?	no	173	100
Do you change the cropping pattern? Why do you change so?	yes	83	48
	no	90	52
what mechanisms /measures you take to cope up the effect of climate change	Using cropping in the Change of rainfall pattern	173	100

Source field survey 2019

All the respondents reported as they have stories that recounted and passed on to them from elders. Also the respondents mentioned local ways of adaptation last generation have been used as adaptation strategies in overcoming the challenges. They identified ways such as social networking, livestock selling, migration, off- farm activity humanitarian aid and combination of some of these ways.

In general the total survey of HH the respondents reported as social networks, sales of livestock and off-farm employment were strategies community used to employ as adaptation strategies against climate change related challenges. However, most of the interviewed farmers responded as the combination of two or more strategies have been utilized in adapting the challenges by the last recent generation. Also some of the respondents reported as combination of strategies such as: use of the social network(borrow money, in kind support for affected family and covering destroyed livestock/crops during damages), migration and sale of livestock have been utilized and the other responded as social network, migration and humanitarian aid, have been used as adaptation strategies

The current generation also uses some of the above mentioned and some more adaptation strategies. Diversify income sources, use irrigation practices, use improved agricultural inputs (, improved seeds and), early mature crops, sale livestock, temporary migrate, support from relative and food aid. see table 36&37

As table 36&37 shows recently adaptation strategies in Digiba, Anabalesa and Lisana qusa Kebele are Uses. The following activities to prevent the climate earned problems .in sense using multi-strategies, Diversify income source ,use improved agricultural input and sale livestock, temporary migrate, External support from relative and relief (food aid), Diversify income source ,Use improved agricultural inputs, Use early matured crops, Sale livestock Drought resistant crops(maize, sorghum and enset) ,Early cropping Casual labor and petty trade Combination of two or more mechanism

Table 36: Farmers' Coping Mechanism to CC/or variability when caused food security problem

Current adaptation strategies	Name of Kebele and respondents						
	Digiba		Anaba		Lisana		Total
		lesa		qusa			
	%	%	%	%	%	%	%
Use multi-strategies	5	9	4	7.8	7	13	29
Diversify income source ,use improved agricultural input and sale livestock, temporary migrate	7	13	4	7.8	2	3.6	25
Diversify income source, uses irrigation and use improved agricultural input	0	0	0	0	0	0	0
Temporary migrate External support from relative and relief (food aid)	4	7.3	6	12	5	9	28
use single strategy as adaptation	0	0	0	0	0	0	0
Diversify income source	5	9	8	16	6	11	35
Use irrigation	0	0	3	0	0	0	0
Use improved agricultural inputs	2	3.4	7	14	4	7.3	24
Use early matured crops	10	18	2	3.9	8	14	37
Sale livestock	4	7.4	3	5.9	5	9	22
Drought resistant crops(maize, sorghum and enset)	8	15	5	9.8	3	5.4	30
Early cropping	2	3.4	2	3.9	8	14	21
Casual labor and petty trade	3	5.4	5	9.8	4	7.3	22
Combination of two or more mechanism	5	9	2	3.4	4	7.3	19
Total	53	100	51	100	56	100	

Source field survey 2019

In general as indicated in the table 37 from three kebeles 29% of the interviewed farmers responded as they use multi adaptation strategies. Specifically, 25% responded as they utilize combination of diversifying income source, use improved agricultural input and sale their livestock and temporary migration; and the other 28% of responded as they employ strategies such Temporary migrate External support from relative and relief (food aid), The other, 35% of the total respondents indicated as they diversified their income sources and Whereas, others 24% responded as they use improved agricultural inputs (37%), use early matured crops (22%), livestock sale and (30%) Drought resistant crops (maize, sorghum and enset and (21%) as early cropping (22%) Casual labor and petty trade (19%) Combination of two or more mechanism uses irrigation and use improved agricultural input in their adaptation effort.

However the lack of international organization supports government coordination and systematic arrangement in implementation of adaptation strategies in community for coping strategies to implement. Various, strategies, by communities are different in stack holders under these coping strategies.

During these interview and discussion with government's DAs and experts, they indicated as there are some resistance among some community groups in accepting and implementing government initiated and previously existing coping and adaptation strategies, and show dependence syndrome to external food support. then again, in FGDs and KIIs, farmers raised as there are some gaps from the government side in proper implementation of coping and adaptation strategies. for example farmers raised as some of the government initiated activities like forcing people to plant one type of tree, provided forest area to investors though it promote farmers for forest protection and guard, shortage in providing some improved agricultural inputs like livestock varieties and limitation intervention in development activities and solving vital area problem like water shortage. In other way Diversify income source, uses irrigation and use improved agricultural input, use single strategy as adaptation and irrigation are not got responses.

4.4.4.1.2 Grass strip

There are different live stock feeding systems from the modernized livestock feeding systems one is grass strip that is bund of grass laid out on cultivated land along the contour. Usually grass strips are about 1.5m wide and spaced at 1m vertical interval. In addition to be fodder for livestock, they are mainly used to replace physical structure on soil with good infiltration

on gentle slopes. Based on the respondent information the respondents responded as controlling and increasing of grass strip is better choice grazing land. See fig 24



Figure 24.6 Grass strip in Households adaptation strategies (planting grass/) in lemo woreda

Source: Field observation on digiba in January 2019

In addition to survey result from focus group discussion and key informants pointed out the implementation of all soil and water conservation technologies are applicable in the study area. The main important and widely used improved soil and water conservation technologies were physical soil and water conservation measures such as soil bund, fanyajuu, cutoff drain, water ways, stone bunds and check dams.

4.4.4.1.4 Soil bund

That is an embankment constructed from soil along the contour with water collection channel or basin at its upper side. It is used to control runoff and erosion from cultivation fields by reducing the field slope length which ultimately reduces velocity of runoff as a result soil going to be fertile and land degradation improved. See figure 25

4.4.4.1.5 FanyaJuu

This is an embankment constructed by throwing the soil dug from basin to uphill. This conservation structure is also constructed during dry season (by Tafasasi). The aim is to reduce and stop erosion and increase water holding capacity of the soil so as to enhance crop yield. Furthermore, it has a potential to increase or sustain soil productivity and environmental protection. See figure

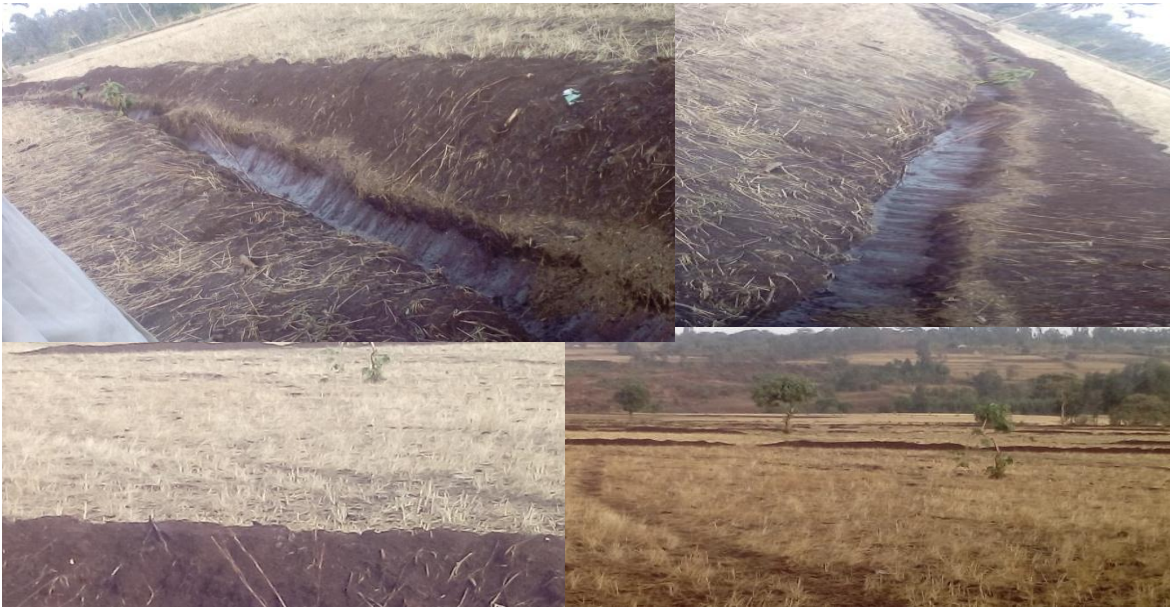


Figure 75. Soil bund embankment constructed by throwing the soil dug from basin to uphill.

Source field survey 2019

4.4.4.1.6 Cutoff drains

This structure is a graded channel constructed mainly in moist area to intercept and divert the surface runoff from higher slopes and protect downstream cultivated land or village. On the contrary, cutoff drains in dry area are used to divert runoff and additional water .see fig 28

4.4.4.1.7 Stone bunds

Stone bunds are embankments or ridges made of stones built across a slope, along contours. These structures prevent water from flowing down the slope, and so also prevent soil erosion. Check dams these are structures built across the bottom of gullies to reduce the velocity of runoff and prevent deepening and widening of the gully. see fig 26



Figure 8 Stone bunds embankments and Cutoff drains

Source field survey 2019

4.4.4.1.9 Planting trees

There are different trees and Enset plants are generated in nursery place to a forestation and feeding purposes in Lemo woreda .among that Households adaptation strategies (to planting trees/) in digiba and Lisana qusa kebele nursery Fig 29



Source field survey 2019

Figure 27 planting places are presented in digiba and Lisana qusa kebele.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

According to my study findings the Food insecurity under diet is the main part that acute challenge in the study area. As the study to identify the trends and the causes of climate variability on agricultural productivity and food security in the study area the result shows

Firstly Temperature trend analysis was carried out to see the overall picture how the two major climatic variables (rainfall and temperature) are changing in the study area. The study result also shows, as households and local government officials responds coincided with the meteorological data result. About 95% and 100% of the interviewed households and government officials respectively thought as temperature and rainfall changing in the area as compared with that of 10 -30 years ago. As the result of these changes, farmer's vulnerability to food insecurity and other climate change related socio-economic problems increased. Also all FGDs argue that increase Change of length in belg 100% and decrease of length in kiramit 96% and of the interviewed know and recognized as climate variability is already occurred in the area and the effects of unpredictable rain fall and temperature fluctuation that resulted either in heavy flooding rain in mid germination and harvesting time it damage crop production or no rain result drought that damaged farm produce and caused crop failure respectively. As a discussion, the impact of climate change on crop production would be mainly through change in temperature and rainfall, which together influenced the length of growing period, time of significant growth rate, increased Evapotranspiration and finally it results the seriously reduction and complete crop failure.

As the findings show households were affected by physical, economic and technological factors in different level .Economic factors such as farm land shortage and fragmentation, poor access to chemical fertilizers and pests, considered as second level factor that affected households of the study area. Technological factor as revealed traditional farming method used and lack of modern technological access and information method were main affecting conditions. Socio-cultural factors could have its own factor on food security in family level. As a study result household livelihood in the area mainly dependent on crop and livestock production that is dependent on rain-fed agriculture.

The study also analyzed the impact of climate variability on food security and food security related problems. The households were relied on rain-fed agriculture that is more sensitive to physical, socio-cultural and technological factors. As a result of the climate variability affected the different communities in food security, where all respondents reported that climate variability affect food production of the survey respondents, 50% and 20 % reported increase in food item price and decrease in of food items availability in the market.

The major impacts were on crop and livestock production. As climate variability affected other socioeconomic activities and services. Poor education due to shortage of food for children, lack of water in school compounds, poor health service due to lack of water in health institutions, and high unemployment. The study also identified major food insecurity related problems. The study result shows that all FGDs, KII, and interviewed households responded as climate variability affect food security through affecting crop and livestock production. Crop yield analysis result also agreed with the community's response. In crop yield analysis, major crops yields such as wheat, barley, Enset, maize, sorghum and teff have show decline trend. As wheat, barley and teff are major crops covering relatively large area, decline in yields of these crops considerably affect the food security of the study area people.

Based on survey respondents indentified as malnutrition, physical weakness, various human diseases, student dropout and migration and human death as major problems occurred due to food insecurity. Because of the variability in rainfall amount in the past 30 years, higher rate of variation in crop yields has recorded, with maximum 555,485 quintals in 2006/7 and minimum of 342788 quintals in 2007/8 production years. Livestock production decrease before ten years than know in quantity and increase price cost respectively for oxen and cows livestock species. Contrary to the cattle population, positive rate of change was observed for goats and donkeys. From this it is possible to conclude that, the climate variability condition, warming of climate, favored by cattle than goats population due their capability to with stand shortage of feed and long dry seasons. The result shows households categorized as severely food insecure 67.1%, moderately food insecure 24.3%, food secured 8.7%.

The most commonly used Coping Mechanisms or strategies cited was like foreign migration to RSA (males) and Arab emirates (female) and females serve better off, males migrate to town and other rural areas, borrowing money from relatives and friends, reducing food consumption by restricting the size, diversity and number of meals, buying less preferred food items from market, selling small animals , sending children to more able relatives in

order to keep livestock and labor work to get money ...etc .are the basic findings of adaptive measures of my research .

The various analyses indicated that the study area is severally impacted by climate variability and the climate variability is negatively affecting the household of the community. The population impacted by climate variability is concededly large. The rainfall and temperature trend in the study area, as long- term meteorological data from NMA shows there is high concentration of rainfall that is unpredictable in nature and there is high fluctuation of temperature with increasing trend. And, the other objective is to differentiate indigenous knowledge use to response the impact of CV is local adaptation and coping strategies at household level, while the finding indicated farmers in both micro agro-ecological zones were aware that climate is changing mainly through observation of rainfall and temperature trends over a long period of time and its difficult effects on natural and human systems. Community households have recognized such challenges so that they were using different adaptation strategies and coping methods as a result that were implemented to enhance soil and water conservation technologies are not well-organized manner.

5.2 RECOMMENDATIONS

Based on the findings and conclusions of the study, the researcher forwarded following points as a recommendation to policy makers and planers:

- ❖ The matter of climate change and its difficult impacts on agricultural production, on human health, on food security, and generally its effects on natural and human systems should be noticed to farmers, students, non-governmental organizations public servants, community, and to societies at large level through mass media (using songs , poems, newspaper, radio, television etc.) and in different meetings for instance in edir,wedding, fernery, churches, mosques and etc through arranging panel discussions by inviting guest specialized the issue to fill the knowledge and skill gap that revealed in the study area and to initiate and to empower the communities and all stakeholders in Lemo woreda.
- ❖ Seasonal variability and fluctuation of Rainfall and temperature was influencing agricultural productivity and food insecurity. as a result, government with the experts from disaster prevention and preparedness, crop and animal production offices and farmers have to integrate in the update information of weather and

climate conditions and there should be recognized well organized weather forecasting and meteorological stations.

- ❖ To deal with food security issue in Lemo woreda the household head and members should involve in different income generating activities for means of living and coping mechanism and the government of Ethiopia and local governors should integrate different research outputs to design income diversifying programs that could relieve the study area from its continual and transitory food insecurity.
- ❖ The lack of water access leads to absence of precondition to use irrigation in the worada. Besides it is a limitation in harvesting water resources in the study area. to increase production and productivity and to assure food self-sufficiency ,to keep safely animals and humans healthy life water harvesting ponds will serve as a minor dam for flood damaging area and in a seasons of water scarcity serve as animals drink, small scale irrigation and indirectly helps to food security. Therefore, the community needs to get aid of technical support from Non government and governmental institutions shall dig water harvesting deep ponds and open wells using man power and as much as possible with tractor giving priority to flooding sites like in lisana qusa Ana balesa kebeles .
- ❖ From my sampling households majority (74.6%) is an illiterate farmer. In previous lack of education has its influence to the dissemination of modern technology among farmers. Therefore, government has to advance that already started integrated adult education by giving due attention and with adequate follow up.
- ❖ To reinforce the coping strategies of farmers, local administrative organs have to arrange and organize work practice sharing program among very poor and poor with wealthy at community level as well as zonal and regional level to give confidence and initiate vulnerable segment of population to involve in all income generating activities within hazard seasons due to climate variability to able to support their life
- ❖ There is a good start of adaptation and coping strategies in the study area, still soil erosion and land degradation resulted from climate related hazards like flooding is a serious challenge to crop production and food security. So, researcher desires well organized implementing to enhanced soil and water conservation technologies with integration of concerning bodies agricultural and natural resource development office, forest and environment protection office, water and irrigation development office, health office and with leading role playing by woreda

administrative office (even by allocating sufficient finance) through incorporating NGOs and community at large. And, the government and any concerning bodies have to motivate and support local adaptation and coping strategies that is very important to the issue under studied and the farmers should develop awareness creation on family planning (to limit population growth), adoption of technologies, pre and post-harvest management and education of household heads are also crucial activities. In general farmers and all concerning bodies in Lemo woreda will succeed in achieving sustainable agricultural production, food security, and economic income if they apply the recommended choice effectively in all aspects.

REFERENCE

- Abebe Tamru. 2000. Indigenous Management and Utilization of Tree Resource in Sideman: In Mother Earth FTTP Newsletter.
- Abebe Enigma (2013). Impact of Climate Variability and Change on Food Security and Local Adaptation Strategies in Arsis Nigel Worde, Central Rift Valley, Ethiopia
- Ahrens, C. D. (2012). Meteorology today: an introduction to weather, climate, and the environment. Engage Learning.
- Ahrens, C. Donald 1988: Meteorology Today: An introduction to weather, Climate, and the Environment, 3rd ed. west publishing company, St. Paul USA. p 157-158.
- Ahrens, C. Donald., 2009. Meteorology Today: An introduction to Weather, Climate and Environment. 9th ed. Belmont, CA.
- Balch, B. G. (2001). Food Insecurity in Ethiopia: the Impact of Socio-political Forces. DIR.
- Bedding ton J, Asaduzzman M, Fernandez A, Clark M, guile M,jaha M, Real L, Memo T, Van Bo N, noble CA, Schools R, Sharma R, Wakhungu ,2011. Achieving food security in the face of climate change: summery for policy makers from the commission of sustainable Agriculture and climate change. CGIAR Research Program on climate change, Agriculture and Food security (CAAFS). Copenhagen, Denmark. Available online at: www.ccafs.cgiar.org/commission
- Christoph, B. Sven,H . & Michael, W. 2008. Climate Change, Food Security and the Right to Adequate food: Stuttgart. Bread for the World and Dlakone Katastrophenhilfe
- Cervigni, R., Morris, M., Carfagna, F., Koo, J., Syroka, J., Guo, Z. &Verbeeten, E.(2016) Evaluating Options: Assessing the Relative Merits of Resilience Interventions.
- Cervigni, R., Morris, M., Fallavier, P., Guo, Z., Boehlert, B., &Strzepek, K. Vulnerability in Drylands Tomorrow: Business as Usual Raising Ominous Prospects.
- Degefa Tolosa (1996) Belg Crop Production as a Strategy of Households' Food Security: A Comparative Study of Belg Grower and Non-Belg Farmers in Munessa Wereda, Arsi Zone. MA. Thesis, Addis Ababa University.
- Degefa Tolosa (2002) Household seasonal food insecurity in Oromiya Zone, Ethiopia: S.S research Report Series- No.26, OSSREA, A.A.
- Degefa Tolossa and Tesfaye Tafesse (2008) Linkages between Water Supply and Sanitation and Food Security: A Case Study in Four Villages of East Hararghe Zone,

Oromiya Region. Ripple (Research-Inspired Policy and Practice Learning in Ethiopia and the Nile Region). Dept. of conservation and Land Mangement, Chatswood, New south Wales.

Devereux, S. (2010) Food Security in Ethiopia, Discussion Paper for Department for International Development (DFID), Sussex University.

Devereux, S. and Maxwell, S. (2001) Food Security in Sub-Saharan Africa. London UK: Intermediate Technology Development Group Publishing.

EPCC (2015), First Assessment Report, - An Assessment of Ethiopia's Policy and Institutional Frameworks for Addressing Climate Change, Published by the Ethiopian Academy of Sciences.

FAO. (2008). Climate Change and Food Security: a framework document. Rome: Food And Agriculture Organization of United Nations (FAO).

Goodwin, N. R. (2008). An Overview of Climate Change: What Does it Mean for Our Way of Life: what is the Best Future We Can Hope For?.Tufts University, Global Development and Environment Institute. Group II Agriculture and Food Security, Published by the Ethiopian Academy.

Hassan R. (2006). Climate change and African agriculture, August 2006. Based on Deressa (2006), measuring the economic impact of climate change in Ethiopian agriculture: Recardian approach, center for environmental economics and policy in Africa (CEEPA) university of Pretoria.(<https://en.wikipedia.org/wiki/Food>) .

IPCC (2007). Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Geneva, IPCC

IPCC (Intergovernmental Panel on Climate Change). 2007b. Climate Change 2007: Impacts, Adaptation and Vulnerability. Summary for policy makers. Cambridge University Press, Cambridge.

Kaur, N. (2013). Ethiopia: Can it adapt to climate change and build a green economy?.International Institute for Environment and Development (IIED).

<http://www.iied.Org/Ethiopia-can-it-adapt-climate-change-build-greeneconomy>

- Markos Ezera (1997) Demographic Responses to Ecological Degradation and Food insecurity: Drought Prone areas in Northern Ethiopia. Amsterdam. Thesis Publishers Ph.D. Dissertation.
- Negra, C. (2013). Agriculture and climate change in national green growth strategies. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) Working Paper, (49).
- Negatu, W., & Musahara, H. (2016). Innovations in Achieving Sustainable Food Security in Eastern and Southern Africa.
- MCKeej. (2008). Deconstruction mgthns about climate change, adaptation and mitigation, in green forum (ed) climate change burning issue for Ethiopia.
- Mulneh Woldetsedik (2010). Fundamentals of Climatology: Teaching and Reading Material on Physical Climatology. Department of Geography and Environmental Studies, Addis Ababa University.
- Sivakumar, M. V. K. (2006). Climate prediction and agriculture: current status and future challenges. *Climate Research*, 33(1), 3.
- UNFCCC (United Nations Framework Convention on Climate Change), (2006). Climate change; impacts vulnerabilities and adaptation in developing countries (<http://unfccc.int/3743.php>) Vulnerability reduction and the community-based approach: <http://upetd.up.ac.za/thesis/available/etd-10232010165854/unrestricted/thesis.pdf>
- (UNEP 2009): Global Assessment Report on Disaster Risk Reduction Summary and Recommendations: Risk and poverty in a changing climate: Invest today for a safer tomorrow.
- WGII, I. (2014). Climate Change 2014: Impacts, Adaptation, and Vulnerability: Summary for Policymakers
- Wheeler, T., Craufurd, P., Ellis, R., Porter, J., and Vara, P. (2000). Temperature variability and the Yield of Annual crop. *Agriculture, Ecosystems, and Environment*, 82, 159-167.
- Woldeamlak Bewket (2009). Rainfall Variability and Crop Production in Ethiopia Case study in the Amhara Region. In Proceedings of the 16th International Conference of

Ethiopian Studies, ed. by Svein Ege, Harald Aspen, Birhanu Teferra and Shiferaw Berkeley. pp. 823- 836 Trondheim.

Woldeamlak Bewket (2009) Rainwater Harvesting as a Livelihood Strategy in the Drought-Prone Areas of the Amhara Regions of Ethiopia.

Johannes G. Michael and Migrate Rifle, (2009). local innovation in climate change adaptation by Ethiopian pastoralists. PROLINNOVA-report, Addis Ababa, Ethiopia.

Yisehak bekele 2011 The impact of productive safety net program on Rural household food security

You, G. J.-Y., and C. Ringer. 2010. *Hydro-Economic Modeling of Climate Change Impacts in Ethiopia*. IFPRI Discussion Paper No. 960. (Washington, DC: International Food Policy Research Institute, 2010).

APPENDIX I:

Questionnaires filled by Households

Dear respondents;

My name is Lonseko Debebe. I am a post graduate student at Addis Ababa University colleague of social sciences, department of geography and environmental studies in a stream of climate change and adaptation. Currently, I am writing my thesis on the impact of climate variability on food security in, Lemo Woreda Hadiya Zone SNNPRG. This questionnaire is designed to obtain or gather data to develop a thesis for academic purpose and so, that are intended to investigate the farmers perception and adoption of impact of climate variability on food security of the rural households in case of. LemoWoreda The success of this academic research depends on your honest answer and, thus you are kindly requested to respond clearly and genuinely. You do not need write your name and you may not respond if you are not comfortable with the questionnaires.

Thank you in advance!

1, Socio economic and demographic profile of HH heads

A. Demographic profile

1. Age of the household head _____

2. Sex of the household head

1. Male _____ 2. Female _____

3. Marital status

1. Married 2. Single 3. Widowed 4. Divorced 5. Separated

4. Family size _____

5. Educational status of the household head

1. Illiterate 2. Elementary 3. Junior 4. Secondary School

5. Higher education

6. Monthly income _____

2. Livelihoods of the households

7. How much money you earn per-year (approximately?)

1. Enough 2. More than enough 3. Not enough

8. What are the main sources of income for the house hold?

1. Crop production 2. Cattle rearing 3. petty trade 4. Weaving 5. Daily laborer 6. Others
specify

9. Is your household income source sustains households annual living cost?

10. Is there a time of a year when your households encounter a shortage of specific food?

1. Yes 2. No.

10.1. If your response is yes, how often it happens?

1. Usually 2. Sometimes 3. Often times 4. Rarely

10.2. For how long months----In which months _____, _____

11. How do you see your income last year (2010/11 E.C)?

1. As usual 2. Above the usual 3. Below the average

12. Do you have livestock? If yes, how many of the following do you have? Before 10 years

Type	oxen	Cows	Sheep	Goats	horses	Donkeys	Poultry	Hives
10 year ago								
Now a day								

13. What is the trend of livestock population in the area?

1. Decreasing 2. The same 3. Increasing 4. I do not know

14. What is the source of animal feed (rank the source of animal feed according to their Importance) ? 1. Communal grazing land 2. Private grazing land 3. Crop residue

4. Hay 5. Other sources, specify _____

15. How do you describe the trend of animal feed?

1. Declining 2. The same 3. Increasing 4. I do not know

15.1. If it is declining, why is that?

1. Expansion of farm land 2. Degradation of grazing land 3. Drought

4. Expansion of settlement (Pop. Growth) 5. Others, specify _____

16. Constraints of livestock rising

No	Constraints	1 yes	2. No
1	Lack of sufficient pasture (feed)		
2	Stock disease		
3	Poor stock management		
4	Traditional attitude towards large number of live stock		
5	Moisture stress (water scarcity due to drought)		

17. What should be taken as a remedy for shortage of animal feed?

1. Distributing communal grazing land for private use 2. Increasing grazing land area

3. Introduction of controlled grazing 4. Reduction in livestock number

5. Modernize feeding and management system 6. Others, specify _____

18. Do you have your own land? If yes, how many hectares do you have?

1 < 0.5 ha 2. 0.5 ha 3. 1 ha 4. 1.5 ha 5. 2.0 ha 6. >2 ha 100

19. How do you perceive the fertility of your farm land?

1. Improving 1. Constant 3. Declining 4. Do not know

19.1. If the fertility of your land is declining what is the indicator? _____

20. How did you get the land you have currently? (More than one choice is possible)

1. Through renting 2. Through share cropping 3. Inherited from parents

4. Allocated by *Kebele*

21. How do you perceive the distance of cultivation field from your home?

1. Near 2. Moderate 3. Far 4. Very far

22. How do you perceive the productivity of your land?

1. Increasing 2. Decreasing 3. Constant 4. Do not know

22.1. If the yield from your farm land is decreasing, what could be the reason behind?

(More than one answer is allowed)

1. Absence of fallowing

2. Poor access to chemical fertilizers

3. Unreliable rainfall

4. Erosion/runoff

5. Over cultivation

6. Pests

7. Moisture stress

8. Other reasons _____

23. How was/is the amount of agricultural production before a decade compared with this time?

1. Has no change 2. Decreased in crop yield 3. Increased in crop yield

4. Standard crop growth.

24. What is your house hold health status?

1. Fully healthy 3. Have prominent sickness

2. Some times (occasionally become) sick

25. What are the causes of disease in your family mostly? (Put in order of severity)

1. Nutritional problems 3. Sanitation problem 5. Malnutrition

2. Poor access to health care 4. Environmental problem 6. Food shortage

26. How far is the nearest modern health center, put it in hour to walk 101 1. During wet season _____ 2. In dry season _____ 3. When there is drought _____

27. Do the household get sufficient water for the whole years?

1. Yes 2. No

28. From where the house hold get water?

1. River 2. Unprotected spring 3. Protected spring 4. Hand dug well 5. Pond

6. Open wells 7. Others, specifying _____

29. The walking distance to water source is _____hr.?

1. During wet season_____ 2. In dry season_____ 3. When there is drought_____

30. How far is the nearest market form your village? Put it in hour to walk

31. Is the market large enough to sell your production?

1. Yes 2. No

32. How long you travel to reach to motor able road

33. To which media you have access? (Allowed multiple response)_____

34. Do you have access to mobile telephone? 1. Yes 2. No

3. General perceptions about climate change and vulnerability in the area

35. Have you heard about the issue of climate change?

1. Yes 2. No

35.1. If yes, what problems you have faced due to the change of climate?

(More than one choice is possible).

1. Fluctuation of rainfall 2. Increased temperature 4. Disease incidence like malaria

5. Deforestation 7. Cold temperature 3. More flooding 6. Hail storm 8. Drought

36. Did you notice changes in the amount of rain fall in your area in last 20yrs?

1. Yes 2. No

37. Did you notice changes in the amount of temperature in the last 20 yrs?

1. Yes 2. No 102

37.1. If yes, what happened to rainfall and temperature in your opinion? (Mark“*” in the box)

Variable s	1.increased	2-decreased	3- No idea
Rainfall			
Temperature			

38. Are you vulnerable to climate change related problems? 1. Yes 2. No

38.1. If yes, which of the following affects your life please put in order of severity?

1. Drought _____ 6. Shortage of animal’s feed_____

2. Food inadequacy _____ 7. Poor grazing land_____

3. Flood _____ 8. Malnutrition

4. Price fluctuations for agricultural products _____ 9. Migration_____

5. Shortage of water supply_____ 10. Poor health_____

11 .Others, specify _____

39. What happened to pattern of rainfall on set and cessation in your area in the last 20 years?

1. Rain fall amount decreased 3. Time of onset became late
2. Rain fall amount increased 4. Time of cessation became earlier or late
5. Rarely season become shorter

4. Adaptive and Coping Strategies

40. Do you think that is it possible to avert or adapt to the impact of climate change by action in your locality?

1. Yes 2. No

41. What local actions/coping do you think and possible in your capacity?

(It is possible to give opinion more than one actions)

1. Reforestation and a forestation 6. Migration to other area
- 2 Doing additional non-farm activities 7. Diversification of household's income
3. Soil and water conservation 8. Change in cropping pattern
4. Irrigation
5. Selling small animals and charcoal 9. Others, specify _____

42. Do you use irrigation?

1. Yes 2. No

42.1. If yes, when you start irrigation? _____

42.2. If no, what is the reason?

1. No access to water 3. Financial problem
2. Cultural practices 4. Lack of awareness
5. No irrigable land 6. Others, specify _____

43. Do you have off-farm or non-farm income resources?

1. Yes 2. No

44. Do you change the cropping pattern? Why do you change so?

1. Because of the change in rainfall pattern
2. Because the changed crop price in the market
3. Governmental or other developmental organizations forced to do it
4. Because of increased temperature 5. Others, specify _____

45. Is there food insecurity in your locality? 1. Yes 2. No

46. If yes what factors do you think have caused food insecurity? Indicate their level of influencing causing the problem?

No	CAUSES OF SHORTAGE PROBLEM	1 yes	2No
1	Rainfall shortage		
2	Torrential rainfall		
3	Animal disease prevalence		
4	Poor soil fertility		
5	Deforestation		
6	Farm land shortage		
7	Pest infestation		
8	Low non-farm income		
9	Poor access to modern farm input		
10	Traditional farm practices		
11	Land fragmentation		
12	Over grazing		
13	Lack of access to market information		
14	Poor access to motor able transport		
15	Shortage of labor		
16	Old age		
17	Poor access to Gov. t/NGO services		
18	Poor access to credit		
19	Land lessens		

47. Do you use food consumption related coping mechanisms in times of food crises? How often did you cope using the following mechanism?

No	Strategy	how offeten		
1	Eating food that were less preferred	2,2-5times/week	3,1-2times/week	4,Never
2	Reducing consumption amount during each meal			
3	Skipping meal for adults to feed children instead			
4	Change type of food			
5	Not eating for whole day some times			

48. How many times does your HHs normally eat every day?

1. 2 meals 2 .3 meals 3.4 meals 4.1 meals

49 .In times of famine caused by drought, who helps you best? Put in order

1. Relatives 3. Friends 3.NGOs 4.The government 5.Traditional association

6. Cooperatives 7. Others, specify_____

50. Do you think the government services are adequate in minimizing your vulnerability and diversifying your livelihood?

1. Yes2. No (please explain your answer) _____

51. What type of aid do the government and other institutions give you?

1. Supplying agricultural input 2. Giving money 3. Food aid

4. Facilitating additional job opportunity 5. Showing different mechanisms

6. Specify (if others)_____

Thank you!!!!

APPENDIX II:

Checklist for Focus Group Discussion /FGD

Check lists questions for focus group discussion to be held at Lemo Woreda January , 2019.

1. How many households are there in kebele? _____
2. What is the main climatic zone of this kebele? _____
A. *Dega* B. *WoinaDega* C. *Kola* D. *Extreme cold* E. *Others*
3. What is major livelihood of this area? Is it related with climate variability? How?
4. Which rain are you dependent on? Put in priority importance?
A. *Belg* B. *Mehar* C. *Kiremt* D. *Bega*
5. How was the vegetation cover in the past? How is today?
6. Is there change in temperature and rain fall pattern? What do you think the reason?
7. Which year was memorable with big crises of crop output in the past two decades?
8. Have you faced food insecurity? How you explain it in relation with climate change?
9. Do you participate in the rehabilitation of natural resources? What is your benefit?
10. What are the local coping mechanisms used to reduce the impacts of climate change and food insecurity? Please list community based, governmental and/or NGOs assistance?
11. Is there irrigation schemes? How you practice it?
12. Have you encountered unconditional pest infestations? When?
13. Do you use fertilizers (organic or inorganic)? For what purpose?
14. Which crop and livestock types is more resistance to climate variability?

Thank you!!!!

APPENDIX III

Checklist for Key Informant Interview /KII

Which include experts from agricultural offices, land and environment protection office, woreda administration, water resource office, mineral and energy office, disaster prevention and preparedness office, Woreda health office, kebele DA, kebele chairman,...etc.

Thank you in advance for your cooperation!!

1. Name _____ 2. Position-----3 Education /profession _____

3. In your view, are there climate change /variability in Woreda? If yes, please tell me the pattern. Which year was the most devastative in the past two decades?

4. Is the amount of rainfall and temperature increased or decreased over 20 years in LemoWoreda? ----- What do you think the reason for this?_____

6. Can you explain the general relationship between climatic variability, agricultural production and food security?

7. Please can you tell me the major agricultural practices (crops &livestock) in LemoWoreda

8. Based on your experience, what look like its implication and trend on crop output in the Woreda for last 20 years?

9. Is there food insecurity problem in the area? What can be its causes?

10. Describe who are likely to be the most vulnerable people to food insecurity in that community and why? What indigenous and learned strategies might be used to support these vulnerable people?

11. Which agro-ecological zones of households are more vulnerable to food insecurity?
Why and in which season?

12. What are the local coping mechanisms used to reduce the impacts of climate change and food insecurity? Please list community based, governmental and/or NGOs assistance?

13. Is there any disease that damage agricultural production rather than climate variability?
Please list them?

14. Is there any irrigation system in LemoWoreda? Which crops produced? How many percent it cover from total land of Woreda?

Thank you!!!!

Hosanna rain fall														
element	year	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	
PRECIP	1985	135.3	40.5	6.8	5.5	10.5	0.4	40.6	214.5	141.7	80.8	116.0	196.4	
PRECIP	1986	133.5	35.7	0.9	29.1	1.5	178.0	125.2	197.8	282.4	135.8	196.8	101.2	
PRECIP	1987	154.7	47.3	0.0	4.5	5.9	81.8	187.7	112.2	320.4	90.0	105.6	170.4	
PRECIP	1988	191.4	112.1	0.0	0.0	20.5	79.2	35.5	93.1	69.5	121.2	194.6	299.1	
PRECIP	1989	146.0	78.4	0.0	139.4	29.4	81.3	104.0	142.5	60.4	121.0	131.5	165.8	
PRECIP	1990	135.3	40.5	6.8	1.0	0.0	144.8	153.1	95.9	114.9	107.2	133.8	125.6	
PRECIP	1991	110.2	9.7	0.0	66.3	7.1	45.7	94.0	31.6	100.2	138.6	210.5	185.9	
PRECIP	1992	104.3	106.2	52.9	3.7	58.9	88.1	119.6	174.5	106.2	171.7	121.4	280.1	
PRECIP	1993	92.7	177.2	0.0	0.1	78.1	107.0	20.6	255.2	285.7	75.1	122.8	199.0	
PRECIP	1994	192.8	0.2	10.1	0.0	0.0	0.0	146.7	83.9	128.9	122.4	148.3	128.7	
PRECIP	1995	160.6	4.2	0.0	98.9	0.5	62.7	70.0	219.6	109.3	82.4	196.0	156.5	
PRECIP	1996	125.6	6.6	16.3	0.0	90.7	17.8	153.0	170.4	162.7	108.8	186.7	129.6	
PRECIP	1997	140.2	318.7	85.3	0.0	28.7	0.0	80.7	177.6	140.1	171.7	113.1	186.4	
PRECIP	1998	235.3	158.5	17.6	0.0	73.8	63.2	107.7	203.6	143.0	159.9	205.3	188.5	
PRECIP	1999	127.7	193.6	0.0	0.0	1.0	0.0	56.5	77.0	122.5	143.5	181.7	107.8	
PRECIP	2000	177.9	64.9	21.0	45.5	0.0	0.0	15.4	205.8	105.2	145.5	86.2	124.5	
PRECIP	2001	101.8	62.0	4.7	5.5	4.8	70.1	184.0	109.6	172.1	91.0	151.9	188.0	
PRECIP	2002	154.7	2.8	0.4	151.8	83.3	47.2	150.7	111.7	135.5	90.0	103.6	314.7	
PRECIP	2003	182.9	11.7	14.3	0.0	35.8	58.9	118.7	194.4	78.7	108.3	150.2	213.3	
PRECIP	2004	181.8	17.5	17.3	14.0	96.8	19.4	90.6	172.0	104.6	123.4	154.2	152.3	
PRECIP	2005	162.6	37.7	67.7	0.0	31.5	18.8	177.8	162.1	197.2	64.6	160.1	98.9	
PRECIP	2006	88.2	50.3	6.0	27.2	28.9	53.9	135.5	160.0	75.8	169.8	183.9	222.2	
PRECIP	2007	210.3	19.4	0.0	0.0	6.0	0.0	119.4	152.1	121.3	163.1	179.9	127.3	
PRECIP	2008	139.0	126.1	116.5	0.5	0.0	1.2	43.0	64.3	238.9	144.6	192.5	136.2	
PRECIP	2009	156.7	169.4	5.1	16.5	43.1	4.8	73.4	85.5	120.1	122.7	188.5	181.1	
PRECIP	2010	138.5	18.8	19.3	33.7	11.8	110.0	139.9	111.3	182.8	94.4	116.0	145.0	
PRECIP	2011	119.3	0.0	49.2	0.0	15.5	11.2	101.7	115.9	232.8	116.0	158.8	182.5	
PRECIP	2012	163.5	1.4	2.4	1.0	0.0	0.0	67.4	138.3	68.3	150.3	233.1	155.9	
PRECIP	2013	173.0	46.4	0.4	0.0	1.0	17.4	65.0	67.9	131.6	182.2	200.8	211.0	
PRECIP	2014	193.0	156.7	169.4	1.3	25.0	117.8	76.6	134.9	251.8	76.2	188.3	270.9	
PRECIP	2015	156.7	169.4	5.1	3.2	0.0	3.0	45.1	19.2	210.0	182.3	187.1	198.0	
PRECIP	2016	138	68.8	111.2	6.3	92.8	0	81.2	258.6	136	123	189	123.8	
PRECIP	2017	225.5	12.4	1.2	13.2	0.6	69.5	77.9	44.6	184	189	143	90.8	
		Hosanna temperature												
		year	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
TMPMAX	1985	19.4	18.3	18.3	15.6	16.4	5.1	23.1	25.0	24.5	25.2	23.1	23.0	

TMPMAX	1986	21.1	18.5	20.9	21.9	22.7	24.0	24.7	25.2	25.2	22.9	23.1	22.2
TMPMAX	1987	20.7	18.2	18.9	20.0	21.1	22.5	22.5	24.9	24.2	25.8	23.8	23.4
TMPMAX	1988	20.3	18.7	19.6	20.2	21.5	23.1	22.0	22.3	22.6	23.2	21.1	22.7
TMPMAX	1989	20.6	19.5	19.4	20.7	22.0	23.6	23.8	23.0	22.0	22.9	22.6	22.2
TMPMAX	1990	21.6	18.6	19.0	21.0	22.3	23.7	22.5	24.7	24.2	23.5	25.0	23.4
TMPMAX	1991	20.3	18.8	19.2	20.7	22.0	23.6	23.0	23.1	22.4	24.4	23.5	23.1
TMPMAX	1992	20.7	18.2	18.9	20.0	21.1	22.5	24.3	21.5	23.4	24.5	22.4	23.2
TMPMAX	1993	20.3	18.7	19.6	22.2	21.5	23.1	23.9	22.5	25.5	23.9	22.9	22.2
TMPMAX	1994	20.6	19.5	19.4	20.7	22.0	23.6	23.7	24.0	25.9	26.2	22.5	23.4
TMPMAX	1995	22.1	18.9	19.3	21.1	23.2	24.6	23.8	23.6	24.1	24.3	24.3	23.1
TMPMAX	1996	19.8	19.4	19.2	20.9	22.6	23.6	24.0	24.6	26.8	23.5	25.5	23.5
TMPMAX	1997	21.3	19.5	20.4	22.5	22.2	22.3	23.2	25.1	26.2	27.3	24.1	22.7
TMPMAX	1998	21.1	19.3	19.5	21.2	21.5	23.1	24.1	23.4	24.8	22.9	24.1	21.7
TMPMAX	1999	21.0	18.7	19.7	21.3	20.9	22.6	23.2	23.1	24.7	23.2	23.9	22.9
TMPMAX	2000	20.9	19.3	18.9	20.9	21.8	22.9	23.6	22.3	25.6	25.1	23.4	24.9
TMPMAX	2001	19.9	19.4	19.7	21.8	22.3	23.1	24.1	24.1	24.1	25.0	22.5	23.7
TMPMAX	2002	20.8	20.7	19.8	21.6	23.7	24.6	24.0	24.0	26.5	24.6	24.0	22.2
TMPMAX	2003	21.6	19.1	19.3	21.1	23.0	23.8	24.0	24.6	25.5	24.0	22.9	22.1
TMPMAX	2004	20.5	19.8	20.2	21.4	21.8	24.0	24.2	24.4	24.5	25.9	24.0	23.5
TMPMAX	2005	21.4	19.8	20.8	21.2	22.5	23.1	23.8	25.5	25.6	26.9	24.9	22.7
TMPMAX	2006	21.7	21.0	19.6	20.9	23.0	23.8	24.2	23.9	25.1	26.7	24.7	25.0
TMPMAX	2007	20.9	20.3	20.2	21.1	22.7	23.7	22.3	24.2	23.3	23.8	23.8	24.2
TMPMAX	2008	21.0	19.2	19.9	20.9	22.4	22.3	24.2	25.2	24.2	24.5	26.0	23.3
TMPMAX	2009	23.3	20.9	20.8	22.2	22.3	21.4	24.9	25.7	26.8	26.7	23.0	24.6
TMPMAX	2010	21.0	18.7	19.7	20.9	22.4	22.3	24.0	24.9	25.9	25.5	24.3	23.4
TMPMAX	2011	21.4	21.2	20.3	21.1	23.8	23.9	24.5	24.5	24.4	24.7	24.4	23.1
TMPMAX	2012	22.1	20.0	20.3	21.1	23.4	24.6	24.2	25.1	26.4	26.7	26.5	23.0
TMPMAX	2013	21.3	19.9	19.6	21.6	22.8	24.2	20.2	24.7	26	27	23.4	22.9
TMPMAX	2014	22.5	20.3	20.3	20.9	23.1	24.2	15.4	25.3	25	25.7	26.5	23.5
TMPMAX	2015	22.4	20.1	20.4	20.9	22.4	22.3	24.0	24.1	23.6	23.2	25.9	23.8
TMPMAX	2016	21.4	20.2	20.8	21.4	23	24	22.3	26.5	24.6	25.1	24.3	23.4
TMPMAX	2017	22.5	20	23.4	21.5	24	24	23.1	25.0	23.5	23.9	22.7	23.4

ቁጥር 2104/2011
 ቀን 21/04/2011

ለሀይማኖት ማስፈጸም
 ሆስፒታል
 Hadiya Zone Lense Woreda
 Health Development Office

ጉዳይ ስም ለመጥቀስ እንደተሞከረው የ2010/11 ምርት ዘመን የሌላ ምርት ወቅት አካሄድ ስብሰታ ለስከ 23/04/2011 ዓ.ም ያለው የምርት አሰባሰብ ሪፖርት ከዚህ በታች እንደሚከተለው የላከን መሆኑን እናውቃለን።

ተ.ቁ	የሰብል ዓይነት	የማሳ ሽፈን በ%/ር	እስከሁን የተሰባሰበ ማሳ በ%/ር	አፈጻጸም በ%	ምርታማነት	ምርት	ተሳተፎ አ/አይር		
							ወ	ሴ	ደ
1	ሰንደ	9510	9510	100	35	332850	16345	1765	18110
2	ጤፍ	3603.75	3603.75	100	12	43245	9780	1351	11131
3	ገብስ	1228.5	1228.5	100	23	28255.5	1110	279	1389
4	ባቁላ	2165.5	2165.5	100	16	34648	4740	1005	5745
5	አተር	845.375	845.375	100	14	11835.3	927	137	1064
6	ቦሎቁ	253	253	100	17	4301	1375	182	1527
7	ምስር	6.675	6.675	100	8	53.4	76	21	97
8	ጎ/ዘር	28.6	28.6	100	11	314.6	1014	910	1924
9	ሽምቡራ	9.35	9.35	100	9	84.15	140	16	156
	ድምር	17650.75	17650.75			455587			

ግልባጭ
 ለመ/ቤታችን እርሻ ዘርፍ

ከሠላምታ ጋር !!
 ግርማ አባ አይደም
 Girma Aba Edeme
 ለሀይማኖት ማስፈጸም ዘርፍ
 C.O.P. Department Head