SMALLHOLDER FARMERS' PERCEPTION AND ADAPTATION TO CLIMATE CHANGE: THE CASE OF ANGACHA DISTRICT IN KEMBATA TEMBARO ZONE, SNNPR, EHIOPIA.

MSc Thesis

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DEDICATION

I dedicate this thesis manuscript to my **wife Terefech Lendido**, and my daughter **Meseret Yohannes** and **Faska Yohannes** for nursing me with affection and love and for their dedicated partnership in the success of my life.

STATEMENT OF THE AUTHOR

By my signature below, I declare and assert that this Thesis is my own work. I have followed all ethical and technical principles of research in the preparation, data collection, data analysis and compilation of the Thesis. Any scholarly matter that is included in the Thesis has been given recognition through citation.

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LIST OF ABBREVATIONS

ADANRO	Angacha District Agricultural and Natural Resources Office
DGC	Department of Graduate Council
ENMSA	Ethiopia National Meteorology Statically Agencies
GDP	Gross Domestic Product
GHG	Green House Gas
IPCC	Intergovernmental Panel on Climate Change
MNL	Multinomial Logit Model
UNFCCC	United Nation Framework Convention on Climate Change
WHO	World Health Organization

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Smallholder Farmers' Perception and Adaptation to Climate Change: The Case of Angacha District in Kembata Tembaro Zone, SNNPR Ethiopia

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Abstract

Ethiopia is one of the agrarian countries in Africa dominated by subsistence farming which is highly susceptible to climate change. This study was therefore aimed to assess smallholder farmers' perception and its impacts and adaptation strategies followed to reduce vulnerability to climate change in the study area. The data was collected from 124 sample farmers using a questionnaire survey, FGD and key informative which were analyzed using both descriptive statistics and Multinomial logit model. Major adaptation options were drought tolerant crops, changing planting date, integrating crops with livestock, income source diversification and soil and water conservation practices. The general scenario temperature and rainfalls data result indicates increases temperature and decreases of rainfalls in study area. The result from the multinomial logit analysis showed that age, education, farm experience, farm size, livestock holding, access to climate information, access of extension service, access to credit, and access of irrigation water are significance factors influencing to farmers' adaptation strategies. Farmers perceived the most important barriers to adaptation were lack of forecasting climate information, shortage of land, lack of credit access, lack of money, lack of extension service, poor potential for irrigation. Therefore, future policy should focus on adaptation strategies through awareness creation, the establishment of meteorology station at district level, mass media and extensions services, access to credit and enhancing research on it.

Key words: Climate change and variability, Perception, Adaptation strategies, multinomial logit model

CHAPTER ONE

1. INTRODUCTION

1.1 Backgrounds of the study

Climate change affects agriculture (Getachew *et al.,* 2017) through the erratic rainfall and variability of rainfall floods, droughts, cyclones and desertification extreme events and reduce crop yield and threaten food security in low income and agriculture-based economies (Deressa *et al.,* 2010). This is problem of the population of the world, particularly poor countries at high risk and it causing loss of life, loss biodiversity, decreases agricultural production and degradation of soil loss income and food security (Devendra, 2012 and Biniam, 2016) and agriculture also contribute releasing carbon dioxide, methane and nitrous oxide to climate change. Climate change is the result of an increased concentration of greenhouse gases (Co_2, Ch_4, N_2o) in the atmosphere as a result of human activities and its possible consequence of climate change has been an international issue. Therefore, climate change is one of the most serious environmental challenges facing at present (Getachew *et al,* 2017). Its impacts directly or indirectly on human activity and is usually observed from the industrial revolutionary periods (Marye, 2011; Rediet, 2011; Betelhem, 2014 and Cyprian A. *et al,* 2014).

The impact of climate change is increasing from time to time (Devendra, 2012 and Biniam, 2016). Ethiopia is one of the poorest and least developed countries in the world. In sub-Sahara regions people engaged in agricultural activities and Agriculture is the most important economic source countries like in Ethiopia (Mesfin, 2012).

Farmers more utilizes that natural resource base livelihoods, this can negatively affect the socio-economic status and in ways enhance climate change (Candida, 2011 and Abid, 2015).

Agriculture is the main source of income and the basis of the national economy, accounting for 41% of the country's Gross Domestic Product. Approximately 85 % of the population lives in rural areas, relying on subsistence farming with less than one ha available for cultivation, while accounting for 95 % of the country's agricultural production (Anne S, 2014).

Ethiopia is the most vulnerable to climate change, because of the low adaptive capacity. This low capacity is due to the extreme poverty circumstances of various parts of the country, frequent natural disasters such as droughts, floods, and agriculture, which are heavily dependent on rainfall (Marye, 2011).

Climate change and its related impacts will be practiced through changing temperatures and precipitation, changes in the frequency and severity of climate extremes and in the dynamics of hazardous conditions (IPCC, 2007). Perception about climate change, its cause, impacts and the necessary response mechanisms to adapt with climate change (Marye, 2011).

1.2 Statement of the Problem

Ethiopia is an agrarian country which is affected by both anthropogenic and natural factors. The main social problem was poverty which is largely associated with over population growth, natural disastrous and a limited use of new agricultural technology (Weldlul, 2016).

The agriculture is major economic sector being mainly dependent on rainfall. Therefore, crop and livestock production failed down. Currently, climate of Ethiopia has become very dynamic and unpredictable and it causes most terrible effects on the agricultural sector by affecting rainfall and temperature.

These challenges arise as a result of variability of rainfall and severe soil erosion due to torrential rainfall; continuous efforts are being made by the Ethiopian government and non

government organizations to control these challenges through environmental protection awareness campaigns and rural mass mobilization for soil and water conservation and planting trees on soil structure still now on campaign but implementation is low. The enormous rural farmers still being illiterate or being less aware on environmental variability, they tended to associate problems related to rainfall variability and drought by wrath of God. Agriculture is one of major economic activity in whole parts of the Africa is believed to be most sensitive to climate change impacts, and this similarly applies to Ethiopia. This makes it very important to understand the real dynamics of climate change impacts at the lower society level, such as small farming households (Deressa *et al.,* 2008).

Climate change is unpredicted impact because it is a natural occurrence that varies with location, socio economic and environmental conditions. The impacts of climate change have been negatively affecting the economic development. Its impact affect the entire economic sensitive sectors particularly agriculture sector. This is due to the fact that the negative effect of climate changes on agricultural production (Kide, 2014).

Farmers' perception strongly affects how farmers deal with climate-induced risks and manage adaptation strategies and the precise nature of their behavioral responses to this it will shape adaptation strategies (Debela *et al.,* 2015). Adaptation is a very important strategy to enable farmers to cope with the negative effect of climate change and variability which in turn it helps to enhance the agricultural production of the farmers. Likewise, knowledge of the adaptation methods on the other side of smallholder farmers might make it better to deal with the challenge of climate change (Kide, 2014).

The capacity to adapt to climate change is not the same within farmers. This reality implies that the adaptation measures at true grass root level of farmers are important to get truth and

suitable policies. Farmers in different agricultural zone have not the same tendency and capacity to climate change impact and adaptation. To address this studying one specific site is appropriate. Therefore, the researcher tried to address this gap of knowledge awareness on climate change in study area.

Therefore, a better understanding of the local scope of the climate change is very important to develop suitable adaptation measures and appropriate policies. In this study area the impact of climate change is negatively affecting the agriculture. The occurrence of increased temperature and erratic rainfall leads to decline the agricultural production of the farmers.

There was no clear understanding about climate change .This showing that people are contributing their share because the level of awareness and perception matters on climate change at study area is still not definitely known; and how civil society organization organize their campaigns on environmental awareness seems not fully researched and hence demands a well-designed investigation in area.

As to the knowledge of the researcher, no prior study was conducted on farmers' perception on climate change and adaptation strategies in this study area. Therefore, considering this knowledge gap, the researcher would study on the local level, it carried out the research was focus on analysis farmers' perception on climate change and adaptation strategies to climate change in Angacha district.

1.3. Objectives

1.3.1. General objective

The generally objective of this study was farmers' on perception and determinants of farmers' choice of adaptation in three rural Kebeles of Angacha District.

1.3.2. Specific objectives

The specific objectives of this study were:

1. To examine farmers perceptions on trends of rainfalls and temperature in the study area.
2. To analyze determinant of adaptive choice of the study area.
3. To examine the challenges encountered to do so climate change.

1.4. Research Questions

The study attempt to answer research question such as:

1. What did you perceive trends rainfall and temperature on the study area?
2. What were the main causes of climate change and variability in the study area?
3. What were challenges that hinder choice of adaptations strategies?

1.6. Scope and Limitation of the Study

The study focused only three Kebeles based on agroecology and through the considering the prevalence of the problem and its scope is limited to the study of farming household " perception on climate change, its impact and responses.

However, the scope of this study is limited by the time and financial limitations and other resources availability. However, it limited in terms of the coverage but its plan can be used as a spring board for more detailed multi-site specific studies.

CHAPTER TWO

2. REVIEW OF LITERATURE

2.1. Theoretical Overview of Climate Change

Climate is a narrow sense usually defined as the average weather or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time from months to thousands or millions of years. Climate change refers any change in climate over time through natural variability or as a result of human activities (IPCC2007, cited in Abirham, 2017). Climate change refers a change of climate which is attributed directly or indirectly to human activities that alter the composition of the global atmosphere and which are in addition to natural climate variability observed over comparable time period (UNFCCCArticle1,1992,cited in Betelhem , 2014).

As we know climate change is increasingly recognized as a critical challenge to ecological health, human well-being and future development (IPCC, 2007 cited in Abirham , 2017). It is one of the main environmental challenges that affect both the current and future generations. As a result, this issues global community took initial steps in 1992 UNFCCC and then Kyoto Protocol in 1997 by formulate rules to limit global greenhouse gas emissions (Abirham, 2017).

United Nation Framework Convention on Climate Change has defined climate change as a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods.

For this research purpose definition given by Intergovernmental Panel for Climate Change has been used, which defines climate change as a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity (Bhusal, 2009 and Otitoju, 2013).

2.2 Causes of Climate Change and Variability

Change in the intensity shortwave solar radiation reaching the earth surface return back to sky in lower strata through the high concentration clouds and water vapor it blocked warm the earth surface seriously causes global warms the Earth's climatic history.

Climate change and agriculture are intimately interrelated processes putting significant effect on each other. Agriculture is a significant driver of environmental and climate change through: through the emissions of GHGs & land use and land use change to climate change while, Climate change affects agricultural production through change in rainfall and temperature pattern, occurrence of extreme weather events (drought, heavy rains, heat waves floods), changes in weeds, pests and diseases conditions; disrupted water availability due to changes in surface and ground water pattern; and changes in the nutritional quality of some foods to food security and livelihood. Ethiopia's share to global GHG emission is very minimal. However, emissions from agriculture and energy sectors different studies observation doubled from recent years in the country (Abirham, 2017).

2.3 Climate Change Observations in Ethiopia

According to IPCC Fifth Assessment Report of Famine Early Warning Systems Network there has been an increase in seasonal mean temperature in many areas of Ethiopia (IPCC, 2014).

Climate change poses a series challenge to Ethiopia. The country is faced with increasingly unpredictable rains, and sometimes the complete failure of seasonal rains – problems which are linked to climate change. It is a country with large differences across a region which is reflected in the country's climate vulnerability (Warner and van, 2015).

Climate change is already occurring now a day, thus past and present changes help to indicate possible future changes. Over the last decades, the temperature in Ethiopia increased at about 0.2°C per decade. The increase in minimum temperatures is more pronounced with roughly 0.4°C per decade. Precipitation, on the other hand, remained fairly stable over the last 50 years when averaged over the country (Marius, 2009).

This is due to their low adaptive capacity and high sensitivity of their socio-economic systems to climate variability and change. Sensitivity and adaptive capacity also vary between sectors and geographic locations, time and social, economic and environmental conditions within a country. Current climate variability is already imposing a significant challenge to Ethiopia by affecting food security, water and energy supply, poverty reduction and sustainable development efforts, as well as by causing natural resource degradation and natural disasters (Rediet, 2011).

2.4 Impact of Climate Change and Variability in Ethiopia

Climate change is a major challenge for agriculture, food security and rural livelihoods for billions of people. Therefore, climate is perceived to be changing thus calling for understanding of livelihoods strategies to guide in developing climate-resilient livelihoods (Halkano and James K., 2014).

Agriculture is the sector most vulnerable to climate change due to its high dependence on climate and weather and because people involved in agriculture tend to be poorer compared with urban residents (S.Mahendra, 2011).

The agriculture is the main economy sources of Ethiopia. This sector plays a significant role in food security for all human being in Africa (Biniam, 2017). The impact of climate change emerging as an unprecedented challenge to development and poverty reduction among millions of rural people living in marginal group of the people with minimal livelihood options This is especially so among rural households (Halkano and James, 2014).

Ethiopia is one of the most susceptible countries to climate variability and changes due to its high dependence on rain-fed agriculture and natural resources (Abirham, 2017). Currently, climate change is already imposing an important challenge to Ethiopia in food security, water supply, poverty reduction and sustainable development efforts, as well as by causing natural resource degradation and natural disasters.

At the present day, an environment issue is a serious problem in Ethiopia. This is due to their low adaptive capacity and high sensitivity of their socio-economic systems to climate variability and change (Rediet, 2011 and Betelhem, 2014).

The overall impacts of climate change on agriculture are expected to be negative. Agriculture plays a dominant role in the economy of Ethiopia, contributing about half of the GDP, provides employment opportunity for majority of working force and generates considerable foreign exchange earnings.

The country is certainly rated as among the most susceptible to climate change as a result of its low adaptive capacity. The country has common experience extreme climate events like floods and droughts, and other climate related hazards. The variability of rainfall and the increasing temperature are responsible for the frequent droughts that lead to famine, adversely impacting on the people's agriculture (Abirham, 2017). Low adaptive capacity it farmers exposed to climate change (Sekaleli and Sebusi, 2013).

2.5 Farmers Perception on Climate Change

Climate change is gradually becoming a major concern to mankind but most of the people, who are most vulnerable, are not aware of the real consequences of the global warming (Devkota, 2014). Farmer's perception about their environment is critical because their perception fundamentally determine the socioeconomic activities in their locality.

Successfully mitigating and adopting adaptation strategies to climate change require changes in the behavior of billions of human being, who each day make individual choices that collectively have enormous impact on the earth's climate. However, many programs are inconsiderate of communities. Assessing the awareness and knowledge of the beneficiaries of a given program is necessary, if such programs are to find support amongst targeted areas and be integrated into the day-to-day management of operations (Marye, 2011).

Farmer's perceptions on long-term climate change, as well as various farm-level adaptation options. From change of it the farmers using different adaptation options were drought tolerant crops/plants, different income diversification, changing sowing dates, using integrating farming such as rearing livestock's and producing crops and soil and water conservation methods (Betelhem, 2011).

2.6 Farmers Adaptation Strategies

Adaptation refers to "adjustments in ecological, social or economic systems in response to actual or expected stimuli and their effects or impacts. This term refers to changes in processes, practices and structures to moderate potential damages or to benefit from opportunities associated with climate change" (IPCC 2001; cited in Rediet, 2011). Adaptation hence involves adjustments to decrease the vulnerability of communities, regions, and nations to climate variability and change and in promoting sustainable development (Otitoju, 2013 and Betelhem, 2014).Adaptation measures are very specific to a particular location and situation. (Betelhem, 2014).

2.6 .1 Mixed Farming

Ethiopia largely depends on rain - fed agriculture. A rainfall is fail cropping production also difficult and exposed to the risk. Countries like Ethiopian, it was stated that, owning livestock may safeguard the farmers against the effect of crop failure or low yields during harsh climatic conditions. Crop production can be mixed with rearing livestock's and reduce risk in this way (Betelhem, 2014 and Abrham, 2017). If the issues occur farmers have to sell livestock it contribute to extra income, because animal products can be

sold, and livestock can also be sold during difficult periods. Selling of livestock is main coping mechanism to climate variability in Ethiopia (Betelhem, 2014).

2.6.2 Soil and Water Conservation

Soil and water conservation was one of the adaptation strategies found in (Betelhem, 2014). Many areas of Ethiopia are mountainous and crop sowing high lands. Often they are located in a hill side or in a valley side. The degree of the severity of erosion, 50% of the highlands are significantly eroded, while 25% is seriously eroded (Mesfin, 2010). In addition to conserve soil and water now a day's these activities are increasingly important because climate change to some extent is accelerating these processes helps to enhance climate change adaptation strategies (Betelhem, 2014 and Mesfin, 2010).

2.6. 3 Planting Drought Resistant Varieties of Crops

Drought resistant crops in climate change could help in reducing vulnerability increase adaptive capacity to climate change (Akinnagbe and Irohibe, 2014). Cultivation of drought tolerant crops such as Enset (Enset ventricosum) as a source of both food and livestock feed (Abayineh and Belay, 2017). The use of drought-resistant crop varieties have been tried by smallholder farmers as adaptation methods to climate change in study area (Akinnagbe and Irohibe, 2014).

2.6.4 Irrigation

Success of adaptation depends on accessibility of fresh water in drought season. In Ethiopia rain fed agriculture will remain very important for food security (Betelhem, 2014). At similar status irrigation can be an important strategy for making agriculture activities.

Mainly adaptation methods provide benefits even with recent climate change scenarios. because water becomes a limiting factor, irrigation effectiveness will become an important adaptation instrument, in dry season, because irrigation practices for dry season are water intensive.

Recently, due to climate change access of surface and groundwater was decrease and reduced soil moisture during the dry season, while the crop water demand is expected to increase because of increased evapo-transpiration caused by climate change (Akinnagbe and Irohibe, 2014). Farmers use the irrigation is one of the least practiced adaptation strategies among the major adaptation methods identified in Ethiopia (Betelhem, 2014).

2.7 Conceptual Frame Work

Now a day's intensive temperature and erratic rain fall become a serious global issue; it has adverse effect on ecosystem being directly or indirectly. In order to minimize the adverse effect of climate change farmers taking adaptation measure were an important option. Before taking adaption measure farmers should have to understands change on local climate select which factors that affects and assist adaptation practices is critical because, it affects that the implementation of adaptation measures. Because it indicated in following figure one, the conceptual framework of this study was based on hypothesis that adaptation to climate change is depend on exposure of livelihood assets and adaptive capacity of farmers, it was determined by various socio-economic and institutional explanatory factors (Betelhem, 2014).

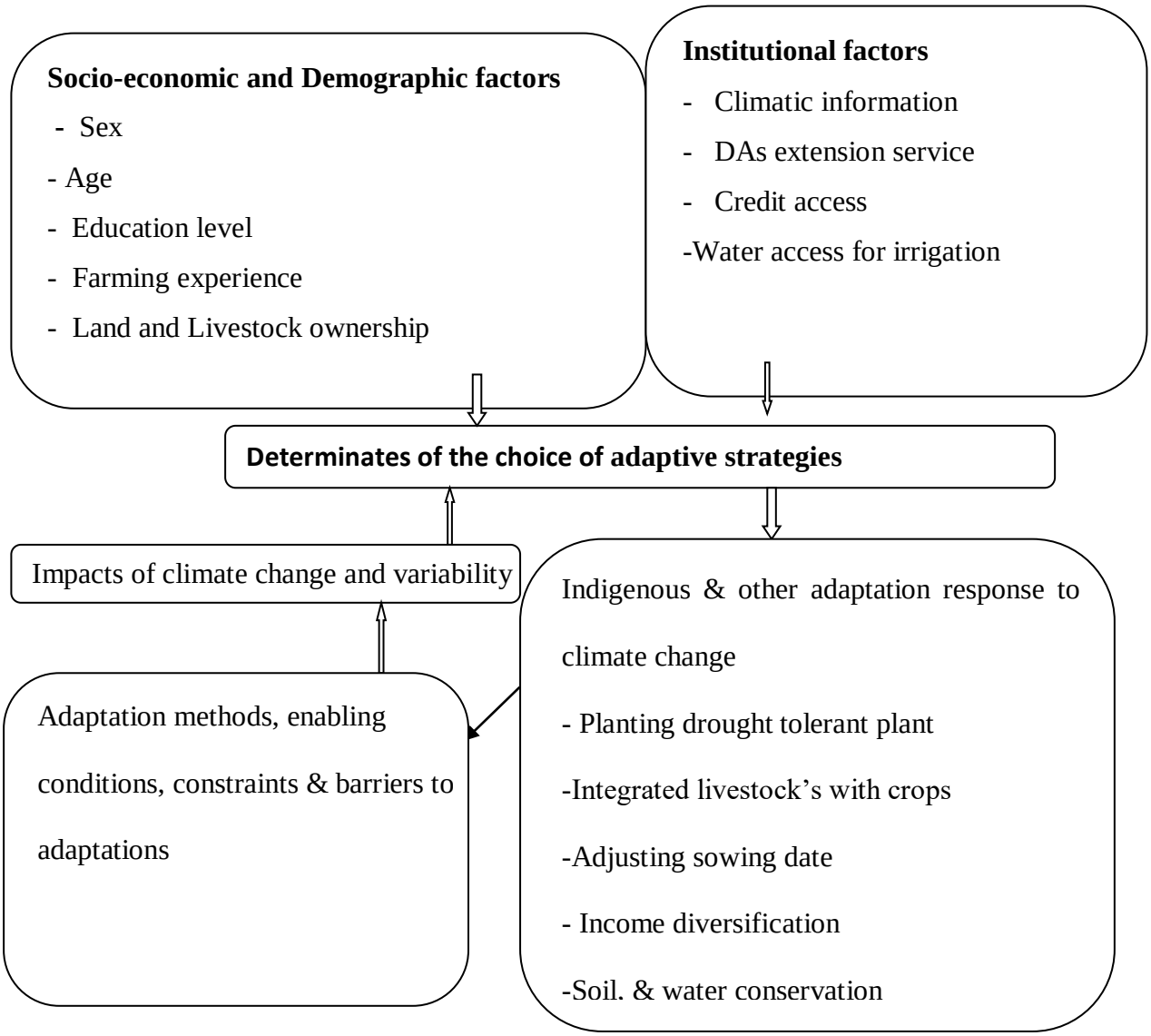


Figure 1. Conceptual framework to determinants adaptive choice of farmers' (adopted and modified from Betelhem, 2014).

This Conceptual frame work shows farmers' perception on climate change and choice of adaptation in relation to explanatory factories.

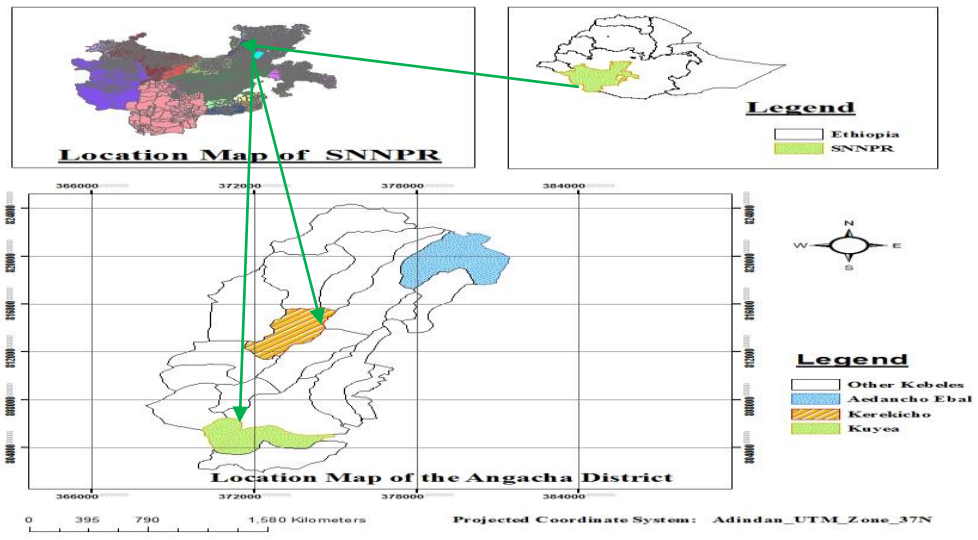
CHAPTER THREE

3.1 RESEARCH METHODOLOGY

3.1. Location Map of Study Area

Geographically, Angacha district is found in Kembata Tembaro Zone, SNNPR. Angacha district is one of the seven administrative districts of Kembata Tembaro Zone. It has seventeen rural Kebeles administration and four urban *Kebele* administrations.

Angacha district is situated about 255 Kms South West of Addis Ababa and 130 Kms Northwest from Hawassa (the capital city of the SNNPR) and 32 Kms from zonal capital city (Durame) in the Northwest direction. The study area share boundaries with Hadiya zone in North, Doyogena district in West, Kachabira district in South, Kedidagamela district in East and Damboya district in Northeast. Angacha district is situated at $7^0 15'$N to7^0 24'N and 37^0 47'E to 37^0 52'E



Sources: Angacha District Agricultural and Natural Resources Office, 2018

Figure 2**.** Location map of the study area.

3.1.2 Population of the study area

According to the Population House of Census, the total population of Angacha District is 88060, whereas the total land area of the district is 177.543 square kilometers. Out of this total population 44o42 (50.01 %) were males while 44018 (49.99 %) were females. on the basis the average land holding per persons is 0.5 hectare while the average population density stands at 496 per square kilometer. population density is likely to get higher with the population increasing at annual average growth rate of 3 %.

The massive of these population 81,249 (92.3%) lives in rural administrative areas and is engaged in crop production and animal rearing while the remaining 6,811 (7.7%) is living in town.

Table 1.Population of the study area

Population	**Number of population**			**Percent**
	Males	Females	Total	
Rural population	40556	40693	81249	92.3
Urban population	3486	3325	6811	7.7
Total	44042	44018	88060	100

Sources: CSA, 2007

3.1.2 Description of Bio-physical Conditions of the Study Area

According Angacha District Agricultural and Natural Resources Office**,** (ADANRO, 2017) the study area is characterized by highly undulating and hilly topography intersected by valley bottoms and gullies, which is constituted about 70% of the district high land area; 25% is mountainous land and the remaining 5% is low plains. The topography ranges from

1501-3028 masl *(*ADANRO, 2017). Agro- ecologically, the district is classified as *Dega* (35%), *Woyna* Dega (60%) and *kolla* (5%) *(*ADANRO, 2017).

3.1.2. Climate

According National Meteorology Statically Agency data analysis average annual rainfall ranges from 509 mm to 1616 mm. As a result of this, annual ranges rainfall variation by 1107mm *(*NMSA, 2017). The rainfall is characterized by erratic and uneven distribution throughout the year. The main rainfall season occurs during *kirmet* season (June, July and August) up to September but, additional rainfalls are *belg* season. The rainfall reaches its peak in the month of July month. Unpredictability of rainfall, are the main constraints for growing crops and drinking water for organisms. The rainfall shows that high annual interval throughout the year *(*NMSA, 2017). On the contrary, unusually and intensive heavy rainfalls occur and cause serious damage on soil through soil fertility states degradation (Mesfin, 2010).

3.1.3. Soil and Natural Vegetation

According to Angacha District Agriculture and Natural Resources Office the main soil types of the area include black basaltic soils (Vertisols) and red basaltic (Nitosols) soils (ADANRO, 2017). In area where the slope is steep, the soil is highly eroded due to high torrential rainfall and absence of vegetation cover. Vegetation cover of in area is a manifestation of climatic and human factors. Before, it is understood that area was gifted with dense vegetation cover (Desalegn, 2010). Due to over cultivation and overgrazing trigger causes by population increase, the vegetation cover has increasingly depleted.

3.1.4 Land Use and Agriculture

Agriculture essentially composed of crop production and livestock husbandry. They were the major livelihood of the farmers in the district. The agricultural carry out in use in the area is traditional oxen-plough and hoe-culture practices.

The main staple food crops grown in the district are teff, barley, wheat, maize, sorghum. Root crops, enset, and potato are also grown in the district. Among the perennial crops enset (false banana) plays an important role in the life of the people by its multi-uses as a source of food, fiber, animal fodder, constructional material, to make mats for sleeping, its leaf serves an umbrella during the rainy season.

According information obtained from ADANRO of the district, the crop productivity was low due to torrential and erratic rainfall that damage crops during rainy season, fragmentation of agricultural land, over cultivation due to high population density and lack of alternative means of livelihood for the people, lack of appropriate farm technologies and inputs and shortage of farmland. In order to prevent the crop failure, farmers of the study area practice diverse and intensive intercropping and relay cropping techniques such as traditional ditches to minimize the problem of seed loss after sowing, water logging problem and soil erosion, practice mixed cropping (inter cropping) to minimize the risk of total crop failure use agro-forestry system.

3.1.5 Crop production

Agriculture, mainly composed of crop production and animal husbandry, is the main livelihood. The Majority of the farmers in the area are occupied in mixed agriculture. Crop cultivation and livestock production are practiced. Crop cultivation is totally rain fed, but

some villages were start traditional small-scale irrigation. The area practiced two rainy seasons, *kiremt* and *belg* season.

They are used for the cultivation of long cycle crops. Among the perennial crops enset (false banana) plays an important role in the life of the people by its multi-uses as a source of food, fiber, animal fodder, constructional material, to make mats for sleeping, its leaf serves an umbrella during the rainy season (ADANRO,2018). In addition, to these functions it helps to carbon sequestration in photosynthesis.

The main staple food crops grown in the area were teff, wheat, maize, peas and beans. Root crops, enset, and potato are also grown in the area. In recent times crop productivity is very low. As a result, many youths engage migration to South Africa and Sudan to promote their livelihoods.

3.1.6 Livestock husbandry

Most of the households used livestock as the source of income in, addition to crop cultivation. According to (ADANRO, 2018) report out of the rural population about mixed farming and they are engaged in livestock production. The total livestock population in study area is 1349116. Donkeys and poultry comprise the heights proportion, due to adapt climate changes challenges from total livestock, but horse, sheep, goats, mule population decreased challenges climate changes (ADANRO, 2018).

One of the most important factors that contributed to low productivity of the livestock is insufficient feed due to declining of natural grazing land. The pasture lands are losing ground very rapid due to expansion of crop farm. In addition to the major livestock diseases

and Poor management in animal husbandry that have significant impacts in livestock productions. There is only one for three Kebeles lack of skilled man power, unavailable of veterinary drug supplies, hampered livestock's production, and shortage of budget and transport services in the district (ADANRO, 2018).

The major source of livestock feed in the region is natural pastures, crop residues, industrial by-products and thinning/weeds. But the middle and better income groups purchase animal feed like hay and crop residues from the very poor people. This makes the poor to be poorer (ADANRO, 2018).

Due to climate change crops production failed, in order to avert the crop failure, farmers of the study area tried to practice mixed farming. Some of the techniques used by the farmers were traditional ditches to minimize the problem of seed loss after sowing, use agro-forestry system; livestock are integral part of the crop production.

Table 1. Livestock Population number of Angacha District, 2018

Types of livestock's	Number
Cattle	124394
Sheep	11101
Goats	7224
Donkeys	15357
Mule	5990
Horse	3247
Poultry	61313
Beehives	1490

Sources: Angacha District Agriculture and Livestock Offices, 2018.

3.2 Methodology

In an attempt to attend to the stated objectives, the following sample size selection, data collection techniques and analysis methods were employed in the research process. This was carried out from 17th rural kebeles namely; *Adancho Ebala, karacho and Kuya* were selected purposively, out 17 based on climate change.

This study was conducted to examine stallholder farmers' perception and causes of climate change and adaptation strategies hereafter were farm households to turn away vulnerability and new varieties to improve adaptation capacities and finally specify sustainable strategies to cope up with the problem.

The study has therefore generated primary data through information collecting from rural households, Key Informants, focus group discussion and government and non-government staff working at local levels and through field observations. This activity was again carry out with collecting secondary data from relevant literature and government offices and non-government reports offices.

Collecting the necessary data and generating valuable information demands deep understanding of the hypothetical grounds of the research design and methodology and undoubtedly defining the dependent and independent variables.

As this research has focused on investigating smallholder farmers' the perceptions, values and attitudes of rural households and government staff on climate change and adaptation strategies being exercised by rural households and communities a survey or cross sectional research design was use to collect relevant data and produce suitable information. The literature states that a cross sectional design requires the collection of data on many cases and at a single point in time in order to gather a body of quantitative or qualitative data in

connection with two or more variables, which are then observe to find out patterns or associations

3.3.1 Sample size and sampling technique

The study was conducted in three rural Administrations Kebeles (KAs) the lowest political administrative units in Ethiopia. The study district and the specific Kebeles for data collection were chosen based on a set of variables differentiating one district and Kebeles from other Kebeles. Mainly variables related to physical elements relief structure, altitude, soil degradation, land use cultivation practices, vegetation cover, access of irrigation water, exposure to erratic rainfall pattern, access to forecasting climate information and access of credit services, agricultural extension services have served as a basis for selection. To develop selection of the specific district and rural Kebeles administrations, districts and rural Kebeles were systematical sorted similar agro-ecology bases and representative district and Kebeles were selected purposely considering the above variables.

The sample size of respondent small farm households was determined by using (Yamane, 1967 cited in Mesfin, 2006) formula. Sample size formulae and procedures were this study used a simplified formula provided by (Yamane, 1967) to determine the required sample size at 95% confidence level, degree of variability=0.5 and level of precision= 9% (0.09).

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

Where as

n = is the sample size

N = is total population size (total household heads size)

e= is the level of precision.

From the total (2112) small farming household heads, by using Yamane (1967:886) provides a simplified formula to calculate sample sizes of household heads were registered in *Adancho Ebala Kebele* (689), *Kerekicho Kebele* (772) and *Kuyea* (651).

By using simple random sampling technique, proportional to the inhabitants villages were recognized, from the registered of households. From each village 40, 45 and 38 household heads were selected, respectively. Respondents in the study were in cases missing where household heads were; randomly were substituted for missing household heads.

$$n = \frac{2112}{1+2112(0.09)^2}$$

$$n = \frac{2112}{17.1153}$$

$$n = 124$$

While the formula indicated a sample size of 123, considering that the calculated number is an estimated and indicative figure and more significantly the data sources used for the research were diverse using 124 sample farm households was considered sufficient. In this regard it should be noted that apart from addressing questionnaire to farm household heads, data was also collected from critical sources including key informant interview, focus group discussions, field observation and documents produced by the relevant sectors on climate change perception and adaptation. As the number of respondent farm households across the three study villages in the selected study Kebeles did show marked difference (Table 3.2),

the sample size was unequally distributed across villages. Male headed and female headed farm households were proportionally included in the sample based on data obtained from DA's office. At each stratum, sample households were chosen using simple random sampling techniques from the list of farm households in each village.

Table 2: Sample size determination

Sampled Kebeles	Agro-ecology	Total households	Sample size
Adancho Ebala	*Kolla*	689	40
Kerekicho	*Woina Dega*	772	45
Kuya	*Dega*	651	38
Total		2112	124

Sources: Angacha District Agricultural and Natural Resources Office, 2017

3.3.2 Data Ccollection Methods

Primary data collected through the survey questioner, key informative interview, FGD. Secondary data collected through the using available sources of information such as published and unpublished sources. The main purpose of using both approaches technique was to get households demographic and biophysical information, to know the proportion of the affected group of people and peoples" perception on local climate variability and change with pattern past temperature and rainfall records and to know cause and impacts of climate variability and change as well as to assess adaptation strategies. This includes data's from governmental offices, central statistical agency, internet, University libraries.

3.3.2.1 Survey Questionnaires

Close ended and open ended questions were prepared to the select 124 sample small farming households to get data about local communities' perception on climate variability, its impact on their agriculture and adaptations practices. The closed ended questions enabled the respondents to select one option that best convene the reviews, while the open ended question was included in order to give opportunity to the respondents to express their perceptions and ideas concerning climate change under study and often they were only possible way to reviews large enough to allow statistically analyses the results.

3.3.3.2 Key informant interview

It was intended to ten Key informant interview obtain detail information on the issues. To get detailed information, the researcher used semi structured interview method because of its flexibility and makes clear any time when there is ambiguity. The key informant interview were conducted with development agents (3) , village leaders (2) , model farmers (2) elders (2) and agricultural office experts representative (1) , about the cause and impacts of climate variability adaptation strategies in the study area.

3.3.3.3 Focus Group Discussion

The researcher selected ten respondents in each Kebele based on socially respected within society and peoples were known to have better knowledge to days and past climate change within environment, social and economic status of the study area.

At each Kebele, one focus group discussion was held. The focus group discussions were made with member of selected educated youths representative (2), elder (2), religious leader (2), women (2) and officers (2) of the sample 'Kebeles. The main purpose of focus group discussion was to understand the level of perception of the people about climate change impacts, its cause and their responses. The major discussion topics were on the local community understanding of climate change and its cause, major hazards and their impact and adaptation strategies and barriers to employ them effectively.

3.3.3.5 Document review

Field documents which was found at district offices and others area. Population Census reports, activity progress reports, relief distribution that contain demographic characteristics, climate distribution, and economic information were reviewed and supplemented the primary data.

3.3.4. Data Analysis and Interpretation

The collected data was both qualitative and quantitative were statically processed. The objective one, two and three were analyzed by using SPSS version 20 and by using Microsoft Excel and presented in the form of tables and graphs. In addition to these, objective four was analyzed by using statically package STATA version 13.The interrelationship of independent variables with dependent variables analysis by multi-logit model.

In order to answer the research questions of the study through qualitative and quantitative methods based analysis and interpretation were applied. The qualitative information collected using interview was analyzed using qualitatively.

Errors related to inconsistency of data were checked and corrected during data cleaning, whereas the quantitative data produced by questionnaire and from ENMSA gridded data had been analyzed using descriptive statistics.

Descriptive statistics like mean, percentage and frequency distribution were used to analyze quantitative data Pearson correlation was used to measure the strength of linear association between (the small farming households' perception and attitude about climate variability and change with temperature and rainfall data 33 years (1983-2016). The rainfalls variability was indicated by coefficient of variation and percent of deviation.

A significance tests were also used to see whether there is a significant association between responses provided by informants of different age groups and educational background with their perception towards climate change and variability and livelihood adaptation strategies. Objectives one, two and three were analyzed by using SPSS version 20 and by using Microsoft Excel and presented in the form of tables and graphs.

3.3.4.2 Hypothesized Dependent and Independent Variables

Dependent variables for this study, the dependent variable in the practical view of determinates choice of adaptive strategies by households from the set of it mentioned below.

Determinates of choice of adaptive options is planned to be carried out by the assumption of Multinomial legit model. They were represented in the model by drought tolerant plants , changing sowing date, integrating livestock with crops, income source diversification and soil and water conservation.

Angacha Agricultural Extension Office tried to identify and carried out the above adaptation options to climate change. Independent variables for this study the most important variables projected to have influence on the adoption of adaptation strategies were grouped under small farming household characteristics, Socio-economic and demographic factors ,and institutional factors. Such mentioned variables were based on (Betelhem, 2014). The explanatory variables for this study are those factors which are expected to affect small holder farmers' choices of adaptation strategies against climate variability. Based on the findings of past studies on climate change adaptation strategies, the following variables are hypothesized to explain smallholder fanners' choice of adaptation strategies to climate change.

Sex of household head : It is a dummy variable that takes a value of 1 if male and 0 otherwise. Some study stated that male headed household has appositive effect (Temesgen *et al*, 2008) and negative influence on climate change adaptation strategies. Therefore, this study hypothesized that sex of the household head, being female-headed and male-headed, differ significantly in their choices of adaptation strategies to climate change due to major differences in terms of access to assets, education, and other critical services such as credit. Therefore, the study hypothesized the relationship between sex of the household head and adaptation options to climate change may be indeterminate.

Age of household head: It is a continuous variable measured in the number of years of the household head that indicate the experience in the climate change on the adaptation strategies to climate change. Therefore, the study hypothesizes the relationship between age and adaptation mechanism to climate change may be indeterminate.

Education level of household head: It is a continuous variable. Adaptation to climate change is a response for understanding the issue and its long-term consequences. Positive and significant effect of education on up taking adaptation methods to the changing climate is observed in Ethiopia (Temesgen *et al.,* 2008). Higher educational credentials of the household head and any other member of the household with the highest education increase the knowledge base about climate variability and related adaptation.

Farm income: It is a continuous variable measured in Birr. The farm income of the households has a positive and significant impact on improved crop varieties, soil and water conservation techniques, and crop diversification. When the main source of income in farming would increase, farmers tend to invest on productivity smoothing options such as drought tolerant crops, soil and water conservation and income sources diversification options, using mixed farming.

Land holding: It is a continuous variable measured in hectares. Large land holdings allow farmers to diversify their crop and livestock options and help spread the risks of loss associated with changes in climate. Since land holding is associated with greater wealth, the study hypothesized land holding has positive relation crop diversification with adaptation option to the climate change.

Livestock ownership :It is a continuous variable, which refers to the size or numbers of livestock owned by household measured in terms of Tropical Livestock Unit (TLU). Ownership of livestock has positive and significant impact on the probability of using, soil and water conservation techniques, planting trees, and changing planting dates as adaptation strategies. It is, therefore, hypothesized that farmers with large number of livestock are expected to use improved crop varieties, adjusting planting date and soil and water conservation practices as adaptation strategy because it serves as proxy for wealth status.

Access to climate information :It is a dummy variable and takes a value of 1 if there is access to forecasting information about climate change and weather forecasting and otherwise. Access to temperature and rainfall information from different sources has significant impact on the possibility of using different adaptation measures like improved crop variety and crop diversification. This study, therefore, hypothesized that access to climate information increases likelihood of using changing planting dates , drought tolerant plants and income diversification as adaptation strategy.

Extension contact: It is a discrete variable measured by the number of contacts. It creates access to information and technical assistance on agricultural activities and adaptation methods through extension services. Access to extension services has a positive impact on the probability of adopting adaptation strategies to climate change.

Therefore, this study hypothesized that extension contact increases the possibility of using change planting dates, income diversification and soil and water conservation using drought tolerant crops strategies as adaptation strategies to climate change on agricultural production.

Credit : It is dummy variable that takes a value of 1 if received credit, 0 otherwise. Availability of credit eases the cash constraints of the households and allows to purchase inputs such as fertilizer, improved crop varieties, and irrigation facilities. Credit received has a positive and significant impact on possibility of using adjusting planting date and crop diversification as adaptation strategies to climate change and variability on agricultural production.

Table 3. Variable description and hypothesis for the impact of the independent variables on dependent variables

Explanatory variables	Description	Expected sign
Sex	Dummy(Male =1,female=0)	+/-
Age	Continuous(in years)	+/-
Education level	Continuous(illiterate=1,literate= 0)	+/-
Farming experience	Continuous(in years)	+/-
Farm - size	Continuous(ha)	+
Livestock ownership	Continuous(TUL)	+
Extension service	Dummy (yes=1,No=0)	+
Access of Climate information	Dummy(Mete.=1 otherwise=0)	+
Access of Credit	Dummy (yes=1,No=0)	+
Access of water irrigation	Dummy (yes=1,No=0)	+

Source: Field survey, 2018

CHAPTER FOUR

4. RESULT AND DISCUSSIONS

The results of the study on small farming households' perception on causes, impacts of climate change and variability by connects recorded meteorological data of the area with household survey, Focus Group Discussion and key informative interview. First section of the document deals with general information about sampled household. Second Section consist analysis of meteorological data. The third Section deals small holder farmers" perception on climate change and variability and its impact and the fourth section deals farmers" adaptation and determinants choice of adaptation in the study area.

4.1 Demographic and Socioeconomic Characteristic of the Respondents

4.1.1 Sex, Age and Education status of the sample respondents

The empirical result of household survey shows that, small holder farmers sampled were 124 household among this 72.8 % was male household head and 28.2 % was female household head.

The age distribution of the respondents ranges from 45-50 years with an average age of 46%, 40-45 years with an average of 34.7 %, above 50 years with an average 17.7 %.

Educational level of respondents was held to be a significant explanatory variables that determines the readiness of the farmers to take new ideas and innovations concerning climate change adaptation strategies and wise use resources. The survey results indicate that (69.4 %) of the household heads were unable to write and read, and 25 % were grade 1-4,was 4.8% were grade 5-10 and 0.8 % diploma level .

Table 4 : Sex, Age and Education status of the sample respondents

Variables	Response	Frequency	Percent
Sex of HHH	Male	89	71.8
	Female	35	28.2
Age of HHH	30-35 years	2	1.6
	35-40 years	1	0.8
	40 – 45 years	42	33.9
	45-50 years	57	46
	above 50 years	22	17.7
Education of HHH	Unable to read and write	86	69.4
	Grade 1-4	31	25
	Grade 5-10	6	4.8
	Grade 10+3	1	0.8
Total		124	100

Source: Filed survey, (2018)

4.1.2 Farm Size and Livestock Ownership

The size farms determining factors for adaptation strategies because farmers engaged in farming activities. It is determinant factors for climate change adaptation mechanism. As it was indicated in (Table 5) 90% of household heads has between 0.25-0.5 hectares, but only 10%.of households heads had 0.75-1 hectare of land holding. The indicates that size of land is very small. Therefore, cultivate over the soil within a year this in turn leads to more

climate change in by releases of one of green houses gas to atmosphere is N_2O through tillage soil by aerated oxidation of carbon increases.

Livestock has the positive for climate change adaptation strategies because when crop cultivation is failed rearing livestock as the source of income. The some farmers improved livestock's in the district were cattle, sheep. According to survey observation of domestic animal possession was carried out in the area. As the information from focus group discussion average ownership of domestic animal in the study area shows that the number of domestic livestock's assets some decreased over time like traditional cattle, sheep but the others like modern cattle, donkey, and hen increases helps to adaptation strategies . As the information from focus group discussion old traditional animal species in all study areas of have changed modern productive cattle species. This table indicates that 58 % of farmers have holds livestock's 41.9 % engaged more in crop production rarely in livestock.

Table 5: Farm size and livestock ownership of respondents

Variables	Response	Frequency	Percent
Did you have sufficient farming land?	Yes	30	24.2
	No	94	75.8
	Yes	72	58.1
Did you have rearing livestock?	No	52	41.9
Total		124	100

Sources: Field survey, (2018)

4.2. Institutional Factors

4.2.1 Accuses of Climate Change Information and Extension Services of Respondents

Access to information about seasonal forecast of the daily weather condition and climate change is essential to know the coming weather condition and to take adaptation measures (Abebaw, 2016). Access of perfect information on climate change is not a simple. The existence of well functioning weather stations and proper processing of weather information and distribution of weather forecasts and acceptance of the information by farmers is assumed to influence adaptation efforts to climate change (Weldlul A. L., 2016). Even though, there were no formal sources that deliver weather information.

Table 6, indicate that result shows that only 32.3 % of the farmers had access to forecasted climate information from meteorological stations by different agents while the rest 67.7 % farmers did not get forecasted climate information from any sources. According to this result most farmers did not ready to adapt climate change. In line with this, participants of Focus Group Discussion were also confirmed that, information of climate change adaptation strategies to farmers was very rare from the responsible body.

This extension service is essential to make farmers' to adopt climate change adaptation strategies. The farm to farm extension service as a source of information and exchange and sharing of experience among farmers' helps by development agent (Kide, 2014). It is necessary to provide basic information related to agriculture and enhance the knowledge and skills o f farmers. The provision extension service is very important for information, knowledge and skills on climate change adaptation through extension advice. This survey result indicates that about 27.6 % farmers were getting that, extension service on climate change adaptation. However, 72.2 % did not obtain it. This shows that, most of

the households have got better knowledge about causes and consequences of climate change and variability and adaptation measures.

Table 6. Access of Climate Change Information and Extension Services of respondents'

Variables	Response	Frequency	Percent
Did you have get climate change information?	Yes	40	32.3
	No	84	67.7
Did you have get extension service?	Yes	34	27.6
	No	90	72.2
Total		124	100

Source: Field survey, (2018)

4.2.2 Credit access and Water access for irrigation

Access to credit service is a significant factor fully fills the financial gap of the farmers. It could purchase the necessary farm input and technologies that are crucial for improving agricultural production and also to carry out income generating activities. This result indicates that, about 27.4 % of households had get credit from institutions. The result indicates that, about (27.4 %) of households that, they had get credit from institutions. It increases financial resource to build the capacity of households to recover climate shocks and to make use Credit was significant. It also minimizes their susceptibility by enabling them to solve scarcity of utilization. From this result of the survey data, most of the households about (73 %) did not use credit, adaptation hard to it.

Access of water for irrigation is essential in that it enable the capacity of households to produce within a one year two and above years. Some farmers' water bodies for irrigation

and it free from dependence of rain fed agriculture. This table result shows that, only 20.2% of farmers have access to use small scale irrigation while 80 % of farmers did not use small scale irrigation, due to the lack of experiences uses of water harvesting. Due to this reason the most farmers in the study area dependent on rainfalls. Therefore, the farmers exposed to low adaptation mechanism to climate variability and change shocks.

Table 7. Credit access and water access for irrigation respondents

Variables	Response	Frequency	Percent
Did you have accessible credit?	Yes	34	27.4
	No	90	72.6
Did you have use irrigation?	Yes	25	20
	No	99	79.8
Total		124	100

Sources: Field survey (2018)

4.3 Trends of Rainfall in the study area

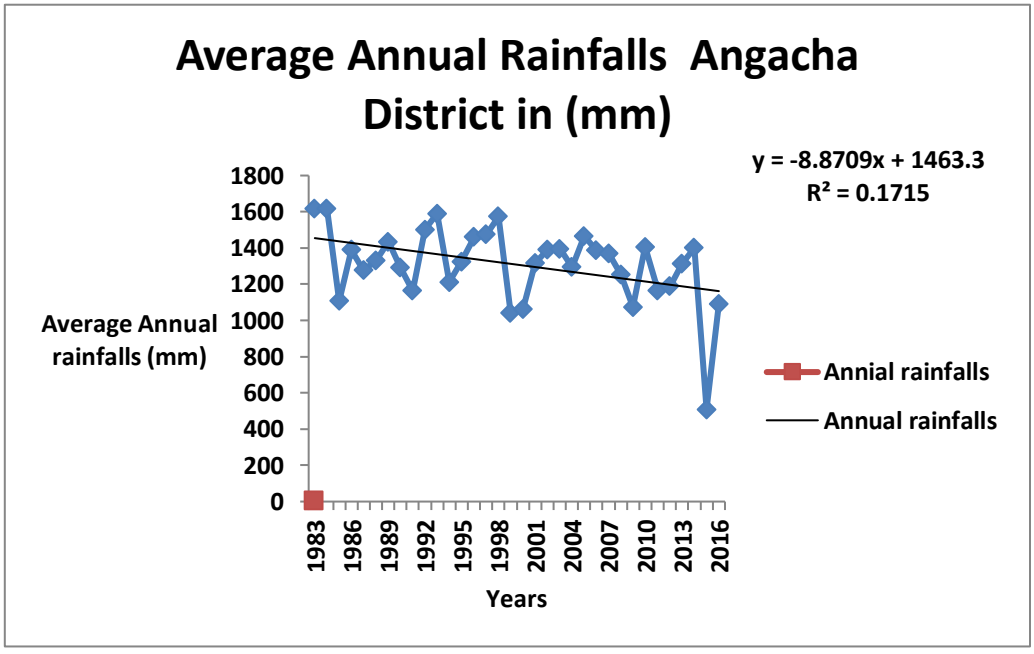
Climate change is a main problem that poses a severe challenge on the ecosystem, therefore; various labors are made to control the problems associated with climate change. The analyses meteorological data (1983-2016) indicate that increases of temperature decreases of rainfalls in the study area.

More specifically the seasonal distribution and amount of precipitation have become difficult to predict, while rainfall distribution during the cropping season is a significant factor influencing crop production. Ethiopia's agriculture is highly influenced by these climatic conditions and has a long history of coping with severe weather events (Weldlul A. L., 2016).

Increasing temperature and variability of rainfall will influence Ethiopia's agriculture and

is projected to exacerbate the existing conditions, which could lead to further increase of land degradation, soil erosion, cut trees. Although the damage will not be the same throughout the study area, but vary in agro ecological zones can benefit from a slight increase in temperature during the right time of the season.

Annual rainfall trend of the Angacha district ranged between 509 (mm) in driest years to 1616 (mm) in the wettest years. Annual rainfall has practiced inter-annual dispersion over the last 33 years. This analysis indicates that the linear trend line shows that decreasing annual rainfall in the station. The linear trend line of annual rainfall indicates somewhat declining trend with 8.87 mm within this years. The mean annual rainfall shows that annual amounts were below the most average 1301.1mm but rain falls recorded in the following years.



source: NMA, 2018 (drawn by the author)

Figure 3. Average Annual Rainfall at Angacha District

The study area has practiced both below average and above average rainfall over the last 33years. In years like 1983, 1984, 1985, 1987, 1994, 2001, 2002, 2003, 2004, 2005, and 200 recorded below the average amount of rainfall while1986, 1988, 1989, 1990, 1991, 1992, 1993, 1995, 1996, 1997, 1998, 1999, 2000 and 2006 were wetter years.

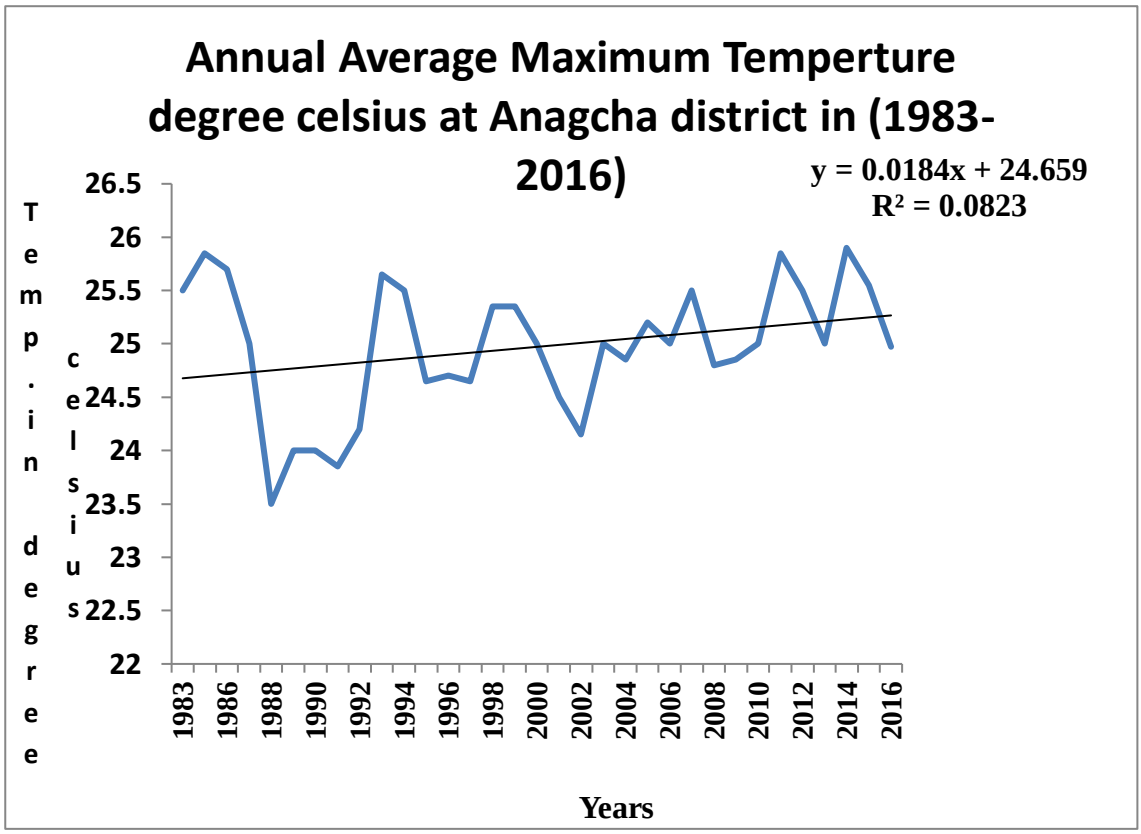
4.3.2 Trends of Temperature

Focus Group Discussion and key interviews groups, experts and the elders indicated that the temperature pattern has changed and shown an increasing intensity. The survey result expressed that out of the total household heads included in the survey, majority of them perceived there is long-term change in temperature in Angacha over the past 33 years. Out of which, 96% recognized increased in temperature and the remaining only 4% has not noticed any change of temperature.

Table 8 . Farmers' Perceptions on Temperature.

Variables	Response	Frequency	Percent
Did you have perceived temperature?	Yes	119	96
	No	5	4
Total		124	100

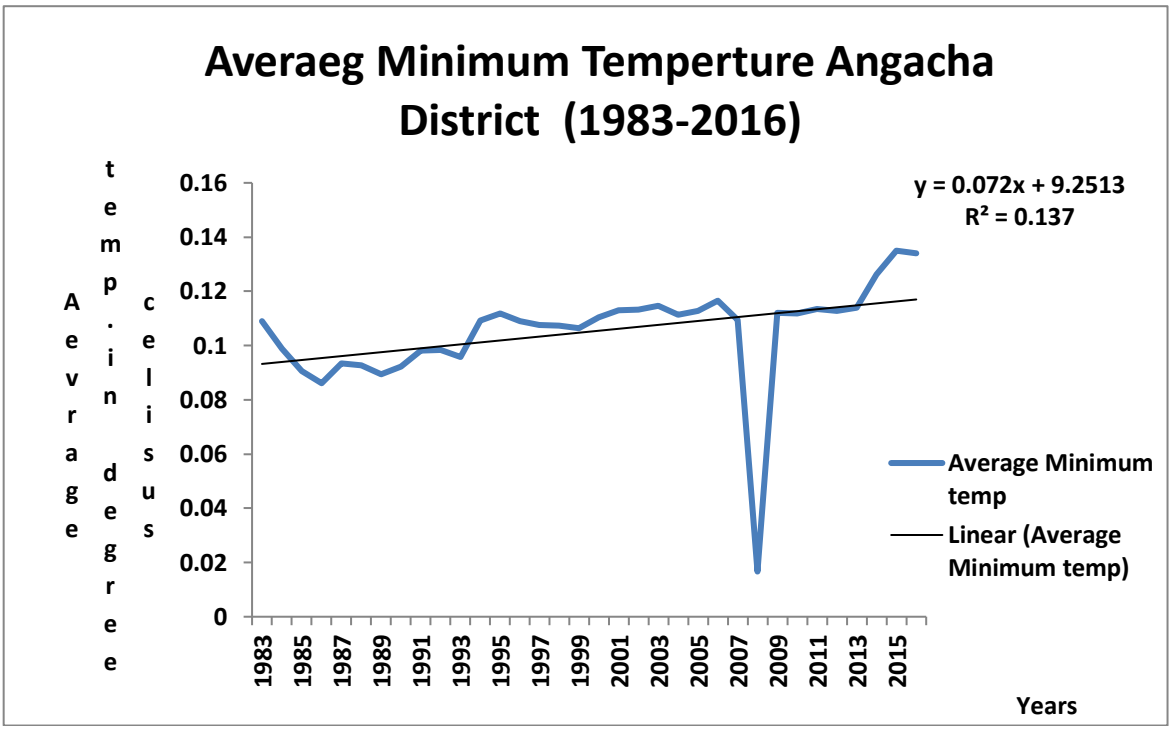
Source: Field survey, (2018)



sources; NMSA ,2018 (drawn by the author)

Figure 5. Average Maximum Temperature at Angacha District in (^{o}c) (1983-2016)

To analyses the farmers perceptions on the temperature change, data recorded National Meteorological evolved trends and variability. Analysis of linear trend of temperature was shown increases of the temperature on district level. As figure 6, indicates, the average yearly maximum temperature of Angacha district over the past 33 years has increased by about 0.018 ^{0}c whereas, the minimum temperature has also increased by 0.072^{o}c.



Source: NMSA, (2018)

Figure 5. Average Minimum Temperature at Angacha District in (^{o}c) (1983-2016)

4.4. Farmers Perception on Climate Change

Results on perception of climate by farmers on climate change in the study Areas. Clear understanding of the level of perception of temperature and rainfall pattern by farmers is understood as an essential element to direct potential actions on climate change adaptation.

For any type of climate change adaptation strategies on subsistence agriculture, natural resource management farmers who perceive the change in climate are hypothesized to make adjustments in their farms to decrease climate change impacts if not they face hard barriers. Though, identifying farming adaptation options to climate change is not an easy work as there are no adaptation interventions for climate change. It is significant to have an insight of farmers' views on temperature and rainfall trends in advance with indigenous knowledge to climate change adaptation.

Farmers were perceived that current weather conditions with that of 33 years ago and the analysis results farmers perception showed that on the details of climate change indicators as related to rainfall and temperature are indicated in Table 9, increases intensity rain falls (94.4%) whereas only (5.6 %) did not perceived any trends of the rainfalls, (93.5 %) of farmers perceived shorten duration of rainfalls but only (6.5 %) of did not perceived it, (95.2 %) of farmers perceived that irregularities of rainfalls but (4.8 %) of farmers did not perceived it, (96 %) of farmers perceived rainfalls comes late and goes early but only (4%) did not perceived it, (92.7 %) of farmers perceived dry of water bodies but only (7.3%) did not perceived it, (96 %) of farmers perceived increases of temperature but only (4%) did not perceived it.Accordingly, the majority of respondents have indicated that the rain fall amount has decreased rainfall pattern has become irregular and the temperature has increased and few farmers did not perceived.

Table 9. Farmer's perception on climate change last 30 years

Variables	Response	Frequency	percent
Increases rainfalls intensity	Yes	117	94.4
	No	7	5.6
Shorten rainfalls duration	Yes	116	93.5
	No	8	6.5
Rainfalls comes late &goes early	Yes	119	96.0
	No	5	4.0
Irregularities of rainfalls	Yes	118	95.2
	No	6	4.8
Total		124	100

Sources : field survey (2018)

4.4.1 Causes of climate change

Table 10, result shows that causes of climate change respondents perceived that anthropogenic activity (83.1%) , Natural factors (1.6 %) and warth of creator (15.3 %) with super natural force punish against human action have been the causes of climate variability and change.

The large part of the farmers, (83.1%) responded that the causes due to anthropogenic interaction miss use of natural resources as a result of overpopulation settlement, wood for fuel crop cultivation, trees for lumber and Straw for animals feed, destroy watershed structure digging mining and unprotected farm plots from animals' contacts.

Table 10. Households head perception on causes climate change

Variables	Response	Frequency	Percent
What were the causes of climate change?	Anthropogenic activities	103	83.1
	Natural factors	2	1.6
	Warth of creator	19	15.3
Total		124	100

Sources: field survey,(2018)

4.5. Adaptation strategies of Farmers

Due to the negative effects of climate change on crop production and rearing livestock's farmers develop their own adaptation strategies such as sowing dates, farmer's using mixed

farming; diversify income sources, soil and water conservation, and planting drought tolerant crops.

4.6 The Major Barriers to Adaptation Strategies in Angacha

As shown in the above sections, a large number of small holder's farmers believe that temperature and rainfalls have become hotter and drier respectively. All the respondents and most of the FGDs participants, key interviewed informants perceived changes in temperature and precipitation. However, some farmers have taken remedial actions for changes in rainfall patterns and temperature changes, they were not successful. In other words, farmers' adaptation options were not successful due to various perceived limitations.

The survey assessed farmers' perceived barriers to using various adaptation options. Survey results obtained from household heads, FGDs, and key informants on barriers to taking up adaptation options indicate that poverty, water scarcity, lack of fully extension services, lack of information about the weather or long-term climate change, shortage of farm land size, low level of knowledge and skills on climate adaptation strategies, shortage of credit, shortage of animal fodder and health service, lack of agricultural technologies were major constraints of adaptation for many peoples in the study area. These studies support the findings of such study.

Poverty: Poor households have low adaptive capacity because adaptation comes at an asking value. The farmers in the area indicated poverty as a major constraint.

Shortage of farm land size: - It is significant major constraint of adaptation to impacts of climate change noted by the farmers. Many Farmers responds that very shortage of land

holding size was stated as the main cause. Farmers explained that a decrease in their respective land holdings size and farm fragmentation made traditional soil conservation techniques.

Lack of meteorological information: - Lack of information is one of the most important barriers to adapt in the study area. The respondents and agricultural found in the area declared that lack of access to timely meteorological information is one most vital constraint for making adjustment to erratic rainfall to adjust planting dates. Weather forecasts related with onset and offset of rainfall. The weather information that rarely delivered to them for pre-harvest is very general and lack specificity. This adversely affects the accuracy, trustworthiness and acceptability of meteorological reports.

Shortage of water : - It was mentioned as one of the most critical constraints to climatic change adaptation. Water is potential adaptation measures to reduce climate related impacts especially rainfall variability. Even if the farmers were well aware of the importance of application of small-scale irrigation most farmers could not employ them because of scarcity of water in the area.

Shortage animal fodder: - Even though both crops and animals are susceptible to climate change and variability, animals seemed to be less affected because of their ability to move. They can escape spatially and temporally stresses full conditions of climate change. Animals were the sources of income in study area; therefore, number livestock seriously decreases due to lack of animal feeds in area. Farmers were aware of this but could not transform from farming to livestock as scarcity of feed and water is a very severe problem in the area.

Lack of health services: - A considerable proportion of the respondents and FGDs participants indicated lack of animal health care centers each kebeles and poor service in the area as one major constraint to adjust and improve livestock management and diseases. Due to frequent droughts, livestock exposed to different animal disease. For example, a considerable number of livestock died in throughout the years.

Lack of agricultural technologies and inputs: - large number of farmers considered lack of suitable agricultural technologies and inputs as a barrier that hinder to change cropping pattern by introducing new and high value crops, diversify new variety crops in their farms, improve farm productivity, and changing use of chemicals and fertilizers. Other barriers The survey results showed that lack of institutions that can assist and facilitate desired changes, lack of credit opportunity, high dependency on rain feed agriculture and food scarcity were some of the problems informed by the households.

Table 11. Farmers' Barriers to Adapting to the Climate Change

List barriers to adaptation strategies	Frequency	Percent
Lack of weather forecasting information	33	26.6
Lack of extension services	12	9.7
Shortage of farm land size	34	27.4
Lack of knowledge and skills curb climate change	13	10.5
Shortage of credit access	15	12.1
Shortage of water	13	10.5
lack animal feeds and epidemic diseases	4	3.2
Total	124	100

Sources: field survey, (2018)

4.7. Determinants of Farmers' Adaptive Choices of Climate Change

Multinomial logit model was engaged to guess the determinants of farmers' adaptive choices of adaptation strategies to minimize the impact of climate change on livelihoods. In this analysis, there was no adaptation option used as base category and the expected coefficients compared with the base category. The likelihood ratio statistics indicated by the Chi-square test were found to be significant as indicated in the following analyze.

Table 12: Marginal effect explanatory variables from of multi logit model

Explanatory Variables	Drought tolerant crops Coef. p-value	Changing sowing /planting date Coef. p-value	Integrating crop with livestock Coef. p-value	Diversify income sources Coef. p-value	Conserve soil & water Coef. p-value
Sex	0.204	0.103	0.208	0.301	0.209
	0.139	0.140	0.005*	0.208	0.309
Age	0.174	0.183	0.303	0.205	0.320
	0.013**	0.57	0.840	0.025**	0.240
Education	0.401	0.320	0.206	0.132	0.231
	0.09***	0.08***	0.188	0.0633	0.031***
Farm size	0.174	0.035	0.240	0.301	0.322
	0.033**	0.024**	0.058*	0.095*	0.196
Farming exp.	0.340	0.214	0.204	0.302	0.401
	0.204	0.159	0.481	0.393	0.628
Liv. own	0.108	0.341	0.305	0.340	0.207
	0.152	0.297	0.065*	0.064*	0.369
Ext. service	0.208	0.209	0.117	0.065	0.101
	0.015**	0.013**	0.394	0.213	0.028**
Climate info	0.400	0.123	0.370	0.401	0.112
	0.070*	0.036**	0.447	0.805	0.075*
Credit access	0.311	0.211	0.300	0.110	0.340
	0.081**	0.061**	0.501	0.040**	0.010**
Irrigation	0.313	0.207	0.109	0.230	0.111
	0.096	0.036**	0.051**	0.221	0.039**

Notes: *** significant at 1%, ** significant at 5%, and * significant at 10% probability level

Results presented in Table, 13 show sex, age, education, farm size, farming experience, frequency of extension visit, access to climate information, access to credit and access to water for irrigation have a significant positive impact on dependent variables. The overall results of the Multinomial logit analysis in Table 13 showed that sex of household head, age of households ,education level, farm size, ownership of livestock, access to information on climate change ,DAs extension service, access to credit, and, declining of rainfall, irregular distribution of rainfall and high temperature significantly influence farmers adaptation to climate change. Many of these variables are also indicated as important variables in the studies of (Weldlul, 2016).

Some of independent variables are extremely significant to affect decision for a particular adaptation option and may be no significant for the other adaptation measures. Thus, the multinomial logit analysis results showed that the decision of choosing each adaptation measure to climate change and variability influenced by different factors at different levels of significance by some factor. Results of multinomial logit analysis also showed that most of the estimated parameters conform to the expectations except farming experience which is not significant in influencing farmers' adaptation strategies.

4.7.1 Sex of household heads

The female households heads in Ethiopia are less likely to adapt due to their limited access to information, inputs and other resources as a result of different barriers (Wilson and Million, 2011) but stated that male headed households are likely to adapt, because male headed households are more likely to get information about new technologies and undertake risky businesses than female headed households.

The result of these study also indicate that when the Sex of the house hold head increases by the probability of using integrating crop with livestock as an adaptation option increased by factor of 0.005 significant level.

4.7.2 Age of the household head

Age of the farmers is an significant explanatory variable in climate change adaptation strategies. The result of these study also indicate that when the age of the house hold head increases by one unit the probability of using utilize income diversification, drought tolerant crops by factor 0.025, 0.013 at 5% significant . It means that the probability of taking up climate adaptation strategies was high in through age farmers develop their experience. The age of the farmer's increases, they are expected to get more experience in weather forecasting. This helps add to probability to working on different adaptation strategies on climate change. This result is in line with the findings of (Kide, 2014).

4.7.3 Education level of household heads

Farmers with increases level of education are more possible to adapt climate change. An increase in education level is also an increase knowledge and skill so the more educated farmers more adapted than an uneducated farmers (Betelhem, 2014). The study had hypothesized that farmers with increases level of education be supposed to more possible to adapt climate change. The result of this study indicate that, an increase in level of schooling by 1 year increases the probability of using drought tolerant planting or crops and changing cropping date or planting dates, conservation of soil and water by a factor of 0.09 and 0.08 and 0.031 at 1% significant levels . This can be explained as an increase in education level

is an increase in knowledge and skill so the farmers more perceived climate related issues ready to adaptation strategies.

4.7.4 Farming experience

This is because more experienced farmers are assumed to have better knowledge about weather information and its implication on agricultural practices. It helps to a positive effect on climate change adaptation strategies (Abayineh and Belay, 2017).This indicates that as they become more experienced in farming they adapt climate change/ variability (Betelhem,2014). This study hypothesized that increase farming experience by 1 year, increase adaption options.

4.7.5. Farm size of house holds

It is statistically significant explanatory variable in this mode (Kide, 2014). Farm size increase one unity has positive effects on climate change adaptation strategies significant association, with the size of farmland increases (Betelhem, 2014). The probability of particularly planting drought tolerant and integrating crops with livestock (Abayineh and Belay, 2017).This study hypothesized that large farm size increase the likelihood of using adaptation to climate change. An increase farm size by 1 hectare, increase the probability of adopting adaptation options (Abayineh and Belay, 2017). The drought tolerant corps and plants, change sowing date and income diversification as an adaptation measure by a factor of 0.033, 0.024 and 0.095 at 5%, 10% significant level, respectively.

4.7.6 Livestock Holding

The livestock own by farmer is significant explanatory variable in this study. Livestock plays a great role increasing food security by serving as source of food, income and traction

and purchasing improved crop variety. This study results indicated that size of livestock holding is found to positively and Significantly tell to the adaption strategy (Abayineh and Belay, 2017).

4.8.6 Extension Visit Service

The farmers' extension service positive relationship between access to information and the adoption of farmer adaptation option (Betelhem, 2014). Extension services helps to share out information about technology on farming activities and adaptation method through extension visit and increase the probability of up taking adaptation options (Abebaw, 2016). The study hypothesized that, frequency of extension visit contact increases the probability of adaptation to climate change. The empirical result of this study shown that an increase in extension visit by one contact increases the probability of adopting planting drought tolerant crops or plants, changing planting dates and conservation of soil and water by a factor of 0.015 and 0.013 and 0.028 at 5% significant levels. This may be explained by the fact that increased frequency of extension visit services helped the farmers to more adapt to climate change.

Still now majority of the farmers did not adopt using drought tolerant plants or crops, and also according to weather furcating information farmers changing planting dates extension agents work a lot in promoting the significance of using drought tolerant plants or crops, changing planting dates and soil and water conservation technologies.

4.7. 7 Access to forecasting climate information

A farmer getting reliable climatic information increases the probability of adaptation. Access to reliable climate information is a significant explanatory variable that increases

adaptation options (Abayineh and Belay, 2017). This study hypothesized access to climatic information increases the positive chance of adaptation. The result show that increases in climatic information increase the probability of using drought tolerant crops, changing planting dates and soil and water conservation by a factor of 0.070, 0.036 and 0.075 by a factor of 5% significant levels, respectively.

These indicates that their sources provide information by giving emphasis on different techniques of using drought crops ,cropping dates and soil and water conservation methods and the farmers have better information and knowledge to execute it at their farm land.

4.7.8 Credit access

Credit access of the farmers is an important explanatory variable in climate change adaptation strategies. It is essential to increases the adaptive capacity through saving and engaging in accumulation of income sources as an asset. This means there is a positive relationship between credit and adaptation to climate change and variability (Betelhem, 2014). In line of this, study hypothesized that there is a positive relationship between credit and adaptation strategies. Access of credit increase by one unit increases the probability of adopting drought tolerant plants, diversification of income and soil and water conservation as an adaptation option by a factor of 0.081, 0.040 and 0.010 at 10 %, 5% significant levels respectively each. Accessibility of credit increase adaptive capacity of farmers, which leads to decrease economic obstacle will be able to adapt climate change and variability.

4.7.9 Water for irrigation

Access to water for irrigation has positive effect on farmers' adaptation to climate change. This study hypothesized access to water for irrigation increase the probability of adopting adaptation to climate change by a factor0.036, 0.039 ,0.051, at 5 % significant respectively.. This can be explained as an increase in access of water for irrigation an increase farmer's ready to adaptation strategies. As a result of this, farmers and others in order to enhance potential source of water for irrigation they have to conserve soil and water by using different physical and biological methods of conservation.

CHAPTER FIVE

5. Summary, Conclusion and Recommendation

5.1 Summary

This study was conducted in Angacha district in Kembata Tembaro Zone of SNNRP. It was carried out on the smallholder farmers' perception on climate change, its impact and adaptation strategies towards climate change. The main objective of this study was to assess farmers' perception on climate change and variability, its impact on their livelihoods and adaptation measures in study area.

Farmers' perception on cause, impacts and necessary response mechanisms to cope with climate change impacts is important for any population in a given community. Systematic random sampling technique or methods was applied to select the study sample Kebeles and households in villages. At initial stage, Angacha district was selected purposely and the Kebeles in the district were systematic in to three groups based on homogeneity of their agro-ecological zones.

In the second stage, Kebeles were arranged in agro-ecological base out those three Kebeles systematical selected because in order to save time and finance. Three out of seventeen Kebeles systematic randomly selected namely *Adancho Ebala* Kebele from *kolla, Kerekicho* Kebele from *Woina Dega* and *Kayea* from *Dega* agro-ecologically zone.

In the third stage, from total 2112 household heads were selected randomly using simple random sampling technique, proportional to the inhabitants of villages recognized, study sample were selected from the registered of households. Accordingly, 40, 45 and 38 household heads were selected from those each Kebeles.

Both primary and secondary data were used for this study. Primary data were collected from a through questionnaires interview method and Focus Group Discussion whereas secondary data was collected from different organizations and published sources.

Descriptive statistics were used to provide insights about the most affected social groups by climate change, types of adaptation strategies to climate change and to explain constraints facing farmers not to adapt and to assess the different socio-economic characteristics o f the sample respondent households.

Farmers Perception on climate changes and variability: The majority of local community perceives long-term change and variability in local climate, these were increases intensity annual rainfall, change of rainy season, increased in frequency of drought and soil degradation there was also seasonal variability in pattern and distribution of rainfall. This also confirms the metrological data finding.

Trends of local climate: The meteorological data analyze indicate that, there was inter-annual variability of annual rainfall and it has an increased trend. Similarly with the annual rainfall there was also inter-annual variability in the amount of *belg* and *kiremt* rainfall. Accordingly, both *belg* and *kiremt* rain shows decreasing and increasing trend respectively.

In addition to these both average maximum and minimum temperature shows increasing trend. Due to increased temperature and erratic rainfall, the area become exposed to drought and experienced a number of drought years.

Adaptation strategies used by farmers in the study area include using drought tolerant plants, changing and adjusting planting date, mixed faming, diversify income sources, soil and water conservation and using irrigation. The farmers have faced various interconnected constraints that can make their life very difficult in the presence of climate related hazards. Farmers sort out their major challenge for their failures to adapt it include lack of technical knowledge, lack of irrigation water, lack of money, lack of climate forecasting weather information, shortage of land.

Determinants of adaptation: Multinomial logistic regression analysis was engaged to determine the explanatory factors influencing household's determinants adaptive choice of adaptation measure to climate change. The result from the multinomial logit analysis shows that sex, education level, age, farm size, livestock owner ship, farming experience, frequency of extension service, access to forecasting weather information on climate change, access to credit, and, and access to irrigation have a significant impact on farmers" choice of adaptation to climate change. Farmers have high farm size; access to forecasting weather information on climate change and access to credit are more likely in taking adaptation measure to climate change. Farmers with higher off-farm income may be slow in taking more adaptation measures as non - farm activities by themselves act as adaptation measures affecting household's choice of adaptation measure to climate change.

5.2 Conclusion

The study was carried out to assess the perception of small farming households and adaptation strategies by farmers to climate change. Farm households were characterized in terms of important variables such as demographic attributes, asset holds, literacy level, access to credit services, access to irrigation water sources, extension services. Taking into consideration all the interacting factors observed in the study the following major conclusions are drawn.

Characterization of the respondent households in terms of asset endowments indicated that a large proportion of the small farm households were resource poor and their literacy level is low. Traditional farming is a dominant agricultural economic sector and farmers' capacity to resist incidence of drought is limited.

Small farmers' perception on climate variables was studied from farmers' point of view and it was compared against the empirical findings from weather data gathered and analyzed from weather stations. The general scenario indicates that small farming household level awareness on climate change is relatively high. Despite these findings there were no visible strategic and integrated actions taken by the government institutions and all relevant stakeholders to reduce the impact of climate change by enhancing adaptation mechanisms to climate change.

Accordingly rain fall amount and distribution, on set and cessation time of rain fall, rise in temperature, failure of the short rainy season that is critical for crop production and growing livestock fodder and frequency of drought, and decline of water bodies are perceived by the majority of farm households. Farmers were little attempt made themselves and other

stakeholder to make the most of on this awareness and look for more innovative technologies.

The existence of some respondents associating environmental degradation and climate change as a natural happening and also as an act of God has a damaging effect. The variable rain fall pattern such as shortage of rain fall and late and early stop of rainfall are common incidents observed particularly in study area. Many farmers, being resource poor have, faced food shortages during some months of the year; the flow of streams has become intermittent, animal fodder were deteriorated and the livestock performance is weakened. Based on rainfalls shortage many farm households fall back to deforestation and charcoal making. All these incidents seem to have led to deterioration of the woodland resource bases and local conflicts on natural resource use have become recurrent problems. The very shocking incident observed in this study is that there seems no responsible body protect their environment and planting trees and protecting early planting trees in everywhere from successive climatic variability. Under such situation it will be difficult to establish sustainable climatic adaptation interventions that could lead to long term solutions.

Climate change is an inevitable event that will happen again in the years to come. What is nowadays considered necessary is to maintaining of a stable environment that will make possible the rural households to adapt to unforeseen situation. The adaptation strategies practiced by farmers are encouraging and if systematically studied and documented they can promote efforts to improve farmers' resilience. Finding of technologies that are suited to changing climatic variables and effective understanding of variables influencing farmers' motivation to climate adaptation can promote government efforts to tackle the adaptive capacity problems in the agricultural sector. It is true that in the study districts and the area

at large there are a number of institutions in charge of handling the climate change issues. Lack of defined strategy to address the issue of climate change and lack of an integrated plan that is approved and owned by each stakeholder in the system is a common problem describing in the study area. Under the existing practice it is not good to control climate change related problems. It needs integration to control climate change related problems.

5.3 Recommendations

Based on the result of this study, and given the negative trends in local climate and low adaptive capacity o f climate change , there is a need for vital action designed at addressing the causes of climate change and adaptation strategies. Therefore, the recommendations were forwarded to farmers and responsible bodies.

1. The government and other responsible body should increase local people's perception on the cause's climate change and adaptation strategies through training.
2. The government should establish meteorological station, at district level and make climate information available to local community
3. Model farmers' extension services should be scale up or distributed in line with the current existing climate condition needs. Environmental protection offices and NGOs have to work on the development agent's by continually updating the extension workers' knowledge so as to improve the productivity and production on both crop and livestock through transfer of improved technologies, knowledge and practices
4. To improve farmers adaptive capacity the government introduce through training on climate change causes and support farmers financially to enhance their participation in small scale irrigation and water harvesting, improved agricultural inputs should

be distributed timely to farmers, diversify income sources through on-farm and off-farm income earning opportunities. In order to protect their environment and restore natural resources the government should confirm the ownership of the local community towards natural environment.

5. Government and other responsible body should create credit institutions to provide credit to solve the financial problem of the farmers

REFERENCES

Abate F.S., 2009. Climate Change Impact on Livelihood, Vulnerability and Coping Mechanisms: A Case Study of West-Arsi Zone, Ethiopia. M.Sc Thesis. Lund University Masters Program in Environmental Studies and Sustainability Science (LUMES).

Abayineh A. and Belay S., 2017. Determinants of smallholder farmers' decision to adopt adaptation options to climate change and variability in the Muger Sub basin of the Upper Blue Nile basin Ethiopia: Centre for Environment and Development, College of Development Studies, Addis Ababa University, p.o.box 1176, Addis Ababa, Ethiopia.

Abebaw Assaye, 2016.Smallholder Farmers' Adaptation Strategies to Climate Change: The case of Ankesha Guagusa District of Awi Zone, North Western Ethiopia. M.Sc Thesis. Haramaya University, Haramaya.

Abid1 M., J. Scheffran1, U. A. Schneider, and M. Ashfaq, 2015. Farmers' perceptions of adaptation strategies to climate change and their determinants: the case of Punjab province, Pakistan

Abirham Cherinet, 2017. Community Perception on Climate Change, Its Impacts and Adaptation Strategies: the Case of Ensaro Woreda, North Shewa Zone, Amhara Regional State. M.Sc Thesis. Addis Ababa University.

Abrham B., John W. R., Teshale, W and John F. M. 2017. Smallholder farmers' adaptation to climate change and determinants of their adaptation decisions in the Central Rift Valley of Ethiopia, Agriculture & Food Security.

Addisu Damtew, 2011. Benefits and challenges of adopting of soil conservation techniques in Goromti watershed, central Ethiopia Addis Ababa University.

Angacha District Agricultural and Natural Resources Office, 2017.

Akinnagbe O.M. and Irohibe I. J., 2014. Agricultural Adaptation Strategies to Climate Change Impacts in Africa Bangladesh J. Agril. Res. 39(3): 407-418, ISSN 0258-7122

Anne Skambraks, 2014. Smallholder Farmers' Adaptation to Climate Change in Zenzelima, Ethiopia: A Case Study of Female and Male Farmers Perception of and Ability to Adapt to Climate Change in Zenzelima, Ethiopia. University of Natural Resources and Life Sciences Vienna Department of Sustainable Agricultural Systems Division of Organic Agriculture European Master in Organic Agriculture and Food systems

Betelhem Abebe, 2014.Adaptation to Climate Variability and Changes in the Small Farming Households, Dire Dawa Administration Addis.MSc.Thesis. Addis Ababa University.

Biniam Debela, 2016. Gender and Climate Change: Determinants of Female Farmer's Adaptation Strategies to Climate Change – A Survey Study in Atsbi Womberta, Ethiopia. Department of Civics and Ethical Studies: Journal of Citizenship and Morality, Vol.1, No.1, November, 2017, 1-49 .http://mu.edu.et/jcm/

Candida E. M.,Manase E. P., Rurangwa F.., Nancy P., Godwell E. Ole M., Seif S., 2011. Impacts of Climate Change on Biodiversity and Community Livelihoods in the Katavi Ecosystem

Cidy. Devendra, 2012. Climate Change Threats and Effects: Challenges for Agriculture and Food Security I. Akademi Sains Malaysia. II. Title. III. Series. 577.5522

Deressa T., Rashid M., Claudia R., Tekie A., Mohamed Y., 2009. Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. Journal global environmental change.

Deressa, T. R.M., Hassan, and C. Ringler. 2008b. Measuring Ethiopian Farmers' Vulnerability to Climate Change across Regional States. International Food Policy Institute, IFPRI Policy Brief 15-5

FAO 2008. Climate Change and Food Security: A Framework Document. Wulf Killmann Chair person Inter departmental Working Group on Climate Change. Rome.

Getachew T., Melaku B. and Bereket T., 2017. Farmers' Perceptions and Adaptation Strategies to Climate Change and Variability: The Case of Kacha Bira Woreda, Kembata Tembaro Zone, Southern Nations, Nationalities and Peoples Ethiopia. Journal of Environment and Earth Science ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online) Vol.7, No.3 www.iiste.org

Halkano J. B., and James K., 2014. Climate Variability and Response Strategies among the Gadamoji Agro-Pastoralists of Marsabit County, Kenya: Department of Environmental Education Kenyatta University. International Journal of Humanities and Social Science Vol. 4, No. 11

Jeff Spickett, Helen Brown and Dianne Katscherian 2008.Health impacts of climate change: Adaptation strategies for Western Australia .Environmental Health Directorate

Kide Gebru Tesfay, 2014. Small Holder Farmers' Adaptation Strategies to Climate Change in Ethiopia: The Case of Adwa Tigray Region. M.Sc Thesis. Mekelle University College of Business and Economics Department of Economics.

Marius Keller, 2009.Climate Risks and Development Projects Assessment Report for a Community-Level Project in Guduru, Oromiya, Ethiopia.

Marye Belete, 2011. Local Peoples' Perception on Climate Change, its Impact and Adaptation Measures in Sidama Wereda of South Gondar. M.Sc Thesis. Addis Ababa University.

Mesfin Desalegn, 2010.Challenges and Prospects of Land Rehabilitation Practices: A Case of Angacha Woreda, Kembata Tembaro Zone, SNNPR. M.A Thesis, Addis Ababa University.

Mesfin T D, 2012. Communities' communities' perception on climate change and attitudes towards livelihood adaptation strategies in ware Jarso district, Ethiopia. M.A Thesis. Addis Ababa University.

NAPA (National Adaptation Acting Plan of Action), 2007. Climate Change National Adaptation Programme of Action of national metrological agency, Addis Ababa, Ethiopia.

Nega D, Caroline M, Kerry B, Ross C and avid McNeil, 2015. Perception of climate change and its impact by smallholders in pastoral/agropastoral systems of Borana, south Ethiopia: springer plus 4:236 doi: 10.1186/s40064-015-1012-9

Nigus G A.2011. The impacts of climate change on rural livelihood and their adaptation methods the case of Alamata Woreda, Southern Tigray. M.A Thesis. Addis Ababa University.

Otitoju, M A, 2013. The Effects of Climate Change Adaptation Strategies on Food Crop Production Efficiency in Southwestern Nigeria agricultural economics university of Nigeria, Nsukka (pg/Ph.d/09/50851)

Rediet Tsegaye, 2011. Vulnerability to climate change/variability and Local coping strategies in Ebinat Woreda, South Gondar Zone. M.A Thesis. Addis Ababa University.

Rohini P. Devkota, 2014. Climate Change: Trends and People's Perception in Nepal.

S.Mahendra Dev, 2011. Climate Change, Rural Livelihoods and Agriculture (focus on Food Security) in Asia-Pacific Region.

Sekaleli T.S.Tand Sebusi K, 2013. Farmers' Response and Adaptation Strategies to Climate Change in Mafeteng District, Lesotho ATPS Working Paper No. 74

Tadesse D Y, 2011. Assessment of the practices and aspects of farmland management in Gozamen District, East Gojjam zone, Addis Ababa. M.Sc Thesis. Addis Ababa University to Climate Change across Regional States. International Food Policy Institute, IFPRI Policy Brief 15-5.

Tsegaye Ginbo Gatisso, 2014.Impacts of Climate Change, Variability and Adaptation Strategies on Household Food Security in Southern Ethiopia. M.Sc Thesis. Economics (Resource and Environmental Economics) Addis Ababa University.

UNFCCC, 2007. United Nations Framework Convention on Climate Change: Martin-Luther-King-Strasse UNFCCC Secretariat. Bonn, Germany.

Via Paolo di Dono, 2010.International Fund for Agricultural Development, Rome, Italy.

Warner and Mr P. van, 2015.Climate Change Profile: Ethiopia was developed in cooperation between: the Netherlands Ministry of Foreign Affairs (MFA) and Ethiopia.

Weldlul A. L., 2016. Analysis of Smallholder Farmers' Perceptions of Climate Change and Adaptation Strategies to Climate Change: The Case of Western Amhara Region, Ethiopia. Doctor of philosophy in environmental management, University of South Africa.

Wilson K. And Million G, 2011. Investigating how development interventions increase community-level adaptive capacity in Ethiopia. In the new voices, different perspectives: Proceedings of the Africa Adapt Climate Change Symposium 2011. Addis Ababa, Ethiopia

Yubraj Bhusal, 2009. Local peoples' perceptions on climate change, its impacts and adaptation measures in mid-mountain region of Nepal.

Appendix 1. Questionnaire for household survey

Hawassa University

School of graduate studies

My name is Yohannes Gabore, a graduate student of Hawassa University, department of climate Change and Sustainable Agriculture. I am conducting a research for the partial fulfillment of (MSC) degree in climate change and sustainable Agriculture. The purpose of this questionnaire, interview, information collected data in this interview will be used for academic purposes and that they were strictly confidential MSC this about community‟ perception of climate change impacts and their livelihoods adaptation strategies to climate change/variability for educational research going to conduct in two rural administrative Kebeles of Angacha district, Kembata Tembaro Zone, Southern Ethiopia. I kindly request respondents to fill this questionnaire honestly and carefully.

Kebele _____

Enumerator_____sing_____Questionnaries code_____

Instruction: encircle (use tick mark) write the answer as may be necessity indicate your appropriate response (do not write your name)

Thank you very much for your time!

Appendix I. Structured questionnaires to be completed by household head

Part I. Socio economic and demographic aspects of local households

1. Sex of house hold head: 1. Male 2. Female
2. Age of household head___1. 35-40 years 2. 40-450 year 3. 45 -50 years 4. 50 above years
3. Educational status of household: 1. Unable to write and read 2.Grade 1-4 3. Grade 5-10 Diploma 10 +3

4. Current occupation of the household 1. Farmer 2. Trader 3. Daily laborer 4. Other (specify)

Part II. Farmers perception on climate variability

1. Do you believe that there is climate change /variability in the area? A. Yes B. No If yes what are the indicators of climate variability and change? (Multiple answers is possible)
2. Are you heard about climate change before? A. Yes B. No
3. From which source you heard about climate change? 1. Radio 2. School education 3 Television 4. Government Organization 5. Non-government Organization 6.pulic meeting 7. National Metrology Statically Agencies 8. Mobile line 9. DAs 10. Training on climate change
4. What are causes of climate change? 1. Anthropogenic activities 2. Natural factors 3.Wrath of God
5. If your answer is in Q 12 is anthropogenic? What are they? 1. Popn settlement 2. Wood for fuel 3. Crop cultivation 4. Trees for lumber 5. Straw& leave for animals feed 6. Crop residue for fuel

Part III. Indicators of climate change and variability

No	Indicators of climate change and variability	Yes	No
1	Increase in daily temperature		
2	Decrease in rainfall amount		
3	Increase intensity of temperature		
4	Rain falls comes late and goes early		
5	Fluctuation of rainy season		
6	Drying of local ponds and springs		
7	Decrease volume of rivers and streams		
8	Reoccurrence of drought		
9	Flooding and torrential rainfalls		
10	Frequent occurrence of thunderstorm		

11	Increasing of evapo transpiration and shade the leaf		
12	Increasing soil & water pollution?		
13	Increasing land degradation?		
14	Increasing loss of biodiversity?		
15	Decrease of crop production?		
16	Increases crop pest?		
17	Increases animal disease?		
18	Decreases vegetation cover?		
19	Frequent occurrence frost trend?		

1. Do you have your own farm land? If yes how many hectare _____
2. Type of agriculture practiced A. Arable farming B. mixed farming C. Irrigated
3. If you used irrigation estimate the size of cultivated land _____ hectare
4. Do you have livestock? A. Yes B. No
5. Did you have used improved seed? 1.Yes 2.No
6. Did you have use agricultural inputs? 1. Yes 2. No
7. Did you have rearing livestock? 1. Yes 2. No
8. Which society group affected in climate change? 1. Landless 2. Female 3. Male 4. Elder's 5. Poor 6. Rich

Part IV. Adaptation strategies of vulnerable household

1. Did you have enough food? 1. Yes 2.No
2. If your answer is No, how did you provide food to your family? 1. Sell livestock 2. Sell fixed assets 3. Aided grain from government 4. Borrow money 5 .Move to other places (migrate)
3. Did you have uses off-farming system? 1. Yes 2. No If your answer is yes, then, what are they? 1. Burning charcoal 2. Rent land 3. Engaging daily labor

Part V. Climate change adaptation strategies of crops

No	Climate change adaptation strategies of crops	Yes	No
1	Did you have use early mature crops?		
2	Did you use planting drought resistant?		
3	Did you have use adoptions of new varieties		
4	Did you exercise adjusting sowing date?		
5	Did you have exercise mixed farming?		
6	Did you use crop diversification?		
7	Did you have exercise chemical fertilizer?		
8	Did you have use mulching practice?		
9	Did you have use small scale irrigation?		

Part VI. Climate change adaptation strategies of Livestock's

No	Adaptation strategies to climate change	Yes	No
1	Did you have breed new &drought resistant livestock?		
2	Did you have diversified herd composition?		
3	Did you have selling unproductive?		
4	Did you have selling animals before long dry season?		
5	Did you have accumulated animal fodder before dry season?		

VII. Climate change adaptation strategies of water

No	Climate change adaptation strategies of water	Yes	No
1	Did you have practice rain water harvesting?		
2	Did you have watershed structure to percolate water?		
3	Did you utilize underground water for irrigation?		

VIII. Climate change adaptation strategies of vegetation cover

No	Climate change adaptation strategies of vegetation cover	Yes	No
1	Did you use area closure degraded land for regeneration?		
2	Did you use planting grass on structure?		
3	Did you planting broadleaf trees on trench?		
4	Did you use conserving soil and water?		

VIIII. Constraint to adaptation strategies

No	Constraint to adaptation strategies	Yes	No
1	Did you have lack awareness affects adaptation strategies?		
2	Did you have poverty affects adaptation strategies?		
3	Did you have poor infrastructure affects adaptation strategies?		
4	Did you have poor technology affects adaptation strategies?		
5	Did you have Poor administration affects adaptation strategies?		
6	Did you have lack of credit access affects adaptation strategies?		
7	Did you have knowledge and kills affects adaptation strategies?		
8	Did you have lack initiation of hard working affects adaptation strategies		

Appendix III. Questions for Key Informant Interview

1. Did perceiv change of temperature and rain fall in Angacha district in the past 30 years?

   A. Yes B. No

2. If you're the answer is yes, what were the causes of climate change/ variability? Is it anthropogenic or natural factors?

3. If you're the answer are anthropogenic factors? What were they?

4. Did you perceived indicators of climate change/ variability? 1. Yes 2.no

5. If you're the answer is yes, what were they?

6. Did you have understood the impacts of climate change on agriculture and natural resources?

7. What were the main impacts of climate change on the crops and the environment?

8. What were the main impacts of climate change on the livestock and the environment?

9. List down who is the more vulnerable society in climate change/ variability?

10. What were the farmers coping mechanisms used to reduce the impacts?

11. What are the main challenges and how do you think they can be improved?

Appendix IV. Questions for Focused Group Discussion (FGD)

1. Did perceived change of temperature and rain fall in Angacha district in the past 30 years? A. Yes B. No

2. If you're the answer is yes, what were the causes of climate change/ variability? Is it anthropogenic or natural factors?

3. If you're the answer are anthropogenic factors? What were they?

4. Did you perceived indicators of climate change/ variability? 1. Yes 2.no

5. If you're the answer is yes, what were they?

6. Did you have understood the impacts of climate change on agriculture and natural resources?

7. What were the main impacts of climate change on the crops and the environment?

8. What were the main impacts of climate change on the livestock and the environment?

9. List down who is the more vulnerable society in climate change/ variability?

10. What were the farmers coping mechanisms used to reduce the impacts?

11. What are the main challenges and how do you think they can be improved? What does climate change mean?

Appendix V. Check list for Field Observation

The researcher will observe if there is:

Major economic activities of people in their environment

1. Crop production status
2. Rearing status of livestock
3. Land degradation and conservation of soil and water
4. Government and Non-government activities on protection of environmental
5. Tracing and small scale irrigation

Appendix VI. Average Monthly Rainfalls Angacha District in (mm)

Year	Jan	Feb	Mar	Apr	Ma	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1983	41	27	166	223	276	129	189	230	219	85	26	5	1616
1984	0	2	29	27	241	117	150	147	141	4	26	32	916
1985	10	0	66	246	157	71	156	154	173	50	17	7	1107
1986	0	123	99	181	209	187	191	154	165	53	1	26	1389
1987	2	64	181	116	313	66	84	225	136	88	0	1	1276
1988	24	78	29	166	66	121	216	207	249	175	0	0	1331
1989	50	114	80	147	58	157	182	198	185	88	9	166	1434
1990	19	211	137	123	149	129	159	140	162	45	12	4	1290
1991	22	76	124	57	167	147	168	176	146	27	0	53	1163
1992	51	114	97	156	134	137	186	261	164	118	59	24	1501
1993	99	97	34	267	235	103	200	194	181	175	5	0	1590
1994	0	2	129	154	212	179	203	175	150	0	7	0	1211
1995	0	73	112	291	112	102	192	209	163	17	2	52	1325
1996	62	31	192	218	184	199	193	200	148	6	28	0	1461
1997	39	1	77	209	136	150	113	169	151	243	167	19	1474
1998	72	87	113	188	157	168	244	188	149	179	28	0	1573
1999	24	0	74	74	148	164	184	169	145	206	0	0	1188
2000	0	0	23	220	148	156	157	163	161	112	41	36	1217
2001	0	15	205	145	175	160	256	183	166	153	8	9	1475
2002	64	38	154	114	142	114	198	254	200	0	0	111	1389
2003	18	39	124	183	125	182	223	211	221	12	31	26	1395
2004	106	29	102	199	50	62	209	187	208	112	15	16	1295
2005	43	15	127	236	256	111	148	141	249	87	53	0	1466
2006	6	58	147	183	129	152	207	235	117	109	16	27	1386
2007	27	49	107	173	186	214	189	189	215	21	0	0	1370
2008	3	14	32	93	187	158	230	181	144	106	105	0	1253
2009	38	21	45	67	96	115	169	174	148	115	10	75	1073
2010	24	101	135	167	167	115	174	292	161	24	22	23	1405
2011	19	8	53	89	227	145	193	196	161	6	69	0	1166
2012	0	0	48	145	84	204	271	178	251	6	1	0	1188
2013	14	1	123	130	154	164	210	201	177	113	19	8	1314
2014	12	63	117	164	242	55	194	187	212	123	31	1	1401
2015	0	0	20	19	70	75	51	134	89	8	34	9	509
2016	4	11	38	275	150	83	138	126	159	68	39	0	1091

Source: NMSA, 2

Appendix VII. Average Monthly Maximum Temperature Angacha District in (^{o}C)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1983	25.3	25	26	24	23.3	23	21.7	21.3	21.7	23	24	25	283.3
1984	25.3	26	26.3	27.3	24	21	21	20.7	21.7	24.3	25	25	287.6
1985	25.7	26	26.7	24	23.7	21.7	20	20	22	23.3	25	25.3	283.4
1986	25.7	25	25.7	23.3	23.3	21.7	20.7	21	22	23.3	26	26	283.7
1987	25.7	25.7	24.3	23.7	23.7	22	21.3	21.3	22.7	23	24.7	25.7	283.8
1988	26	25.3	26.7	25	24	22	19.7	20	21.3	22.3	23.7	24	280
1989	24	24.7	25	22.3	23.7	21.3	19.3	21	21.7	22.3	24	23	272.3
1990	24	23.7	23.7	23.3	23.3	21.3	19.7	20	21.3	23	24.3	24	271.6
1991	24.7	24.7	24	24.7	24.7	22	19.3	20.3	22.7	24	24.7	24	279.8
1992	23.7	24	25.3	24.3	24	21.7	19.7	20.3	21.3	22.7	23.3	24	274.3
1993	23.7	24	24.7	23.7	23	20.7	19.3	20.3	22.3	23.3	24.3	24.7	274
1994	26	27.3	25.3	25	23.7	21	20	20	22.7	24.7	24.7	25.3	285.7
1995	26	26	24	23.3	24	23	20.3	20.7	22	23.7	24.7	25	282.7
1996	24.3	26.3	25.3	24	23.3	20.3	19.7	20.7	22	24	25	25	279.9
1997	24.7	27	26.7	23.7	24	22.3	20	21	23.3	23.3	23.3	24.7	284
1998	24.3	25	25	25.3	23.7	22	20	20.7	22	22.7	24.7	25	280.4
1999	25.7	27.7	25	25.3	24.3	22.3	20	21.3	22.7	22	24	25	285.3
2000	26	27.7	28	25.7	23.3	21.7	20.3	19.7	21.7	22.7	24	24.7	285.5
2001	24.7	26.3	24	25	23	21.3	20.3	20.3	22.7	23.7	24.7	25.3	281.3
2002	24.3	26.3	24.3	25	23.7	22	21.7	20.7	22.7	24.7	25.7	24.7	285.8
2003	24.3	26.7	26.3	24.3	25	22	20	20.3	22	24.3	25	24	284.2
2004	25	25.3	26	23.7	24.3	21.3	21	21	22.3	23.3	24.7	25	282.9
2005	25	27	25.7	24.7	23	22	20.3	21.7	22	24	24	24.7	284.1
2006	25.7	26.3	25	23.3	24.3	22.7	20.7	20.3	22	24	24.7	24.7	283.7
2007	25.3	25	26	24.7	24	21.3	20.7	20.7	21.7	24	25	24.7	283.1
2008	26	26.7	27	26	24.3	22.3	19.7	20.7	22.3	23.7	24	25	287.7
2009	25.3	26	26.7	25.7	25.3	24.3	21.7	22	23.3	23.3	25.7	24.3	293.6
2010	25	24.3	24.7	24.3	23.7	22.3	21	20.7	21.7	24.7	25	24.7	282.1
2011	25.3	26	26	26.7	23.7	21.7	21.3	20.7	21.7	24.7	24.7	24.7	287.2
2012	26	27.3	27.3	24.3	25	22.3	20.7	21.3	22.3	24.7	25.7	25.7	292.6
2013	26	27.3	25.7	25	23.7	21.3	19.7	20.7	22.7	23.7	24.3	25	285.1
2014	25.3	25.7	26.3	25.7	24.3	22.7	21	20.7	21.7	23.3	24.7	24.7	286.1
2015	27	28.1	26.5	26.2	25.7	24	24.5	26.1	25.5	25.3	27.3	24.8	311
2016	25.6	26	26.5	23.5	23.9	22.7	23.9	22.8	23.2	25	24.3	25.5	292.9

Source: NMSA 2018

Appendix 4: Average Monthly Minimum Temperature Angacha District in (^{o}c)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1983	9.7	11.3	12.3	11.7	12	11.3	11.7	12	11	10	9	8.7	130.7
1984	9	8.3	10.7	11.7	11.7	10	10.3	10.3	9.3	9	9	9.3	118.6
1985	9.7	9.7	10.7	11.3	10	10.3	11	7	8.7	7	5.7	7.7	108.8
1986	9	9.7	9	10	8.3	9	9	8.7	8	7.3	7.3	8	103.3
1987	9	8.7	10.7	9.3	10.3	9.7	9.3	9.3	9.3	9.7	7.7	9	112
1988	9	10.3	10.3	11	9.7	9.7	9.3	9.7	9	8.7	7	7.7	111.4
1989	8.7	9	9.3	9.7	9	9	9	9.7	8.7	8.3	8	9	107.4
1990	8.7	10.3	10	10.3	9.7	8.7	9	10	8.7	9	8.3	8	110.7
1991	10	10.3	10	10	11	10	10.3	10	10	9.3	9	8	117.9
1992	9	10	10	10	10.7	10.3	9.7	10.3	9.7	9.7	9	9.7	118.1
1993	10	10	9.3	11	10.7	10	9.7	9.3	9	9	8.7	8.3	115
1994	9.3	11.3	12.7	12	12	11.3	11.3	11	11	9.7	10.3	9.3	131.2
1995	10	12	12.3	12.7	11.7	11.3	12	11.3	10.3	10.3	9.3	11	134.2
1996	11.3	11.3	12	12	11.7	11.7	10.7	11	11	9.7	9.3	9	130.7
1997	11	10.7	12	12	11	10.7	10.7	10.3	10	10.7	11	9	129.1
1998	10.7	11.3	12.7	11.3	11.7	10	11	11	10	10.7	9.3	9	128.7
1999	9	10.3	12	12	11.3	11	10.7	11	10.7	11	9.3	9.3	127.6
2000	10	11.3	12.3	12.7	11.7	11	10.7	11	11	11.3	10.3	9.3	132.6
2001	10	11.7	12	12.3	12.3	11.7	11.7	11.7	11	10.7	9.7	10.7	135.5
2002	11	11.3	12	12	12.3	11.7	11.3	11	11	10.3	10.3	11.7	135.9
2003	10.3	11.7	12.7	12.7	12.3	11.7	12	12	11	11	11	9.3	137.7
2004	11.3	11	11.3	12.7	11	11	11	11.7	11	10.7	10.7	10.3	133.7
2005	10.7	11.3	13	12.7	12	12	11.7	12	11.7	10.3	9.7	8.3	135.4
2006	10.7	12.3	12.3	12.3	11.7	11.3	12	12	11.7	11.7	10.7	11.3	140
2007	10.7	11.3	11	12.3	12	11.3	11	11	11.3	10	10.7	8.7	131.3
2008	10.3	11	11	-99	12	11.3	11.7	11	11.3	10.7	9.7	9	20
2009	10.7	11	12	12	11	11.3	11.7	11.3	11.3	10.7	10.3	11.3	134.6
2010	10.3	12.3	11.7	12.7	12.3	11.3	11.7	9.3	11.7	11	10.3	9.7	134.3
2011	10.7	11.3	12.3	12.3	12.3	12	11.7	11.3	11	10.7	11.3	9.3	136.2
2012	10	11	12	12	12.3	11.7	12	11.3	11.3	11.3	10.3	10	135.2
2013	10.7	11.7	12.7	12.3	12	12	12	12	11.7	11.7	8.3	9.7	136.8
2014	11	13	13	12.7	13	12.7	13.3	13	13	12.7	12.7	11.3	151.4
2015	13.1	13.9	14.1	13.5	13.9	13.6	13	13	13.1	13.6	15	12.2	162
2016	13.8	13.3	14.4	13.9	14.5	13.3	13.9	13.7	13.4	12.8	12.6	11.2	160.8

Source: NMSA, (2018)

Biographical sketch

Yohannes Gabore Jofe was born septmber1, 1964 in Kembata Tembaro Zone, Angacha city, Southern Nations and Nationalities and people Regional State Ethiopia. He attended primary school in Kalama elementary school and secondary school. He joined Dilla University in 2002 and graduate with degree in civic and ethical studies. He has been working in Angacha preparatory school from 1998 until now he joined Hawassa University School of graduate studies in 2015. He is married.