Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

Fakulteten för landskapsplanering,
trädgårds– och jordbruksvetenskap

The Impact of Climate Change and Adaptation through Agro ecological Farming Practices

A Case Study of the Konso area in Ethiopia

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Master's thesis · 30hec · Advanced Level A2E

Agro ecology- Master's Programme

Självständigt arbete vid LTJ-fakulteten, SLU

Alnarp 2012

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Department: Agro ecology

Type of student project: Master's Thesis

Credits: 30 credits
Education Cycle: Advanced Cycle, A2E
Course title: Master's Thesis in Agricultural Science
Course code: EX0486
Programme: Agro ecology

Place of publication: Alnarp
Year of publication: 2012
Picture Cover: Meron Awraris
Title of series: Självständigt arbete vid LTJ-fakulteten, SLU
Online Publication: http://stud.epsilon.slu.se

Key words: Ethiopia, Konso, Climate change, Sustainability, Livelihood and Agro ecological farming practices.

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Acknowledgments

Special thanks to the Swedish government for giving me this opportunity to participate in Agro ecology master's programme.

I am most grateful to my two supervisors at the Swedish University of Agricultural Sciences in Alnarp Sven Nimmermark and at Mekelle University in Ethiopia Girmay Tesfaye. Thank you for your inputs and support during the whole project. Furthermore I pass my thanks to Christina Kolstrup and Lennart Salomonsson for your advice, support and fix my travel to Ethiopia.

My acknowledgment goes to Konso wereda Agricultural Office professionals, especial thanks to Ato Kassahun head of the wereda Agricultural Office. Likewise, I wish to thank Ato Torayte head of Mekane Yesus Developmental and Food Security Project.

Besides, I would like to thank Awasa Agriculture Office, all the participant of Konso wereda small scale farmers and extension officers.

Above all, my greatest thank goes to God almighty for giving me strength and knowledge to go through this work. Last but not least, especial thanks to my father, mother and my family who assisted and helped me like they always do.

Abstract

The purpose of this study was to investigate how the impact of climate change through time affects the livelihood of Konso farmers, their agricultural practices and the overall environmental friendliness of the Konso's. Further the purpose was to identify how the impact of climate change reduces through time their resilience and adaptation of agro ecological farming practices.

Thirty agricultural professionals, thirty extension officers, ten farmers, one nongovernmental organization three elders of the community and five women participated in the study.

The study was based on a questionnaire translated from English, oral interviews and discussions with a group for collecting necessary and important information for the study and for analysis work.

In general, the impact of climate change in Konso is manifested in two extreme weather events; drought and flood which lead to serious socio-economic problems and frequent food insecurity. Furthermore, the result indicates that the Konso people are well known for their natural resource conservations and various agro ecological practices. However, there are determinant factors or constraints to apply agro ecological farming practices as it needed in the wereda. The impacts of climate change in Konso have increased the vulnerabilities of the society and resulted in frequent severe food shortage and poverty problems.

This study indicate that the Konso wereda is affected by the impact of climate change not because of the working culture of the society rather there are factors which can affect or reduce the resilience of the society and their adaptation of agro ecological farming practices. Moreover, the study suggests that if the main factors of the problem i.e. increasing population number, deforestation, shifting cultivation, expansion of free ranching and others contribute for more climate change impacts get a solution then the rest of the problem will be solved.

Key words: - Ethiopia, Konso, Climate Change, Agro ecological farming practices, Livelihood and Sustainability.

Abstrakt

Syftet med denna studie var att undersöka hur effekterna av klimatförändringarna med tiden påverkar försörjningsmöjligheterna för lantbruare i provinsen Konso lantbrukare, deras jordbruksmetoder och Konsobefolkning specifika miljövänligahet i Konso-talet. Vidare syftet var att identifiera hur effekterna av klimatförändringarna minskar med tider motståndskraften och av jordbrukets ekologiska jordbruksmetoder.

Trettio jordbruksspecialister, trettio lantbruksrådgivare, tio lantbrukare, en frivilligorganisation tre äldste i samhället och fem kvinnor deltog i studien.

Studien baserades på frågeformulär översatt från engelska, muntliga intervjuer och diskussioner med en grupp där nödvändig och viktig information för studien och för analys i arbetet samlades in.

I allmänhet manifesteras effekterna av klimatförändringarna i Konso i två extrema väderhändelser, torka och översvämningar som leder till allvarliga socioekonomiska problem och en ofta förekommande osäker livsmedelsförsörjning. Dessutom visar resultatet att Konso befolkningen är välkänd för sitt bevarande av sina naturliga resurser (conservation) och för sina ekologiska metoder i jordbruket. Det finns dock avgörande orsaker till eller begränsningar för tillämpning av de ekologiska jordbruksmetoder som behövs i weredan. Som ett resultat har effekterna av klimatförändringarna i Konso ökat sårbarheten i samhället och ofta orsakat allvarliga problem med matbrist och fattigdom.

Denna studie visar att Konso wereda påverkas av effekten av klimatförändringarna, inte på grund av arbetskultur i samhället, utan att det snarare finns faktorer som kan minska motståndskraften i samhället genom olika anpassning av jordbrukets ekologiska jordbruksmetoder. Desstom tyder resultatet av studien på att om de viktigaste faktorena till problemet, dvs. ökande befolkning avskogning, skiftesbruk, utbyggnad av fritt bete och andra bidrag till mer klimateffekter, får en lösning så kommer sedan resten av problemet kommer att kunna lösas.

Nyckelord - Etiopien, Konso, klimatförändring, agro-ekologiska jordbruksmetoder, försörjning och hållbarhet.

Abbreviations

CIA: Central Intelligence Agency

CSA: Central Statistics Agency

DFID: Department for International Development

ETV: Ethiopian Television

FAO: Food and Agricultural Organization of the United Nations

FDRE: Federal Democratic of Ethiopia

IFPRI: International Food Policy Research Institute

IIED: International Institute for Environment and Development

IISD: International Institute for Sustainable Development

NGO's: Non-Governmental Organizations

PDC: Prema culture Development Design

SNNPR: Southern Nations Nationalities and People's Region of Ethiopia

UNDP: United Nations Development Programme

UNESCO: United Nations Educational, Scientific and Cultural Organization

Terms	Glossary
Belg	Big rainy season (February- April)
Hohe	A kind of legume plant of which farmers use its green fruit in their diet
Kanta	Sub village
Kebele	Smallest administrative unit
Kola	Arid/ low land
Korem	A kind of root plant used to grow during drought time
Meher	Small rainy season (October and November)
Mora	Traditional house
Payra	Tools used for farming
Teff	Major Cereal grain grown on Ethiopians highlands
Weinadega	Sub humid
Wereda	Administrative unit
Weybeta	Kind of tree of which the leaves are used as feed for animals
Edir	Group of people who gather to help each other during an emergency or crisis situation
Ekub	Group of people who gather to save some money

Table of Contents

1. Introduction

The introduction part provides the reader with the problem of climate change from the global perspectives regarding agriculture to its effect upon Ethiopia farming with a special focus on the Konso wereda of Southern Nations Nationalities and People.

1.1 Background Problem

Climate change is a long term change on average weather condition (FAO, 2008). It was in the late 1970's that climate change recognized as a global environmental phenomenon (Abatzoglou et al, 2007). The implication of changes in temperature, variation in rainfall pattern and sea level is a key factor of climate change affecting economic and social patterns and natural system for present and future generations.

Nowadays, different forms of environmental changes have transformed places or different topographies into rocky hills and deserts while other disappears under a flood (Barnett et al, 2010).

"As communities around the world, face rapidly changing conditions driven in part by global environmental and societal changes. There is an increasing need to understand why these cumulative changes threaten human livelihoods in some cases and create opportunities for others, how communities cope with and in some cases adapt to these cumulative stresses, how public policies might reduce threats and enhance human security" (Brklacich et al, 2010).

1.2 Impact on rural people and food security

Agriculture is a means to feed the ever growing world population and agricultural activities often harm the environment by deteriorating the quality and quantity of locally available natural recourses. Nowadays, the problem is a challenge to implement efficient and profitable ways to produce sufficient safe food, while avoiding extraction and degradation of natural resources and having the environment under rapidly changing climatic condition (Fuhrer, 2007).

Compared to other sectors of a country economy, agriculture is more vulnerable to climate change. The impact of climate change on agriculture and human well-being include three important aspects

I. Biological effects on crop yields
II. Impact on outcomes including prices, production and consumption
III. Impacts on per capita calorie consumption and child malnutrition (Nelsson et al, 2009).

According to FAO (2010), the rising of temperature and variation of rainfall patterns have direct effects on crop yields. Price fluctuation is one of the indicators that show the effect of climate change on agriculture. The primary effect of climate change on human welfare is the change in calorie availability and an increasing number of malnourished children.

Climate change likely to affect either food price or production and nutritional security hence, income disparities and availability of food for the society is very vulnerable to food insecurity (Keulen et al, 1998).

According to IFPRI (2007), *"global climate change poses great risks to poor people whose livelihoods depend directly on agriculture, forestry and other natural resources"*.

Hunter (2007), explain that climate change can reduce the availability of local natural resources, limiting the options of rural livelihoods that depend on natural resources and land become less fertile.

The population in Africa has greatly exceeded the carrying capacity of the continent. Excessive demands have been made on soil, water, rangelands, forests and wildlife. As a result of the degradation of these resources, the quality of life for many Africans has sharply decreased (Owen et al, 1990).

Many countries in tropical and subtropical parts of Africa are expected to be vulnerable to the impact of global climate change. Even so without the impact of climate change water balance is dwindling, it makes the situation very harsh therefore, water supply and water availability is a major problem for a number of countries in the region. The problem of sustainable water supply is a major challenge for African countries and climate change exacerbates an already problem of water supply in rural areas (Alemayehu, 2012). In addition climate change aggravates the impact and as a result countries face semi-arid and arid conditions that make agriculture very challenging (Dinar et al, 2008).

A large number of studies and research constitute an evidence of the variability of climate change and its impact. Besides, the effect of climate change on agricultural production, it also has an impact on various physical, human and capital aspects of the country which indirectly disable the economic, social and political factors of the government, above all the rural people access to the food is threatened (FAO, 2008; FAO, 2010). Predominantly, small holders and subsistence agriculture are more vulnerable to the impact of climate change.

The impact of climate change is not only affecting or changing the surrounding environment of a particular area, it is also the cause for food insecurity in different parts of developing world plus widening the gap between poor and rich.

In 1983 FAO defined food insecurity, *"Food insecurity exists when people do not have adequate physical, social and economic access to food"* (FAO, 2006).

Ethiopia has experienced a worsening food insecurity problem for several years. However, the country has been structurally food deficient since at least 1980's. Drought, war, a fragile natural resource base and weak institutions, inconsistence in governmental policies are structural factors that contribute to food insecurity (Deverux, 2000; Negatu, 2004).

Ethiopia has a total land area of about 1,104,300 square kilometer of which 10.01% is arable land, 0.65% is under permanent crop and 2,900 square kilometer is irrigated land (CIA World fact book, 2012). The country has a population about 82 million. Agriculture remains by far the most important sector of the economy because:

I. It contributes with 42% the GDP (Gross Domestic Product)
II. More than 80% of the country export items are from the agricultural sector
III. Almost 80% of the people depend on agriculture in terms of livelihood and employment (US Department States, 2011).

Ethiopia is one of the examples of how climate change affects Africa (Haakansson, 2009). Based on UNDP (2007/2008) human development report, 46% of the population in Ethiopia is malnourished and 77.8% of the population earns less than two US dollars a day.

Moreover, The World Bank (2012), states that Ethiopia is one of the countries extremely vulnerable to drought and natural disasters such as flood, heavy rain, frost and heat weaves. This extreme weather, because of the impact of climate change, causes the loss of peoples and livestock's live, livelihoods of farmers and their properties disrupts.

From the nine regions which make up FDRE (Federal Democratic Republic of Ethiopia) SNNPR (Southern Nations and Nationalities People Region) is one of the most diversified culture, religion and ethnic group which comprise a tribal matrix of 56 different ethno-linguistic groups (PDC, 2009). Konso is one of the special wereda in the region, the area is commonly known for acknowledged agricultural practices for instance, mixed cropping and agro forestry and a long lasting terracing agriculture system

The complex system of mixed agriculture and terrace farming is practiced in the area for almost 400 years. It keeps the place less affected by different problems such as soil erosion of high hill top areas and further land degradation (Watson, 2009).

Agricultural drought and socio economic drought are perspectives of drought caused by climate change (Dietz et al, 2004).

As agriculture is the main livelihood of the Konso wereda, farmers face both an agricultural drought problem and a socio economic problem. The rapidly growing number of population in the werdea increase the demand of food, resources, land and other basic needs for life, especially, during drought time the problem will become very challenging for the community.

1.3 General background of the problem

Nowadays, the impact of the global climate change has totally changed the environmental and agricultural status of some places. Since 1970's in the special wereda Konso things are changed. Even though, the Konso people are known to be hardworking, due to the socio economic, environmental, institutional change and demographic pressure, their historical and traditional method of natural resource conservation and land management face difficulty to keep the place from hunger and poverty. According to UNDP rapid assessment report (1999), famines have hit Konso almost once every ten years. Konso was devastated by drought starting from 1973/ 74 and 1983/84 and things had not changed in 2007/2008. Nowadays, farmers start to develop the mentality of dependency on food aid to support their family and they see some possibility to get some money from NGO's (Non-Governmental Organizations) working in the area. This can harm indigenous local food production and their working habit which might be withstand all the climatic condition that the area is going to face in the global climate change.

1.4 Aim and Limitation

The overall aim of this thesis is to investigate the impact of climate change on the livelihood of farmers and agricultural practices. To identify the reasons while natural resource management are applied in the area, food insecurity and other environmental problems are threats.

The study aims to answer the following questions

1. What is the present climatic condition and agricultural status of Konso area?
2. Does management of natural resource enhance resilience to climate change and attained sustainable agriculture?
3. What are the measures taken to improve the living standard of the farmers and the rural community?

The main limitation of this study was, as the study is carried out during spring semester shortage of time, no means of transportation access in some of the werda's *Kebele*, no ordered and prepared data or information and some of the information is not easy to find in the wereda's agriculture office.

1.5 Outline of the study

Chapter one explains the introduction of the study. Chapter two describes the background of Konso area and various issues. Theoretical frameworks are demonstrated in chapter three. Chapter four clarifies materials and methods of the study that are used to collect data. Results of the study are given in chapter five. Discussion and analysis of the study are given in chapter six. Finally, chapter seven provides conclusion and recommendation of the study.

2. Background of the study

Chapter two describes in short about Konso, topography of the area, livestock, climatic condition, the type of soil it has followed by agro ecological division and socio economic situation. The purpose of this chapter is to give the readers a short and brief general background introduction of the place.

2.1 Konso

Konso means high hilly, windy and cold place. It is one of the eight special weredas in SNNPR's; it is located in south western part of Ethiopia, (5° 15′ 0″ N, 37° 29′ 0″ E) 600km away from Addis Ababa (Beshah, 2003; ETV Konso documentary, August, 2009).

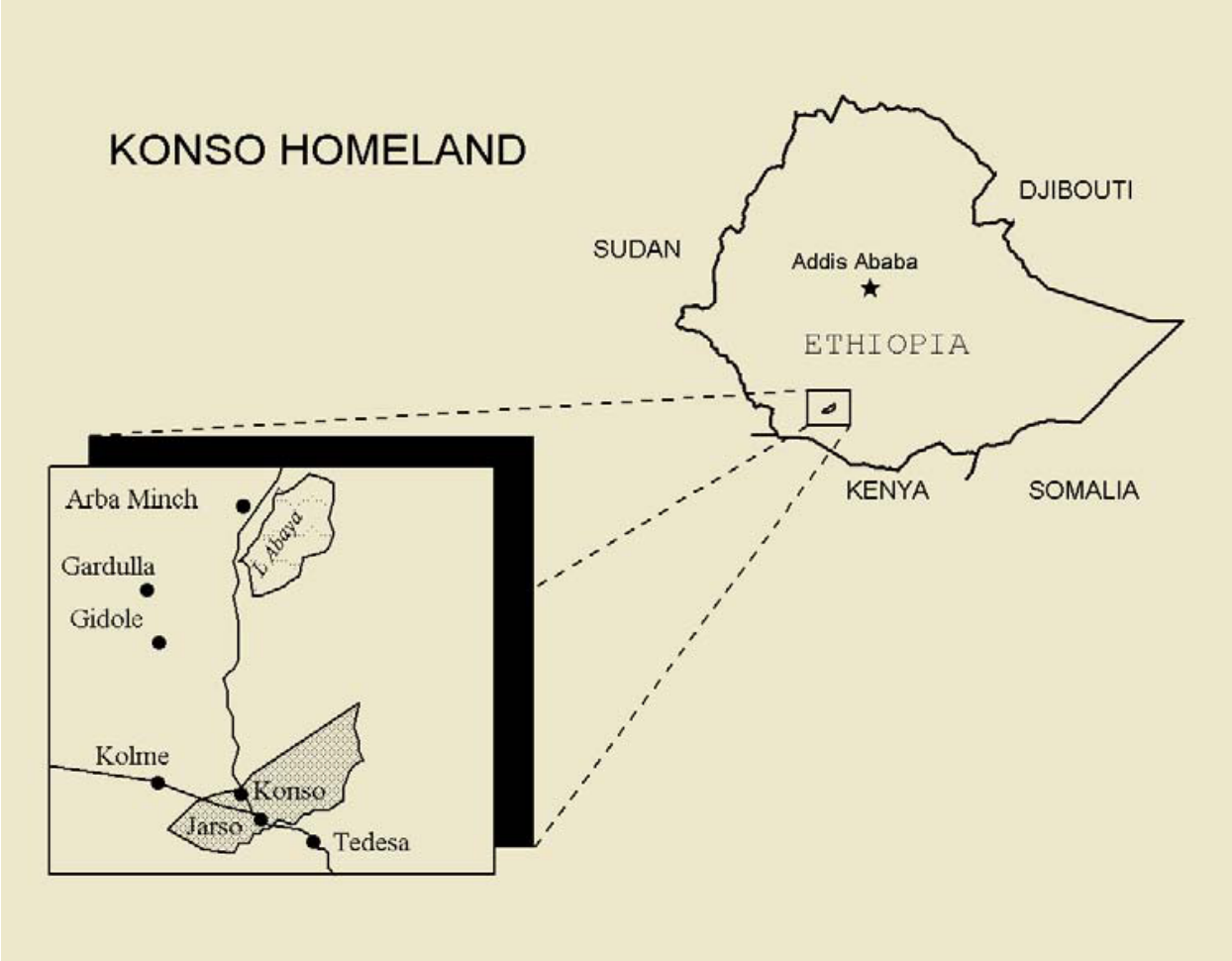

Figure 1: The map of Konso

Source: Konso People Profile, 1993

2.2 Topography

The altitude of Konso varies from 500masl (meters above sea level) to 2000masl (Beshah, 2003). Based on CSA (2007), the wereda has a population of 235,087 of whom 113,412 are men and 121,675 women and an area of 2,274sqkm. Konso has a population density of 103.3. The wereda is surrounded by chained mountains called Kimbero, Kolme and Paticama. Karat is the capital city of the wereda. Segen River forms the eastern and southern borders of Konso, while to the north the Great Plains of Gomida and Lake Chamo and, more to the west the Gidole Mountains and the Woito Valley form natural boundaries (Engels, 1991). The Konso people are known in their agro ecological farming practices and natural resource management.
The hills of Konso rise to the heights of 1,500- 2000m. It has been argued that their terrace construction could be taken as an excellent example of conserving the soil from erosion and to maintain the landscape (Watson, 2009).

2.3 Livestock

Cattle, sheep, goat and chicken are some of the livestock in Konso. Compared to the highland areas a larger number of animals are kept in their compound at the plain areas of Konso (Pound et al, 2006).

The people of Konso have multiple purposes to raise livestock i.e. used as a source of food, retail meat and leather, supply of milk to the families, kept as an important asset and sold during hard time to generate income and provide their manure for recycling nutrient on the fields (Forch, 2000).

Most of the farmers in the highland areas provide weeds, crop leaves, tree leaves and branches for animals to fulfill their needs because of the availability of pasture land and drinking water problems.

Photo 1: Livestock around the compound (Awraris, 2012)

2.4 Climate

The climate of Konso is characterized as semi-arid with irregular and seasonally varied rainfall. The average total annual rainfall is 550mm; the temperature of the area is mostly experienced hot and warm (Ethiopian National metrological Survey Agency, 2008). The annual rainfall variation is between 400 and 1000mm (figure 2). The rain follows a bimodal pattern there are two rainy season's i.e.*"Belg"* big rains with the period starting mid February and lasts to April and the small rain period *"Meher"* occurring around October and November (Cheung, 2008).

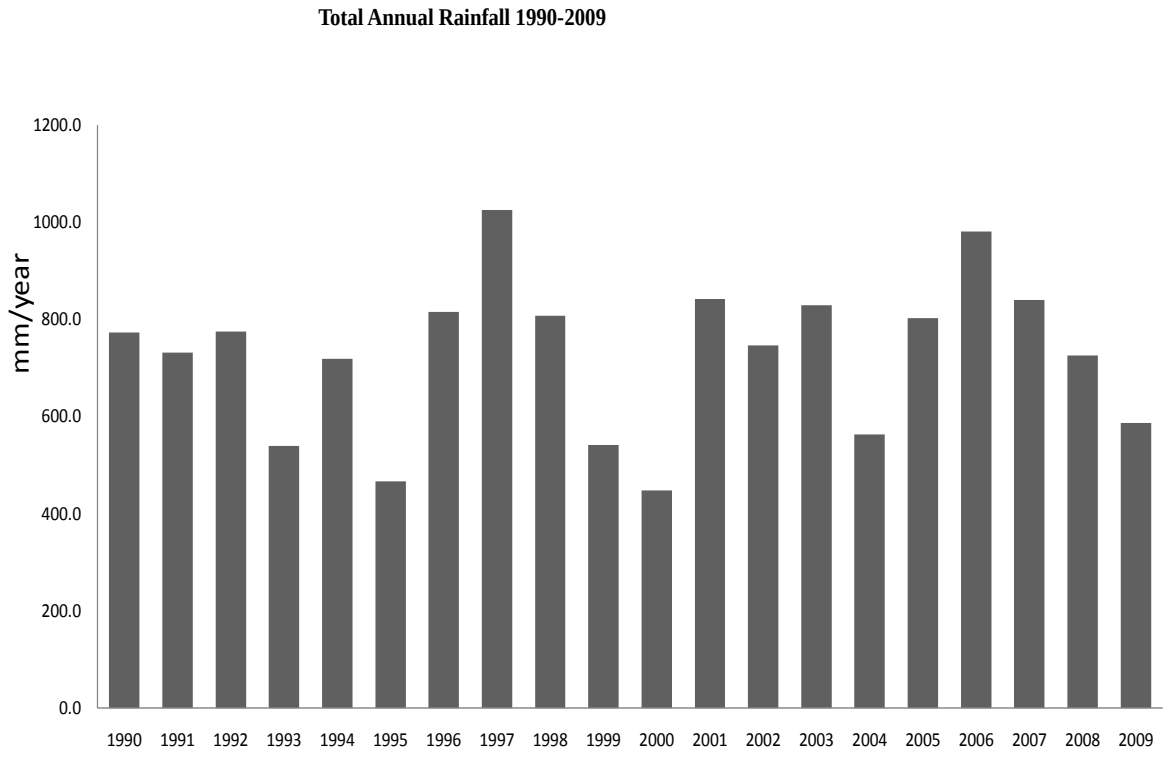

Figure 2: Total Annual Rainfall 1990-2009 (Ethiopian National Metrological Survey Agency, 1990-2009)

Figure 3: Annual Average Maximum Temperature of months in each year (Ethiopian National Metrological Survey Agency, 1994-2009)

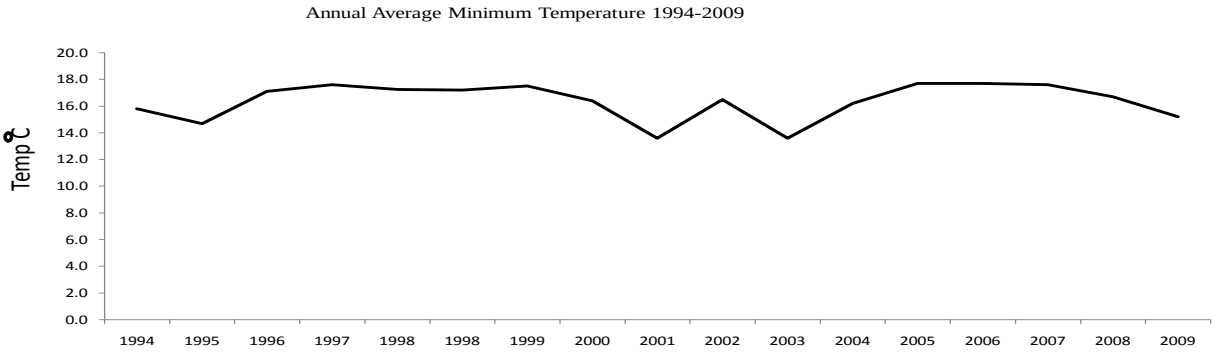

Figure 4: Annual Average Minimum Temperature of months in each year (Ethiopian National Metrological Survey Agency, 1994-2009)

2.5 Soil profile

The soil of the area varies from place to place. The Konso wereda agricultural office studied and estimated that, 35% of the soil is sandy, 30% is clay and the rest, 35% is loamy soil.

Sandy soil- is characterized by less than 18% clay and more than 65% sand. The sandy soils course texture causes a low water holding capacity and a high infiltration rate which represent the main production constraints. Its low nutrient content and nutrient retention cause a low inherent fertility status for agricultural production (FAO, 2000).

Clay soil- is a very fine grained soil with limited air spaces between the particles. Water logging might harm the roots of the plant. Plants grow well in clay soil if the drainage is adequate because of its high nutrient levels (Microsoft Encarta Encyclopedia, 2009).

Loam soil- a soil type which contains roughly 50% sand, 25% clay and 25% silt. A loam soil is a perfect soil for plant growth, drains water well and not too quickly and as a result the plant can absorb nutrients more readily (Microsoft Encarta Encyclopedia, 2009).

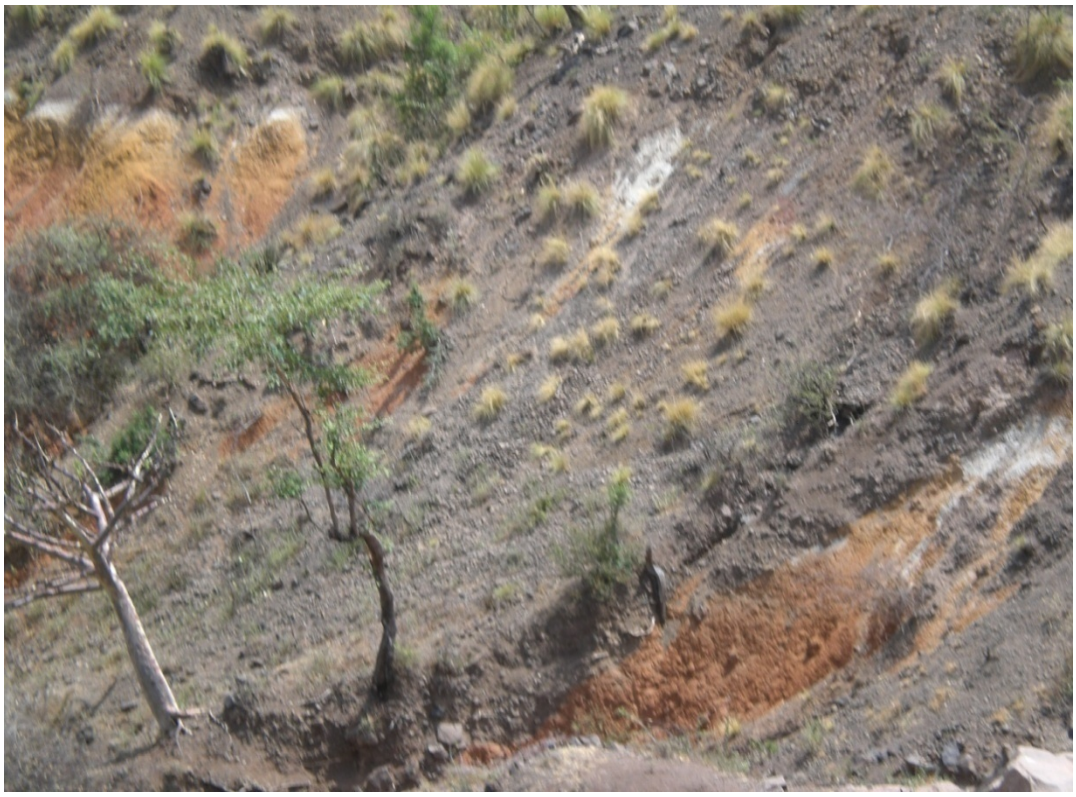

Photo 2: Sandy soil on Konso highlands (Awraris, 2012)

2.6 Agro ecological zone of Konso

SNNPR's has very diverse agro ecological divisions ranging from arid, semi-arid (*Kola*) and tropical sub-humid (*Weinadega*). Based on, the Konso wereda Agricultural Office information the main agro ecological divisions of Konso i.e. 70%, accounts arid (*Kola*) and 30% account tropical sub-humid (*weinadega*).

Sorghum is the main crop which has been grown for several years in the area. It is the main staple crop in the Konso diet; other annual crops include maize, sunflowers, millet, chick peas, kidney bean, soya bean, cotton and cassava **(**McCausland, 2010). The Agricultural Office informed that nowadays, also *Teff*, Barley and Wheat are started to be cultivated in a few places of the wereda.

2.7 Socio-economic situation

Based on the Konso wereda agricultural office information, there are around 35 villages surrounded by stone walls and in each of them there are 300-400 households. The average family size is 6 persons; based on the sample of 15 farmers that are interviewed in the study, average family size ranges 3 to 12. In rural areas of the wereda 96% of the people are illiterate.

The Konso people are known as hard workers, early from their childhood they are engaged in weaving cloths, producing crops and other different activities. There is no gender division of work in Konso and both men and women are engaged in weaving cloth, farming, handcraft work and in addition taking care of children, but women are more responsible for preparing food and other house hold activities (Forch, 2000).

Recently, ways of their living style is improving; most of the family matter has been decided equally by men and women, and if a man has the only power in his family the person will be neglected or isolated by the society. However, few years back it was the men who decided each activity at the household level.

Ward system is a system made of *"kanta"* (sub villages). In the ward system any tribe of the wereda can be a member of kanta. These groups of people are focused on work with new terraces and maintenance of damaged ones, building *"mora"* (traditional houses), maintenance of areas affected by nature and helping each other with their neighborhood if help is needed. Photo 3 illustrates how the *kanta* build *mora*. This social organization is the backbone of the people livelihood (ETV Konso documentary, August, 2009).

Photo 3*:* The neighborhood or"*Kanta"* building *"mora"* (Awraris, 2012)

For most of the farmers, farming is their livelihood activity and they start farming since from their childhood. Their farm lands are in different places of highland, plain areas and on the steep slope hilly areas and they have small plots of land at different places.

Marketing is one of their livelihood activities. Most of the time they are coming out with their handcraft products poetry, wood furniture, different cotton cloths and also they are selling live animals such as ox, sheep, goat and chicken for those people who live in the nearby cities (Beshah, 2003).

The konso people have a culture of producing food firstly for their own consumption and they are coming out to the market with the rest, unless they have reserved food for the coming time they do not sell what they have.

The growing impact of climate change contributes to a frequent food shortage problem. Hence, Konso is one of the food insecure weredas of SNNPR. Growing food insecurity in the wereda partly changes proper utilization of resources such as forests, soil and grazing lands (Beshah, 2003).

3. Theoretical Frameworks

This chapter describes livelihood approaches, participatory approaches and SWOT analysis used as a basis for the analysis and discussion part and give focuses on how to improve and bring sustainable livelihoods of the rural community.

3.1 Livelihood Approach

Livelihood comprises of the capabilities, assets and activities required for a means of living (Serrat, 2008; Leary, 2008).

A livelihood approach give more emphasis to link the assets of natural resources, land, man power and others with the different activities that help to generate income for survival (Ellis, 2000).

Livelihood activities are the means of income for the rural poor people. All the activities are attached with natural resources and high dependency on these activities can threaten the livelihood to continue as it is (Robledo et al, 2005).

When we see agriculture from the point of livelihood it is dominantly livelihood activity. Agriculture is one of the main economic activities of a country and can create a link between human beings and natural resources. Particularly, rural communities are very dependable on it.

Different determinant factors of climate change could be a constraint for the agricultural sector and rural livelihoods. A livelihood approach provides the basis for identifying the constraints to livelihood development and poverty reduction and these constraints may relate to the agricultural sector. A livelihood approach open up for external support, targeted to reduce poverty, depending up on number of factors and development activities (Carney, 1999).

The impacts of climate change create additional stress for rural livelihoods by reducing the existing livelihoods options (Agrawal, 2008). In addition, climate changes add stress on managing natural resource system, which can pose a challenge for socio ecological systems and livelihood of the farmers (Tompkins et al, 2004).

3.1.1 Applying sustainable livelihood approach or development activities

Adaptation and coping strategies

The concept of sustainable livelihood for the rural poor people revolves around the idea of rural development, poverty reduction and environmental management (Scoones, 2005).

The central goal of sustainable livelihoods is to eradicate poverty and enhance the poor farmer's livelihoods (Farington et al, 1999).

Adaptation refers to a planned action, anticipating threat or averting its impacts and infers some measure of progress or consistency of responsibility (Osbahr et al, 2008). Adaptation is a result from exposure to physical and chemical factors in the environment, from interaction with other species (Moran, 1979).

Due to various physical factors, the Konso people focus on attempting to accommodate themselves to environmental problems of their places, and as a result of their adaptability emphasizes they tend to be flexible to any environmental problems.

Adjustment and coping with environmental constraints are mostly made by people that have existed longer in a particular environment (Moran, 1979).It has been argued that governmental and external actors need to strengthen the adaptive capacity of rural people and take advantage of already existing strategies (Agrawal et al, 2008).

Adaptive approaches focuses on conservation, use of various tools to share and communicate understanding of natural resource issues, supporting decisions on resource allocation and provides a frame work for action directed towards changing ecosystem (Gunderson et al, 1995).

The Konso people have been known for their different adaptive technologies considering the difficult climatic condition and topography of the area. They have long been known for their construction of terraces, irrigation methods, intercropping of various species and planting of trees. Moreover, in order to cope up with harsh time problems and environmental constraints, local people are engaged in their own mechanisms of coping strategies and some people are also engaged in different activities for instance small business activities in the city, waving, local butchery, wage labor and brewery.

3.2 Participation Approach

The main focuses of participation approach are providing a means to increase efficiency by involving people and support the new development or services (Jules, 1995).

Using participatory approach in the natural resources management, agriculture and rural livelihoods sector include different issues such as technology, development, stakeholder analysis, community based natural resources management, sustainable livelihood approach (Probst et al, 2005).

In various developmental activities participation has a main role to attain a sustainable world, and the task of ensuring changes is in the hands of different actors of the community (Groot, 2000).

The participation of various institutions in the area such as governmental, non governmental and private organizations is important and has a decisive role in changing the situations. For instance the role of extension is giving advice for the farmers any time when they need because they live near to the farmers, facilitate developmental activities, pass different information from the government. However, lack of modern knowledge of extension, lack of transportation access control them from contacting and updating themselves with new ideas and other physical problems can be a determinant factor to change the situation of the farmers.

Nowadays, it is widely known and acceptable that participatory approach provides development practices and activities, introducing new techniques for the rural poor farmers. In addition, facilitate free and fair ground to upgrade their knowledge and to participate in various development interventions (Ajeigbe and Dashiell, 2010).

Participatory approach facilitates working with the poor people and to plan, implement and follow up development activities in the area (IIED, 2003).

3.3 SWOT Analysis

According to Valentin (2001), SWOT Analysis is a tool to identify how favorable conditions, which are strength realized for opportunities and unfavorable condition weakness exacerbates threats. SWOT analysis evaluates strength, weakness, opportunities and threats in a project, research or any intended activities.

The purpose of the SWOT analysis is yield to strategic insights and details explained in analysis. The structural framework of SWOT Analysis is illustrated in Table 1.

Table 1: Structure analysis

	Internal factor	External factor
Favorable factor	**STRENGTHS**	**OPPORTUNITIES**
Unfavorable factor	**WEAKNESSES**	**THREATS**

Source: Valentin, 2001

Strength defines factors that meet the demand of people and would detect threats. Weaknesses concern the measurement and conceptualization of status characteristics. Opportunities are circumstances which are favorable to economic, social and cultural conditions. Threats are unfavorable conditions which affect the opportunities or difficult situations which affect environment, society, economy, climate and politics of a country (Jackson et al, 2003).

4. Materials and Methods

There are 41 *Kebeles* in the Konso wereda and for the study I selected ten *Kebeles* which are highly affected from shortage of rain for several times and over flood on the past *"Meher"* season. These are Docatu, Duraite, Dera, Buso, Jarso, Abaroba, Birbirsa, Kashale, Doha, and Gera.

Ten farmers one from each *Kebele* were selected, thirty extension officers three from each *Kebele*, thirty agricultural professional of the wereda agricultural office, three elders of the community and five women included. Moreover, one nongovernmental organization also participated.

4.1 The Interviews

The reason why I decided to do interviews was because it is the easiest and simplest way to communicate. Sometimes it is difficult to find all the materials that are needed in the form of hard copy; it is easier to communicate through speech than in writing. Most of the interviews with the targeted group of the community were carried out in Amharic official language of Ethiopia and some of them in their local language.

Ten farmers, one from each Kebele, thirty extension officers three from each kebele and one nongovernmental organization were selected for an interview. The interviews were conducted during a study trip to Ethiopia. Most of the interviews were done on their farm place or in their house for one hour and thirty minute up to two hours. Most of the questions are open ended and to make it easy and save my time I wrote the questions with tally marks, therefore, other than recording their voice I used the tally which makes it very easy when I transcribe. Questions used in the interviews are shown in Appendices attached to the report.

4.2 Questionnaire

In order to fill the gap, I decided to prepare an enquiry which was not focused on one issue rather it covers several things concerning my research findings. The enquiry was carried out during the study trip to Ethiopia from the end of February until the beginning of March 2012. It was handed out to thirty agricultural professionals and extension officers of the wereda agricultural office. The enquiry was originally in Amharic then translated into English.

There were four different answers alternatives: A for− Very high, B− for Medium, C− for Low and D− for I have no opinion or I don't know

4.3 Focus group discussion

I decided to discuss with a focus group because it helps to get more ideas and information. Due to the group discussion new ideas can be raised and the group can freely share their thoughts. The discussions were held during the study trip on their free time weekends and after work under the shade of the big tree with five female farmers. They raised several issues also discuss on solutions for the problems especially aspects related with climate change impact for three hours. My discussion with three elders of the community focuses on past of the area, coping mechanisms and recent problems for two hours and thirty minutes. The reason why I decided to choose women was because they have more duty outside the farm and inside the house and elders because they know more about the past of the area.

4.4 Climatic Condition Sample survey

Sample survey was chosen to identify the current climatic condition of the area and help to show how the climate is changed over years. However, it is difficult to conclude only by using twenty years data but help me as a starting point and as accurate evidence for the information that I collect from the interviewees and enquiries. I used the sample of twenty years monthly rainfall data and sixteen year's monthly minimum and monthly maximum temperature data from Ethiopian metrological station. The data helped me to compare and contrast the climatic conditions of the area today and twenty years back. In addition, it helped me to easily see how various pressures or factors change the climate of the wereda.

5. Results

The following section of the study is based on my findings from the field; all the results are based on the interview questions, the questionnaires and the group discussions.

5.1 Climatic status

Based on Ethiopian National metrological Survey Agency rainfall and temperature data for the past twenty years, Konso has experienced variations in the amount and distribution of a rainfall and a rising of temperature. (See rainfall and temperature graphs on Chapter 2, Section 2.1). Climate change has affected the area with unexpected rain followed by heavy flood and drought. For example, in 2011 *Meher* season (small rain period during October and November) the wereda suffered from unexpected heavy rain and flood. On their second cropping season, *Beleg* (big rain time February until April 2012) I was there for the field trip, as I heard from the farmers sometimes the rain start on mid-January, but at this time the rain did not start until the beginning of March2012. Hence, the farmers could not be able to prepare the land for the next cropping season and the area experienced a very hot and dry weather. In addition, based on the wereda agricultural office information, in 2011-2012 people in *Kebele* like Abaroba, Gera and Doha were prone to food shortage and drinking water problems.

5.2 Impact of climate change

5.2.1 Drought

According to Productive Safety Net Ethiopia (2009), which is a nongovernmental organization working in the wereda. Figure 5 shows that Konso is categorized as one of the hotspot wereda of SNNPR's affected by drought.

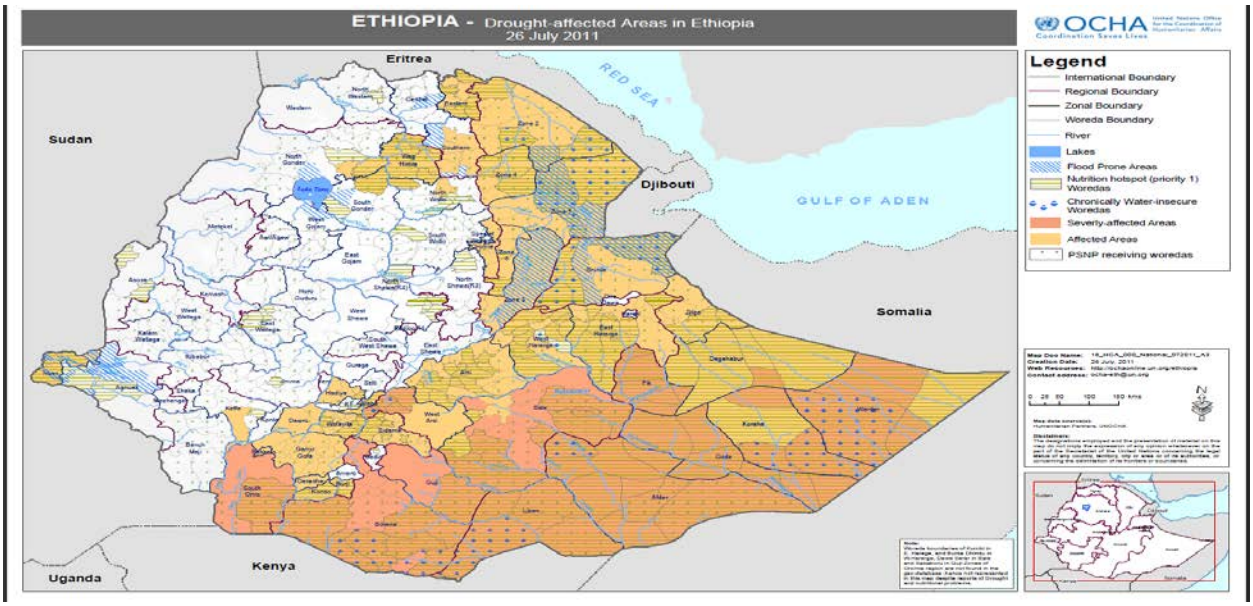

Figure 5: Map of drought affected areas in 2011

The problem of drought in the area lead to food insecurity problem. Nowadays, it is challenging for the farmers to be self sufficient in food production for their own consumption. Therefore, the farmers start looking for aid from Productive Safety Net Ethiopia. The organization provide 30.41 SEK for each member of the family per month. However, this can damage the working culture of the next generations and they prefer to migrate to the nearest cities or working nearby in the Yabelo gold extraction center leaving their family farm land.

The respondents of my questionnaire were asked why drought and food insecurity is a frequent problem in the wereda. Table 2 shows their lists of various reasons or causes for the drought however, their answer is not far from the impact of climate change or the causes of climate change could be reasons to frequent drought and food shortage problems occuring in the wereda.

Table 2: Reasons for drought and food insecurity according to the answers of questionnaire (question 12)

Respondent reasons	**Frequency (number of response)**	**Percent**
Increase population	21.0	28.37
Deforestation	17.0	22.97
Climate Change	9.0	12.16
No rainfall	5.0	6.75
Free ranching	5.0	6.75
No irrigation	3.0	4.05
Slash	3.0	4.05
Soil erosion	2.0	2.70
Overheat	2.0	2.70
No planting trees	2.0	2.70
Heavy rain	1.0	1.35
No fertilizer	1.0	1.35
Burn	1.0	1.35
No free space	1.0	1.35
Losing soil quality	1.0	1.35
Total	74.0	100.0

5.2.2 Flooding damage

One of the severe impacts of climate change is flooding damage and recently, the wereda experienced fluctuations with the amount of rain both in small and big rainy seasons. Sometimes very heavy and unexpected rain followed by flood hits the wereda. For example, recently in 2010 *Belge* season (big rain time February to april) and 2011 last *Meher* season (October and November) it was small rain time but unexpected heavy rain followed by flood eroded the soil, distructed their terraces, destroyed two of their irrigation schemes, took the lives of their animals and loss their crops.

5.2.3 Degradation of land

In addition to the difficult topography of the wereda, traditional system of land use, the absence of rain and shifting cultivation lead the land to lose its quality and to be degraded. According to the respondents and interviwees the main reason for the severe impact of climate change in the wereda could be, rapid growing number of population, deforestation, over grazing of pasture land and topography of the area exposed the land to be eroded.

5.3 Agricultural Status

Agro ecological farming practices of Konso people

5.3.1 Intercropping

One of the common farming practices in Konso is intercropping. The main intercropping practices include:

Sorghum and "*Hohe"* (a kind of legume of which farmers use the green fruit for their meals)

Sorghum and Sunflower

Sorghum and Kidney bean

Photo 4: "*Hohe* "intercrop with Sorghum (Awraris, 2012)

In different *Kebeles* of my study areas farmers usually used the above mentioned crops to grow together in the two cropping season's of *Meher* and *Beleg*.

During *Meher* season, in September the farmers plant Sorghum and Sunflower, sorghum and *Hohe*, then after few days if there is enough space they will add kidney bean, within three months time, kidney bean and *Hohe* are harvested. Finally, if water is available Sorghum is getting ready to be harvested within six month time. The same thing will be happen during *Beleg* season.

The farmer used to intercrop these plants, mainly because of Sorghum is a drought resistant crop and the others are early maturing crops. *Hohe* and Kidney beans grow in a short time with a little water. Sorghum stays on the field for six month, it could provide a shade for the other plants that grow together and those plants do not need too much water and keep the soil moist.

Maize is one of the second important crops in the wereda. Most of the farmers would like to plant it alone because it needs more water to grow. However, the latest years it has been difficult to harvest maize on time as compared to other crops of the area, because the wereda has suffered from shortage of rain.

Most of the farmers in Konso grow trees like Eucalyptus, Moringa olivera, "*Weybeta*" together with different crops. Intercropping trees with crops has its own purpose especially, trees like Moringa olivera have several purposes; used for shade, it has a very high nutrition quality and Moringa leaves serve as their main diet and is used as a medicine for various diseases. The leaves of *Weybeta are* used as a feed for their animal.

5.3.2 Irrigational farming

In the Konso wereda there is only one permanent river called Segen. It is a semi Perennial River, on average it flows four to five months but the farmers could get enough water to grow some of the crops such as sunflower, *Hohe* and Kidney bean in three months time. The other river which holds water only during the rainy time is called Yanda and it is a kind of dry river. From these two rivers, 5000hectares of fertile land is on irrigation for the past nine years. Around 35.000 people are using directly the irrigation schemes to grow their crops and more than 60.000 peoples are indirect beneficiaries through market. Seven irrigation schemes are constructed in the wereda's two *Kebele* Jarso and Birbisa. However, the river Yanda water is available only during the rainy time and the schemes could not be able to support more than these two *Kebeles* people. In addition, to the shortage of Permanent River in the wereda, topography also has its own great impact on irrigation farm.

5.3.3 Manure and Mulch

For the Konso people, the use of animal manure is one way of keeping or adding the soil fertility. Most of the farmers raise their animals near to the farm land or in their living compounds. They use to collect their animals manure and deposited for few days and distribute to the field. But if the animals are far away from the farm field because of not enough space and other reasons, farmers use the manure as a fuel. Nowadays, the rapidly increasing number of people is a reason for the wereda's most farmers having small size of farm land. Therefore, it is difficult to find place for their livestock's near by the farm as a result they are forced to move them to the low land areas.

There is no uniform mulching practice in Konso because some of the farmers believe that leaving the residue on the field help to increases the number of weeds on the farm. Particularly, those farmers on the highland areas are better in practicing mulching than those on the plain areas and because of the shortage of farmland their animals are kept on the plain area where there is enough space, pasture and drinking water is available. However, it is difficult for those farmers who live on the high land areas, to practice mulching where there is no rain. (Photo 5), shows most farmers of the high land areas are forced to sell the residue for livestock consumptions.

Even though, mulching is not practiced everywhere by all farmers, the wereda indirectly benefited to reduce very high transpiration from soil because of the absence of tillage.

Photo 5: Residue prepared for market (Awraris, 2012)

5.3.4 Agro forestry

In Konso, trees are cut down for various reasons of house hold activities. The agriculture office of Konso wereda and two nongovernmental organizations (Mekane Yesus Developmental and Food Security Project and Green Aid Project) provide nursery established trees and fruit trees for the farmers and they also teach the farmers the benefit of planting trees to protect their wereda from more impact of climate change. Nowadays, in addition to supporting the farmers to plant trees, the wereda administration set rules and penalties for those who cut down trees for any personal and household use. However, in Konso shifting cultivation is one of the methods applied for expanding their farm land in order to minimize the problem of small size farm. Therefore, the farmers are forced to slash and burn the nearby forests and add small plots of land in different places. For example, in the case of one farmer who lives in Dorite *Kebele* have 5 hectares of land but it is in four different places, another farmer in Abaroba *Kebele* have 2 hectares of land in two different places, as a result of slash and burns the old forests.

Photo 6: Planting variety of seedlings on the highland of Konso (Awraris, 2012)

5.4 Management of natural resources

The Konso people are known in various ways of natural resource conservation. The famous terracing system protects the soil from erosion.

Terracing- is one of the most historical and traditional ways of soil protection from erosion. They are building a stone terrace on the hilly and steep slope highlands. The Konso wereda agricultural office estimated that there are 35.000 km terraces being built during the last years. The following photograph shows how terracing protect the soil of very highland areas of Konso.

Photo 7: Terracing farm on Konso highland (Awraris, 2012)

All the respondent of my questionnaire were asked, if there are other ways more compatible to protect the soil from erosion in Konso. Their answer was that terracing is the best technique inhabited in the area to protect soil.

Nowadays, in addition to terracing new techniques of soil conservation are introduced through agricultural professionals of the wereda these are:-

Soil band- it is similar to stone terrace but now the farmers introduced to build the terrace with soil where the force of water is not too much at the low altitude area and where the stones are not easily available.

Trench hole- this is preparing of a small hole for planting trees. It is the easiest way for planting trees. Especially, for nursery established trees the soil is prepared very well.

Check dam- It is making a ditch with an outlet to decrease the speed of rivers and flood. (Figure 6), illustrate the ditch has an outlet in each distance on both left and right side and the soil will be deposited in each outlet. It helps to reduce the removal of soil by the run off. Most of the check dams are building to decrease the soil erosion from water runoff on the steep slope and hilly highlands during rainy season.

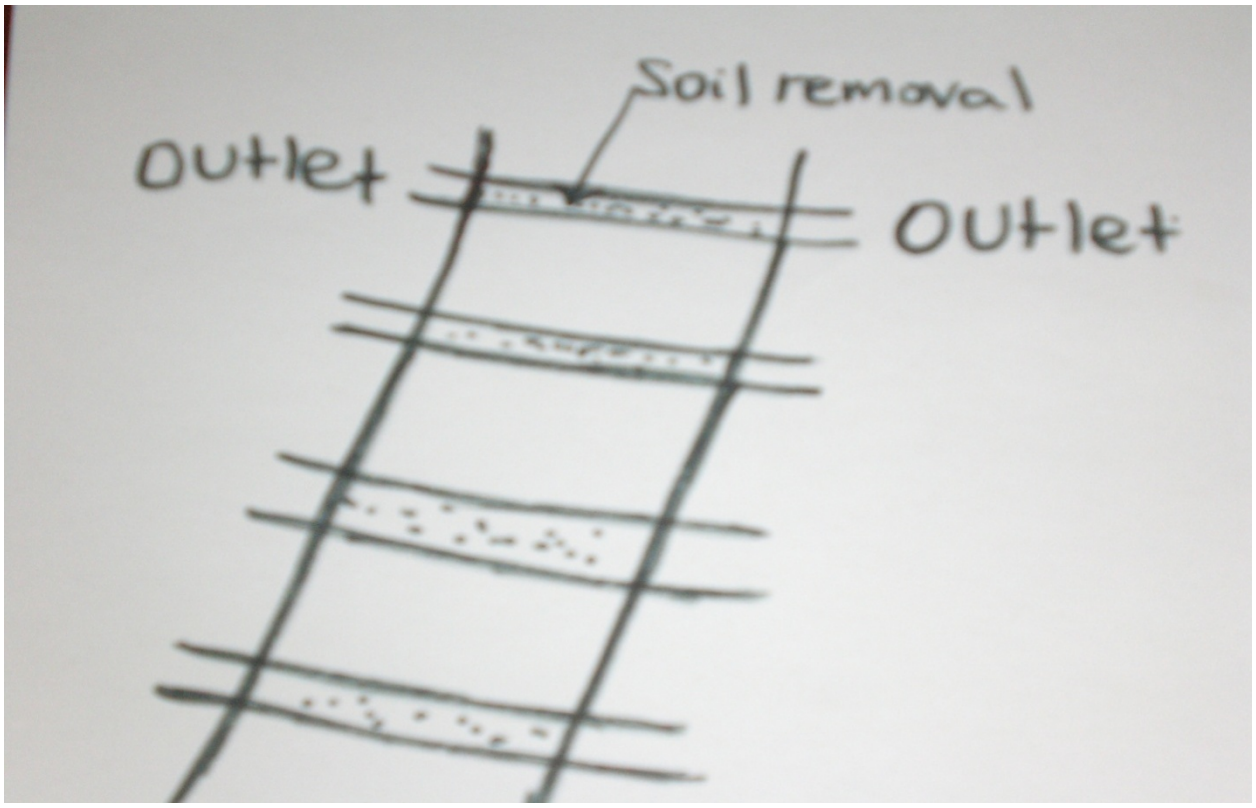

Figure 6: Check dam (Awraris, 2012)

5.5 Sustainable soil management

The Konso people are known in their good management of soil from erosion. However, some of the important practices of sustainable soil management systems that help to increase the quality of soil are not applied such as:-

Cover crops – There are two cropping season's *Meher* (October and November) and *Belge* (February-April) and farmers used to intercrop Sorghum with other crops. The intercropping practices are explained in section 5.3. In Konso most of the farmers land, starting from ends of December until mid-February has been stayed bared. The farmer says it is a transition period from one season to another and they believe in giving rest for the soil in order to keep it fertile and therefore, they collect the residue and leave the land, without covering crops. However, the wereda has suffered from scarcity of rain. Hence, the soil exposed to loss of its moisture on the fallow period. For example, during December 2011 to March2012, most of the farm lands were bare and the farmers expected the rain on time but it was very late and as a result the soil lost its moisture and the land become very dry and difficult to dig.

Tillage system- Because of the topography of Konso tillage cannot be applied, 70% of the wereda is highland. (Photo 8), shows most of the farmers who farm on the highland areas are using a stick made with iron called *"Payra"* and those farmers who farm on the plain areas use oxen plough.

Photo 8: *"Payra"* tools used for farming (Awraris, 2012)

Nutrient Cycling – all the farmers that I made an interview with said that they do not practice covering their land with cover crop which is very important for nitrogen fixation or recycling nutrient and transpiration. As I discuss their reason on the above section cover crop. They do not believe and agree on the use of cover crop. However, they did not use any chemical

additives to recycling nutrients until recent days, but now the farmers introduced and started to use chemical fertilizers for production and pesticides to control weeds.

5.6 Sustainable agriculture

Sustainable cropping system- in the wereda the problems with declining an output trend and the fluctuation of yield stability lead to attaining sustainable cropping system difficult. It is mainly because of various disturbances such as, the impact of climate change on the variation of rainfall and rising temperature. Also different other reason could fluctuate the yield that the farmers should get in each cropping seasons for instance un-proportional farmland size and family size, overexploitation of soil and other natural resources which may result in land degradation and declining soil organic matter or quality.

Sustainable land use- The Konso farmers have known for several years as they achieved production combined with conservation on their most fragile land. The UNESCO in June 27, 2011 announced that it has added the *"Konso cultural landscape of Ethiopia to its world heritage list"* (New Business Ethiopia Reporter, 2011). In Konso conservation of natural resources is remarkable however; the problem of achieving food production together with conservation is the main difficulties that they face. Hence, food insecurity and malnutrition become the major problems and aspects of the wereda.

5.7 Institutional measures

Other than culture, norm and beliefs of the society in the wereda there are informal institutions which are not recognized by the state such as, social organizations including *"edir"* (group of people who gather to help each other during their emergency or crisis situations), *"ekub"* (members of people who gather to save some money also the institution facilitate and involve in different development activities). Though, these institutions have their own role in improving the rural living standard, as part of this study only governmental and non-governmental institutions role are targeted to take measures and to bring changes for the rural livelihood.

Governmental and nongovernmental institutions of the wereda focuses and aim on related issues these are:-

- **Planting trees-** the wereda agriculture office and two nongovernmental organizations distributing nursery established trees throughout the community.

- **Controlling rapidly increasing population number –** the wereda health office and Mekane Yesus Developmental and Food Security Project are involved in teaching the community, how they can control the growth of population and the impact of increasing

population number. As I get the information from MekanYesus project head, the rural farmers still insist on their belief of replacing their generation without any number limit.

- **Strategy for developmental and food security project-** sustainable development to eradicate poverty through time in securing food issue is the aim of both governmental and nongovernmental organizations. Examples are construction of ten drinking water reservoirs in two *Kebele* of the wereda and updating the knowledge of creating awareness on environmental protection work and starting of biogas for household use in one *kebele*.

- **Empowering women-** both governmental and nongovernmental organizations of the area aim to empower all women throughout the community because women have more responsibilities in the family. Hence, empowering women can bring a radical change within a short time.

- **Continuing and introducing new techniques of the already existing culture of natural resource conservation-** especially for the protection of soil the wereda agriculture office work in this sector, mainly because of the topography of the wereda is vulnerable to soil erosion.

- **Expanding irrigation farm on the plain area of the wereda –** irrigation farm is very small in numbers because of the shortage of a Permanent River in the wereda. Mekane Yesus Developmental and Food Security Project are only engaged in constructing irrigation schemes in two *Kebeles* of the wereda. The other *Kebele's* cannot be benefited from the programme because no other rivers pass near by the *Kebele's*.

- **Area enclosure-** both governmental and nongovernmental organizations participate in area enclosure. The land is degraded as a result of repeated people and animal's activities. Therefore, enclosing the degraded part of the land from people and animal contraction until it upgrade is a measure taken by both institutions. They believe that giving rest from any contact help to rehabilitee by itself without putting any cost.

6. Discussions

This chapter of the study discusses and analyses findings from the field. The chapter aims to state the research question based on data findings.

In order to evaluate whether climate change has made a great impact on the farming practices of the wereda small scale farmers, I have concentrated on my research enquiry and interview, based on the results I have reached to the following conclusion for the first research question how the climatic and agricultural status of Konso affected by factors contributing to climate change.

6.1 Factors contributing to the impact of climate change

Population

All the respondent of my enquiry question 6 and interviewees state that, the rapid growing population of Konso is a cause for increasing demand of farmland, wood for construction, for cooking and over utilization of resources within a very short time. Most of the rural households rely on using a range of natural resource. Regarding trees, not only for usual household use, also the impacts of growing number of population lead to clearing forests and changing the places to farmland.

Holdren et al (1974), says that *"Population has direct relationship with development."* Population growth can be a cause for disproportionate utilization of resources, depletion and environmental deterioration.

The Konso are small tribes of Ethiopia (The Konso People Profile, 1993). They were small in number but currently they are growing very rapid.

Watson (1998) stated that, population of Konso lies between 120.000 and 125.000. The (1996) CSA estimated that there are 157.585 people inhabited in the area.

Overtime, the population of Konso has doubled itself in ten years' time and exceeds more than 235,087 (CSA, 2007).

In an agricultural society each individual activity contributes for many of negative impacts on their surrounding environment. Individuals are responsible for destabilization of ecological systems and changing of the environment which results from the practice of agricultural activities (Ehrlick et al, 1971).

A need for more agricultural land increases through time, which brings a challenge for the Konso. Instead of simply farming on their previous farm lands they need more area. Hence, they start to confront with the forests and other resources surrounding their place.

In addition to very rapid growing population the geographic distribution of human population also aggravated massive changes on croplands, pastures, forest plantations and overall the ecosystem (Ramankutty et al, 2002).

A study by the Japan International Cooperation Agency (1999) cited the demographic factors.

Population pressures, particularly on the highlands contribute to:-

- Conversion of forest land into agriculture- contributes for soil erosion and environmental destabilization.
- Conversion of crop residue and manure into fuel- thus depriving soil a chance to replenish itself.

The general manager of Betel Mekane Yesus nongovernmental organization explained that "geographic distribution of Konso people is based on some facts of the area, they are settled or densely populated on the hill top of the highland, because to protect themselves from the disease malaria, to protect from boundary disputes, to provide safe place for their livestock's and families from wild animals". Hence, most of the Konso highlands are degraded and forests of the area vanished.

Deforestation

The respondents to my enquiry question number 6, 80% of them answered that deforestation is the main problem caused by growing number of population and their growing needs hence; it is one of the main factors for increasing climate change impacts.

According to Bishaw (2001)," the problem of deforestation in Ethiopia is because of multiple and interrelated factors of increasing population, overgrazing, exploitation of forest for fuel, fodder, household furniture and clearing forest for agricultural use. Deforestation accelerates the rate of land degradation, enhancing the problem of climate change impacts."

Konso can be considered as the area where trees are cultivated throughout the region. However, because of various reasons deforestation is the main problem of the area. Especially, growing number of population is one of the main factor in the wereda *"when one child is born one thousand trees are killed"* (managing director of Betel Mekane Yesus).

Nonprofit organizations that work in the wereda are also engaged in tree planting activities. Planting new trees or reforestation is one of the methods of sustainable forest management and it requires that a new tree will be planted for every tree cut down for fuel wood or land clearing activities (FAO, 2008).

There are many grove of trees in Konso, trees grow in the highland and provide great importance for different reasons ranging from playing a vital role in keeping the area from being dry to

various ritual and house building activities (Tadesse, 2010). However, the area that is converted from forest to other use is vulnerable to erosion and loss of soil moisture.

Especially, in Konso most of the areas are highland and the risk of soil erosion is very high. Moreover, traditional systems of land use led to rapid land degradation, and deforestation causes both ecological and economic problems which lead to animal and plant species extinction.

Even though, problems did arise in some of the more fragile areas where a large number of people were concentrated farmers often responded with sophisticated and effective conservation measure, which were developed to overcome degradation threats and to maintain or raise crop and livestock yields (FAO, 1993).

Shifting cultivation

According to the interviews with farmers most of them mentioned shifting cultivation as one of the factor for deforestation however; it is Konso's historical and traditional ways to avoid shortage of land problem.

Most shifting cultivation is practiced in hilly and isolated uplands, because of the problems of soil erosion lands tend to be highly eroded and degraded. The resulting ash from shifting cultivation provides nutrient rich seed bed on which a diverse and complete crop cover can be rapidly established. It helps to check losses by leaching or soil erosion (Beets, 1990).

In Konso the main purpose of practicing shifting cultivation, is for the purpose of expanding their farm land. After clearing forests immediately they establish crops without giving time for a crop to cover the land and for the nutrients to recycle. Hence, they are losing two things, forests of the area and the shortage of mineral in the biomass, and the reestablishment needs several years (Beets, 1990).

Nonetheless, their main reason of shifting cultivation is un-proportional size of farm land and increasing number of family size leads them to face food insecurity and malnutrition repeatedly.

Expansion of range lands

The wereda Agricultural Office and Nongovernmental Organizations mentions that free ranching or overgrazing is one of the factors attributing to impacts of climate change. They start area enclosure to save degraded part of the land from more impacts and damages.

Based on Mekane Yesus Ethiopia "the people who live in the plain areas of Konso, they are close to Borena, nomad's people of Ethiopia. More than 50% of these communities on the lowland part of Konso are semi nomad," unlike the Borenas they are settled and structured in one place. Their livelihood is based on their livestock's.

However, unorganized and unstructured ways of grazing pasture land in Konso cause the soil to erode and to lose its quality which results in land being degraded and intensified famines and ecological degradation in the wereda.

6.2 Sustainable livelihoods and coping strategies

The participation of actors in the wereda is not that much satisfied however, the role of governmental and nongovernmental institutions as it stated on the result part help the rural community few steps to improve their livelihood. Therefore, I used these two approaches to see in-depth the third research question.

6.2.1 Sustainable Livelihoods

Poverty

According to the Konso Wereda Agricultural Office, farming is the only livelihoods for more than 90% of the Konso farmers.

They start farming from their childhood, few of them obtain income from weaving, local brewing, bee-keeping and meat retailing. There are no employees and employer relationships; every farmer has his or her own farm. However, the majority of the people lives below the poverty line and isolated from most development interventions.

A person is poor not only when his or her income level is below defined poverty line. Poverty also includes insecurity or vulnerability, levels of health and levels of literacy are scopes that can be influenced by poverty (Farington et al, 1999).

Based on UN Rapid Assesment of Konso special wereda report (1999), information of Konso wereda Agricultural Office, interview with farmers and nonprofit organization representative; it is not an easy task to separate the werda from poverty, mainly because in most recent years the intensity of drought occurrences has increased. As a result people are not only suffering food shortage problem, their access to their basic needs and different livelihoods assets are denied.

Sustainable livelihoods aim to expand certain access to livelihood assets, comprises of human capital, social capital, natural capital, physical capital and financial capital. These are important assets which the poor must make exchange and choices (Serrat, 2008).

Based on the models of DFID sustainable livelihoods framework (Figure 7), illustrate Sustainable livelihood framework of the wereda.

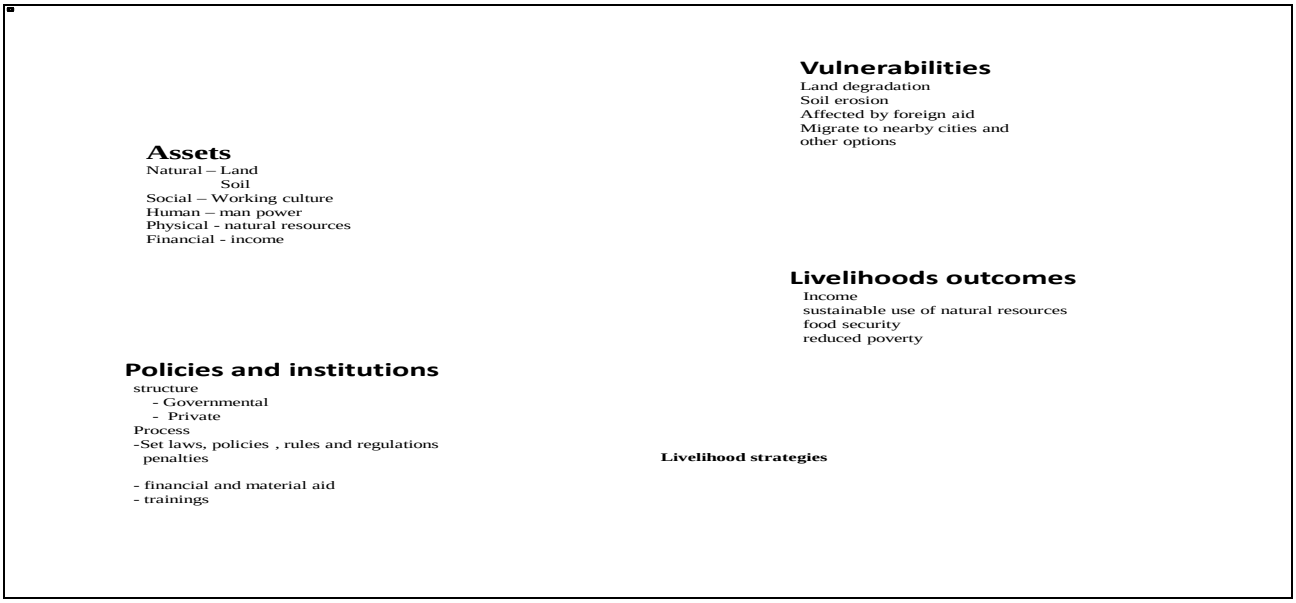

Figure: 7 Sustainable livelihood frame work

Source: (Awraris, 2012) based on the models of DFID sustainable livelihoods framework.

The concept of poverty and its cause underpins sustainable livelihood approaches, that it has influenced thinking and practice throughout the development world. No longer doubt that sustainable livelihood approaches can add value to effort in reducing poverty (Carney, 2002).

According to Watson (1998) and Hallipke (1972) the Konso farmer's access to attaining the livelihood assets is difficult for all households. The problem of poverty is not restricted to house hold level. The access to natural capital, social capital, financial capital and power is based on the people settlement or seniority. People who settle first have easy access to various assets and the other easy access is based on gender. In Konso male has the upper hand.

6.2.2 Coping strategies

Ceccarelli (2010) stated that it is easier for the people adapt to climate change, when working as a group than as individuals.

All the farmers in each *Kebeles* that I interviewed were participating in a new system of adapting natural resource conservation methods. The new system is called five men strategies; it is a participation work of different farm activities and natural resource conservation. Five people work in one group, and the number of groups in each Kebele varies based on the population of the *Kebele.* The group focused on:-

- Natural resource conservation work
- Adoption of new technologies, for conservation work and new farming systems
- Formation of social network – for example agricultural extension, health and sanitation extension

The TARP Phase two- SUA PROJECT (2005) stated that adoption of new technologies or introducing new knowledge to a group of farmers from fellow farmers could be done without cost by participation and all the farmers participate.

New techniques of natural resource conservation such as soil band, check dam and trench hole are practiced for the first time in the wereda. The farmers support by the Konso wereda Agriculture Office and *Kebele's* professionals only constitute in organizing the group.

Adoption of new techniques by farmer participant has economic benefits also helps to decrease the work load of gender (TARP Phase two- SUA PROJECT, 2005). Most of the farm activities and natural resource conservation work will be covered by the participation of genders. There will not be any specific work belonging to women or men. Thus, it could reduce the load of women.

In Konso women are relatively more loaded than men with work inside the house and also outside at the farm. On my discussion with a group of female farmers they argued that "the participation work or five men strategies provide more free time for women by reducing their load on the farm activities." Table 3 shows that most of the burden of household activities and farm activities rely on women.

Male	**Female**	**Joint task**	**Participation work** (natural resource conservation and other farming activities)
- Terracing -Building, maintaining house and *mora* - Fencing	- spreading manure - Looking after children - Cooking, grinding - Collecting firewood - Fetching water - Brewing beer -selling products on market	- Digging - Sowing - Weeding - Harvesting - Scaring birds -waving cloth -Looking after animals -Washing clothes	-terracing -building check dam, trench hole and soil band - spreading manure - Digging - Sowing - Weeding - Harvesting -Looking after animals

Table 3: Division of labor between genders and farmers participation work

Source: (Awraris, 2012)

Locally adopted and traditional coping strategies of a community, its effectiveness and sustainability depend on the intensity and duration of the problems. Moreover, all the coping strategies that are considered hazardous are not efficient or appropriate for long term adaptation, but some strategies are based on survival needs and for short term consideration (Riche, 2009).

On my discussion with the elders of the community, the Konso people have their own traditional and historical experience of coping mechanisms, applied when drought and food shortage happens:-

- Have their own traditional calendar, which tells them whether there will be rain or not, based on the movement of the sun, the stars and the moon, which is experienced by elders of the community.
- Reducing the content of food for their meal or leaving their lunch or breakfast.
- Eating plant roots and weeds during drought time.
- *"Korem"* a kind of root plant they used to plant during drought time and use as a food.
- Looking for aid

6.3 Sustainable agriculture

Despite various approaches and criteria to measure the sustainability of agriculture, I discuss only two of the criteria; sustainable cropping system and sustainable land use, mainly because I used these two measurements of sustainable agriculture in my result part to answer the second research question.

Sustainable cropping system is a sustainable system in which the output trend is non-declining and resistance in terms of yield stability, low fluctuation of stress and disturbance (Spencer et al, 1992).

Sustainable cropping of the Konso agriculture is often affected because of various problems such as rising temperature, low rainfall, unexpected flood, land degradation and other factors. Hence, the farmers yield decline from time to time.

Sorghum is the main staple crop of the Konso people; they are planting it in the two cropping seasons of *Meher* and *Belg*, the second important staple crop is Maize.

On my interview with farmers they were asked to compare the yield of main crops (Sorghum and Maize) five or ten years back and they explained that during the latest three years their yield had decreased or failed.

For example:a farmer from Toraite *Kebele* said that in 2011 the *Belg* season could get 5quintal (500kilograms) of Maize because of shortage of rain which is small when compared to previous years. According to the Agricultural Office the average yield of Sorghum in good rainy time not less than 900kilogram per hectare. The amount of Sorghum collected in the 2011Meher season was less than 1quintal (100kilograms) because of flooding damage in the area.

Farmers from Abarobal Keble told that in the 2011 *Meher* and *Belg* season they faced a complete crop failure of Maize and Sorghum because of drought and unexpected flooding damage. They told that they can only grow 'wild food' plants, such as *Korem.*

Farmers of Doha Kebele, told that in the 2010 *Meher* and *Belge* seasons could not collect more than 10quintal (1000kilograms) Maize and Sorghum.

Also other studies indicate that the sustainable cropping system of the wereda have declined from time to time. Tadesse (2008), made a trend analysis of sorghum yield for three cropping periods 1990-1999, 2000-2004 and 2005-2006, and they showed that yield was much lower in the second cropping years prior to 1990s.

Sustainable land use

There are definitions of sustainable land use and according to Young (1989):

SUSTAINABILITY= PRODUCTIVITY+ CONSERVATION OF RESOURCES

Sustainable land use is achieving production combined with resource conservation. It is not only conservation of soil but the whole range of resource on which production depends.

The Konso people were well known for years in combining two complex systems of food production and resource conservation at the same time. Others can learn much from their development of combining multiple water and soil conservation systems on their hilly highlands, techniques to maintain soil fertility and raise food crops (Watson, 2009).

Sustainable land use is based on complex relationships of socio economic needs, physical resources and biological requirements (Roberts, 1995).

Thus, socio economic needs include various social needs and the result of crop production, physical resource focus on conservation issues and one of the biological requirements is about nitrogen fixation, which is an important factor in crop production. Other research studies states that climate and soil also contribute to control the biological productivity through variation of rainfall and rising of temperature and the quality of soil (Riebsame et al, 1994).

However, the intensity of drought occurrence in the wereda seems to be growing. First it was in ten years intervals, then it occurred in five years' time and recently it seems to start to happen almost in three years' time (Wereda Agriculture Office and NGO).

UNDP (1995) explained that "most of the Konso villages suffered from food deficit and malnutrition mainly because of increasing population which lead to an ever increasing pressure on limited arable land; deforestation, declining soil fertility and degradation of land."

However, it is difficult to conclude that there is sustainable land use in Konso. Despite of their natural resource conservation work which gets awarded by international organization, the community suffers more and more from food insecurity and poverty.

6.4 SWOT Analysis

Table 4 shows analysis of strengths, weaknesses, opportunities and threats of Konso farmers, which originate from the result of the sample survey and enquiries, evaluating the present climatic conditions and agricultural status of the Konso wereda.

Table 4: SWOT Analysis of the Konso wereda farming

Strength	**Weakness**
• Agricultural knowledge • Natural resource conservation knowledge or work • Hard worker	• Rapidly increasing population number • Deforestation • No knowledge of modern technologies • Illiterate • No infrastructure
Opportunities	**Threats**
• reforestation • Irrigation farm • Expansion of cash crop (Teff and Sesam) • Expansion of vegetable farm • Hotel and tourism center • Education • Extension	• Unexpected heavy rain and flood • Increased variability of rainfall and temperature • Size of farm land • Frequent food insecurity • Expansion of desert • Disease (Malaria) • Looking for aid

7. Conclusions and Recommendations

The main aim of this thesis was to investigate from a perspective using sustainable livelihood and participation approaches, the impact of climate change up on Konso farmer's livelihood and their agricultural activities.

To estimate the impact of climate change through time on the agricultural practices, livelihood of the farmers and environmental friendlier of the area the result presented in this study shows that, several factors of climate change have influenced the Konso wereda farming practices and sustainable agriculture. Based on data, the current climatic status of the area is not static; it is highly varying largely as a result of climate change impacts and growing of population. Therefore, farmers could not simply depend on their cropping seasons.

To find out increasing resilience of the society and sustainability of agriculture in the wereda the conclusions from the questionnaire and interviews indicate that, a rapidly increasing population is the main reason for the wereda to be affected repeatedly by the impact of climate change. Furthermore, result in destruction of forests and over utilization of all other natural resources. Nonetheless, there are number of agro ecological farming practices in the wereda however; various social and physical factors of the area could not be able to apply as it needed. As a result, it is clear that natural resource conservation work and the agricultural practices of Konso wereda seem to be severely affected from climate change impact, famine and poverty hits the wereda repeatedly.

In general, measures taken to improve the livelihoods of the farmers and agricultural practices of the wereda are support by the community programmes, governmental and nongovernmental actors of the country, who involved and plan to bring change for agriculture and related activities. Though, developments are seen in different parts of the country where food shortage and drought are major problems. However, in the case of Konso while the wereda gets award of landscape planning and conservation of resources, the problem of food insecurity cannot be easily addressed. Hence, the wereda is one of the hotspot wereda that needs aid according to Productive Safety Net Ethiopia.

I suggest that nevertheless, there are impressive topics and agendas of organizations to improve the wereda from hazardous of climate change. However, from nongovernmental organizations it is only Mekane Yesus Developmental and Food Security Project which works fulltime with engagement in the agriculture sector. The Green Aid Project works only in growing and distributing nursery established trees. The other nongovernmental organizations that work in the wereda have their main targets far from agriculture. Therefore, it would be good if more nongovernmental organizations could work in the area of agriculture since, as I mentioned above, more than 90% of the people livelihoods are based on agriculture.

The result of this study should raise questions for future research in the wereda and the next step should be focused on investigating how the main reason of the problem; the rapid growth of population, could be controlled, since the agro ecological practices and natural resource conservations alone would not bring change and improvement of food shortage in the wereda.

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Appendix I: Interview Questions for the farmers

Background

1. How many members of family do you have?
   Age
   Gender
2. Is farming your only livelihood activity? For how long time?
   Hours per day/ week
3. What is your main duty in your farm work?
   Owner/ employer
   Employee
4. Is there a gender division of labor?
   Men
   Women
5. What kind of systems adopted related with clans?
   Who have the power to decide?

Farming today

1. How much is the size of your farm?
   The same size before some years back
   Increasing
   Decreasing
2. Do you have or rear livestock's?
   What kind and how much
   Cattle
   Cow
   Sheep
   Goat
   Chicken
   Others
3. For what purpose are you rearing livestock's?
   Selling
   Household use
4. What are the main crops that you cultivate on your farm?
   Crops
   Vegetables
   Fruits
   Trees

5. How is the yield when you compare with previous five or ten years?
   Can you tell me in kilogram or quintal?
   Very high
   Medium
   Low
6. What kind of farming techniques are you using?
   Oxen plough
   Hoes
   Digging sticks
   Small farming machine
7. What kind of farming methods are you using mostly?
   Intercrop
   Crop rotation
   Irrigational farm
8. Is there any different other agricultural practices applied in your farm?
   Mulching
   Manu ring
   Cover crop
   Wind breaks
   Contour plowing
   Slash and burn
9. Are you using chemical fertilizers and pesticides on your farm
   Herbicides
   Fungicides

Climate change

1. Can you explain the climatic condition of the area?
2. What is the main impact of climate change?
   Amount of rain and temperature
   Variation of rainfall
3. Is there any specific problem that you face because of climate change?
4. What kind of methods are you using to take care of natural resources?
   Can you explain for me terracing work in the area and other methods to protect soil erosion?
5. What are the main problems caused by climate change?
6. At this time are you able to be self sufficient in producing food?
7. When do you face food shortage? How frequent it is?
   5 years
   10 years

Appendix II: Interview questions for extension services and agricultural professionals

Background

1. What is your main duty in your work?
2. How long have you been in the area?
3. How do you reach to the farmers?
   How many times do you give the advisory service?
   Is it free or with price?
4. Is there any determinant factor to reach the service for every farmers of the wereda?

Impact of climate change

1. How do you define climate of the area?
2. What is the impact of climate change in the area?
3. What things are being considered for the cause of climate change in the wereda?

Measures taken for rural living standard

1. Is there any preventive measure taken to safeguard the area from the impact of climate change?
2. Is there any new technique or measures introduced by the extensions to improve:-
   Outcome of agricultural production
   Food self sufficiency
   Natural resource conservation methods
3. What are the measures taken to protect the role of trees in keeping the environment from being dry or keeping the area from shortage of rain?
4. Can you mention some examples of measures taken by the government or non governmental bodies:-
   To protect the area from further climate change impact
   To increase yield
   To keep the role of trees
5. As an expert of the area what do you suggest to improve the livelihood of the farmers?

Appendix III: Interview questions for the NGO's

Background

1. What is the name of your organization?
   Its purpose and role
2. How many years have you work in the area?
3. How do you reach to the farmer?
4. Do you have a plan to expand your service where the community needs support?

Impact of climate change

1. What are the main constraints of climate change in the wereda?
2. Can you describe how the impacts of climate change affect the community of the wereda?
3. How do you contribute to support the farmer from more climate change impacts?

Measures taken for rural living standard

1. What are some of coping strategies or measures that your organization provides to the farmers?
2. What is the role of your organizations in securing continuous food self sufficiency in the wereda?
3. Is your organization has a role of planting trees?
   Is there any other techniques introduced by your organization to conserve resources?
4. What is your opinion for other nongovernmental organization to work in agriculture sector? Have you faced any difficulty to work alone on this sector?
5. Can you mention some of the changes that you can bring to protect problems related with food insecurity?

Appendix IV: Questionnaire

Personal profile of the respondent

1. Sex M ☐ F ☐

2. Occupation
   Student ☐ Civil servant ☐
   Extensions ☐ NGO employee ☐

3. What is the level of your education?
   High school ☐ University degree ☐
   College diploma ☐ Above ☐

Impact of climate change, natural resource management and production

4. How do you describe the management of natural resource work in the area?
   Terracing work: - Very high ☐ Medium ☐ Low ☐
   Planting trees: - Very high ☐ Medium ☐ Low ☐
   Applying various ways of cultivation: - Very high ☐ Medium ☐ ow ☐

5. Problems caused by impact of climate change
   Variation of rainfall and temperature: - Very high ☐ Medium ☐ Low ☐
   Food self sufficiency: - Very high ☐ Medium ☐ Low ☐
   Endangering natural resources: - Very high ☐ Medium ☐ Low ☐

6. What are the causes of climate change in the wereda?
   Rapidly growing number of population: - Very high ☐ Medium ☐ Low ☐
   Cutting down trees for house hold use: - Very high ☐ Medium ☐ Low ☐
   Slash and burn: - Very high ☐ Medium ☐ Low ☐

7. Which one of the cultivation system is widely used in the area?
   Irrigational farming: - Very high ☐ Medium ☐ Low ☐
   Intercropping: - Very high ☐ Medium ☐ Low ☐
   Crop rotation: - Very high ☐ Medium ☐ Low ☐
   Using cover crop: - Very high ☐ Medium ☐ Low ☐

8. Contribution of livestock's in keeping the fertility of the soil?
   Very high ☐ Medium ☐ Low ☐

9. Contribution of terracing work in protecting soil from erosion?
   Very high ☐ Medium ☐ Low ☐

10. Does the yield vary in different seasons? (for Sorghum and Maize only)
    Yes ☐ If yes, the yield is
    Higher in belge ☐
    No ☐ Lower in belge ☐
    Higher in belge ☐
    Lower in meher ☐

11. Is there any other option than terracing to protect soil erosion?
    Yes ☐ No ☐

    If yes what are they?

    _____
    _____
    _____
    _____
    _____

12. What are the reasons of drought and famine are critical problem of the area and not easy to avoid it while management of natural resource is very well applied in the wereda?

    _____
    _____
    _____
    _____
    _____
    _____