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Farmers' Perception and Adaptation Strategies to Cimate Change and Variability in Arsi Negele District, Oromia, Ethiopia

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Abstract
Ethiopia's agriculture is heavily dependent on rain-fed with low adaptive capacity entail a high vulnerability to adverse impacts of climate change. There has been more erratic rainfall, an increase in temperature, droughts, floods, food insecurity and dramatically decreased of water volumes are a major challenge in the area. The objective of this study was to assess farmers' perception and adaptation strategies to climate change in Arsi Negele district. Both Primary data and secondary data were used. Primary data were collected from household's interviews through structured questionnaire; key informants interview, focus group discussion and field observation from three agro-ecological zones. The data were collected from 139 households who were selected through multi-stage sampling techniques. Secondary data were collected from published and unpublished sources. Descriptive statistics, frequency, chi square and percentages were used to assess farmers' perceptions, impacts of climate change, and their adaptation strategies. The Results showed that almost all respondents were perceived that over the past 30 years they have perceived increase in temperature, decrease in precipitation, and irregular rainfall, and there was no divergence between the twin perceptions of farmers and climatic data records. The most common adaptation options include different or new crop varieties, crop diversification, changing planting dates, implementing soil and water conservation practices, adjustment to crop and livestock management, drought tolerant crops, tree planting activities and migration.
Therefore it is advisable that Future policy making processes should pay due attention to incorporate action plans that strengthen the already existing autonomous adaptation strategies used by these communities.
Keywords/phrases: - Farmers' perception, Adaptation, Strategies, Climate change

INTRODUCTION

Background of the study

Currently, climate change is one of the biggest environmental challenges. It affects mainly those countries and people that depend primarily on agriculture and have few opportunities for economic diversification and structural change. In many parts of the developing world, particularly in the least developed countries, climate change has a negative impact on people's livelihoods, weakening their resource base and limiting their options and capabilities (FAO, 2011). It is anticipated that climate change have had a direct and significant adverse impact on economic growth in many countries in Africa, primarily in the Sub-Saharan region (FAO, 2011). In this regard; Ethiopia is experiencing the effects of climate change.

The Ethiopian economy is dominated by subsistence agriculture which is characterized by small-scale farming and livestock husbandry. The agricultural sector employs 85 % of the country's labor force and accounts for 60% of all exports. Approximately, 80 % of households live in rural areas and are dependent on local agriculture to meet their food needs (WFP, 2009). The contribution of the agricultural sector to the overall economy of the country is estimated to be 41.6 % of the GDP (MoFED, 2010).

The UNFCCC has identified adaptation as option for addressing climate change; and many governments have responded to this consensus by taking adaptation action to limit GHG emissions (IPCC, 2001; UNFCCC, 2007). There is a consensus that the unstoppable growth in CO_2 and other GHG concentrations must be halted if the effect of climate change is to be avoided. To identify and quantify the impact of climate change on socio-economic and ecosystems, many global studies have been carried-out and policy changes for adaptation were proposed.

The Government of Ethiopia is making efforts to address adverse conditions of climate change and has designed adaptation mechanisms. In fact some of the efforts have brought about strategies that have induced changes in the attitude of the affected local communities. Some strategic measures include the development and implementation of national environmental initiatives, as well as policy/ program and project initiatives that directly and/or indirectly address climate change and adaptation mechanisms (NMA, 2007). The Government of the Federal Democratic Republic of Ethiopia (FDRE) has launched the Growth and Transformation Program (GTP) to reduce poverty and the Climate-Resilient Green Economy (CRGE) initiative to protect the country from the adverse effects of climate change and to build a green economy that had help realize its ambition of

reaching middle-income status before 2025.

This study has looked into farmers' perception and adaptation strategies to climate change and variability in Arsi Negele District, West Arsi Zone in Oromia region, Ethiopia. The empirical material of this study is based on current climate impact data and interviews with local stakeholders from the communities in Arsi Negele district of west-Arsi zone, Ethiopia.

Statement of the problem

Continues drought and floods is definitive sign that climate change is indeed affecting Ethiopia. In addition climate change has caused change in the land use pattern, change in crop mix such as the introduction of lowland crops (including maize, haricot bean, pepper and sugarcane) to the areas where they were not traditional known in the area are typical indicator of the change in the different parts of the country. Most crops produced in the main cropping season so encounter moisture deficiency at their maturity period, which brings about decline in productivity (Green forum, 2007).

Ethiopia is known for having ample water resource, but agriculture is heavily dependent on timely onset and cessation, amount, duration and distribution of rainfall. Over 90% of the food supply comes from rain fed subsistent agriculture and rainfall means loss of major livelihood source that always accentuate food deficit (Adgolign, 2006). The sector is also predominantly subsistent, hand to mouth and characterized by poor farming practices(less technology, less agricultural input and resource degradation) (Abate, 2009).

Moreover, rainfall decreases significantly in June-July-August over parts of the horn of Africa, which is the main crop cultivation season in Ethiopia (Abate, 2009).

This fact clearly verifies the high sensitivity of Ethiopia for climatic conditions and low adaptive capacity to respond to the impacts. The warming of few degrees and increases infrequency of extreme weathers had consequently influence agricultural production and makes the society victim of the events and decreases the future adaptive capacities.

However, the adaptive capacity of communities varies with in sectors, localities, agro-ecological zones and within different income levels of the community. Majorities (85%) of the Ethiopian population live in rural areas that are similar to the Oromia region in general and Arsi Negele district in particular has been based on agriculture and livestock for their livelihoods.

Hence, the district is well known for its wheat production in the high land areas and maize production in the low lands areas. A climate change is affecting the study area communities through drought, famine, loss of life. There is an evidence of climate change in the study area in the past that reduced crop yield. The extension of growing seasons of crops and shortage of rain are due to the changing climate conditions.

The shortage of rainfall had affected crop productions and hence has led to household tangible assets losses in the study area. Therefore, this study had assessed farmers' knowledge of climate change and variability, impacts of climate change and adaptation strategies.

Significance of the study

Climate change is affecting the whole world the extent differs from region to region and from locality to locality. Different local studies are needed to assess how the problem is going on. Due to this reason, this study had aimed at showing the level of the knowledge of farmers, impacts of climate change and adaptation strategies in Arsi Negele district.

Adaptation strategies are also differing from community to community. Local studies are necessary to understand the extent of vulnerability at different levels and different adaptation mechanisms that may be replicated and used as corrective measures in other similar situations. Therefore, the result of this study serves to identify the farmers' knowledge of climate change and their adaptive strategies and provide information for different institutions, donors and policy makers. Furthermore, this study can be used as a source material for further studies.

Scope of the study

The study was conducted in west Arsi zone in Arsi Negele District. The scope of the study covers three kebeles (*Lephis, Sayo meja and Daka dalu Harengema)* of the district from three agro ecology highland, midland and lowland respectively. Similarly, the study was restricted on the farmers' perceptions to climate change and variability, impacts of climate change and the adaptation measures under taken by farmers in the study area.

MATERIAL AND METHODS

Description of the study area

Arsi Negele district is one of the district, which is located in Ethiopia, Oromia region of west Arsi zone. The district is located at north about 25 KM distance from the zonal seat of Shashemene town and at south 231 KM from Addis Ababa, the capital of the country. The district is located between $07^0$09'N- $07^0$42'N latitude and

$38^0$25’ E - $38^0$54’E longitude .The district is the center of tourism due to it’s being the owner of beautiful lakes (partly found in Arsi Negele and accounts 32% of the total area of the district) such as Abjata, Langano and Shalla. Arsi Negele town is the district capital. Most parts of the district’s elevation are between 1500 and 2300m except the southeastern part. Gara Duro is the highest peak in the District having 3095 m height above sea level. Arsi Negele has the highest number of rivers in west Arsi Zone. It includes Gedamso, Lephis, Huluka, Awede Jitu, Awede Gudo and Dadaba Gudo. In their agro ecology profile Arsi Negele district belongs to three distinct zones which include 15 kebele’s wet kola, 10 kebele’s woina Dega and 18 kebele’s belongs to Dega.

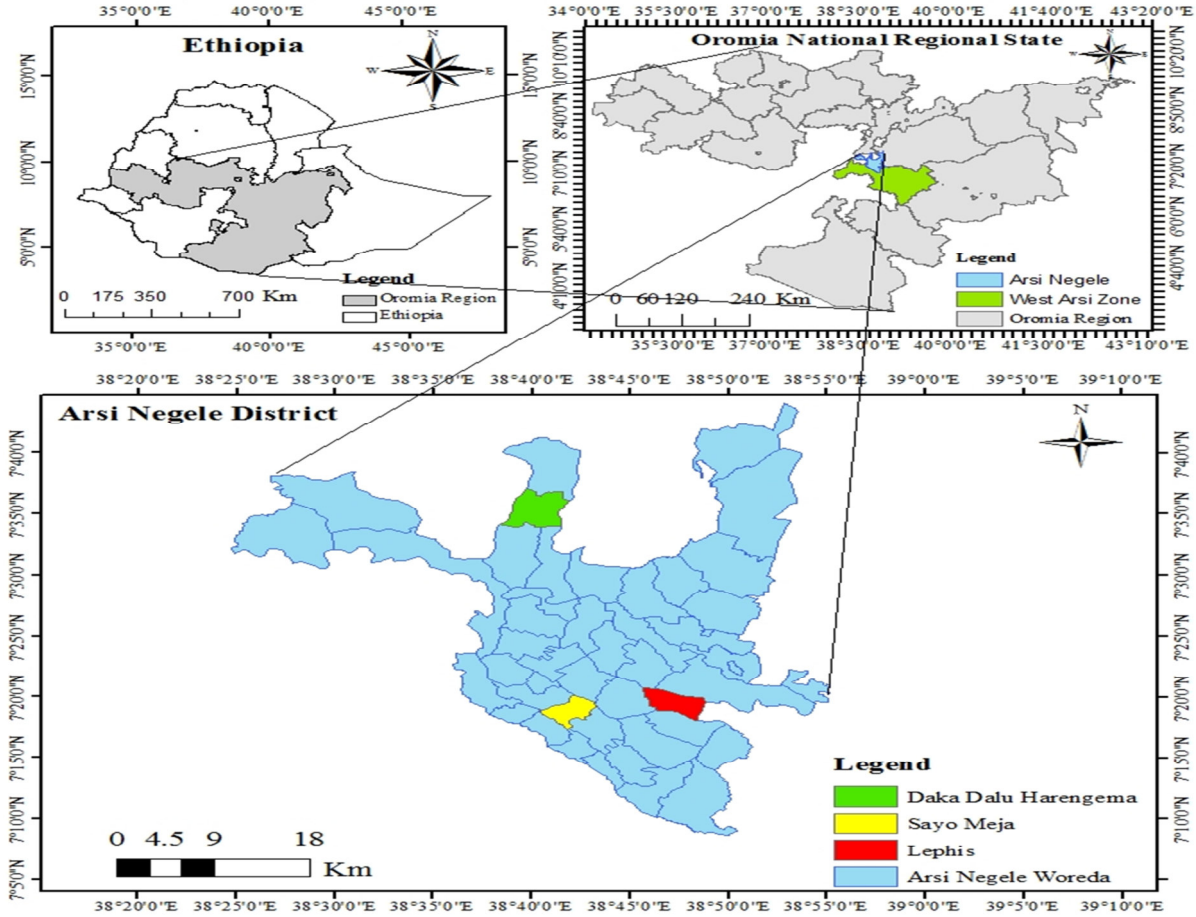


Figure 9: Map of the study area

Population

According to CSA (Central Statistical Agency) (2012), Arsi Negelle agro ecology has a total population of 303,223 of which 150,245 are male and 152,978 are females.

Climate

Climate is one of the important and major factors of physical elements that can affect an area. As mentioned above, the study area is located within the altitude range of 1500-2300meters above sea level and the climatic difference due to variation in altitude is reflected in the types of crops grown and diversity of vegetation (ORS, 2004).

Soil

In Arsi Negele, the residual products of rock decay are rich in iron and Aluminum but poor in biologically important elements like potassium, calcium and sodium and 83 % of the soil is classified as sandy loam, 9% as sand (EARO, 2002). Andosol soil type covers about 52.2 % of Arsi-Negele, while Nitosols cover the remaining 47.8 % (ORS, 2004).

Vegetation

Vegetation of the Arsi Negele district is part of the evergreen dry Afromontane forests that dominate the highlands of Ethiopia. The dominant tree species is *Afrocarpusfalcatus* and *Ficus vasta*. Other woody species include *Cordia africana*, *Celtis africana*, *Albizia gummifera*, *Prunus africana*, *Acacia albida* and *Croton*

macrostachyus (Asfaw, 1996).

Socio-Economic activities

Arsi Negele district has 1395.87km2 areas, which makes it the 6th largest district in West Arsi Zone. A survey of the land in Arsi Negele showed that 41.65 % is arable, 16.78 % water bodies, 5.76 % forest and 35.81 % grazing and others (ORS, 2004). The study site at this district is characterized by crop-livestock based farming systems. It is rich in both crop production and livestock rearing. Maize and wheat are the most important cereal crops grown in the site (ORS, 2004).

Sampling methods

Study site selection

Purposive sampling had been put in to practice to selects study site. From 42 kebele's of Arsi Negele district, 3 kebeles had been selected purposively due to the fact that the district is affected by climate change and variability like recurrent drought and irregularity nature of rainfall more than all other districts in the zone.

The population of the study had been three selected kebele's' of Arsi Negele district Administrative each from different agro ecology namely Lephis from highland, Sayo meja from mid land and Daka dalu Harengema from lowland.

Sample Households Selection

To selects the household sample simple random sampling is used. The sampling of the population had been as follows that is 139 households from all kebeles. The sample size is determined by using the formula provided by (Yamane, 1967 as cited in Israel, 1992) to determine the required sample size at 95% confidence level, and level of precision (5%).

$\boldsymbol{n = \frac{N}{1+N(e)^2}}$, $=\frac{1,582}{1+1,582(0.08)^2} \approx=139$

Where'' n'' is the sample size, ''N'' is the population size (total household heads size), and ''e'' is the level of precision. The respective numbers of household had been selected based on the size of household in each kebele.

To collect primary data from sampled households/farmers through structured questionnaire with closed and open-ended option questions. The information that were collected include farmers' knowledge and behavior of historical climatic extremes, trend of temperature and rainfall, impacts of climate change on livelihoods and environments and adaptation strategies which they apply so as to minimize the risks from climate change.

The questionnaire has also included information about the households' socio economic demographic profile. To make the data collection processes effective and to control the quality of the data, the researchers employed different methods throughout the data collection process. In addition, the researchers are familiar and has a good understanding of the area under study and which helped them to develop proxy and understandable questionnaire to the local people.

Primary data collection

The primary data collection process consists of household questionnaire survey, key informant interview, field observation, focus group discussion. To enhance the chance of meeting the household's heads in their villages and homes, the appropriate times such as early mornings and late afternoon was chosen

Field observations

During field surveys, transect walk was conducted in the three Kebeles with the guidance of the kebele's chairman leading the team, including voluntary farmers, development agents and the researchers. In the meanwhile, the researchers tried to triangulate farmers' responses with actual physical observations; and took pictures of important observations, which are actually put as exhibits to support findings.

To this end, data regarding to farmers perception and existing adaptation strategies to climate change was gathered through field observation in the study area.

Key informant interview

Key informant interviews are qualitative in-depth interviews with people who know what is going on in the community. The purpose of key informant interviews is to collect information from a wide range of people, including community leaders, professionals, or residents, who have first-hand knowledge about the community. These community experts, with their particular knowledge and understanding, can provide insight on the nature of problems and give recommendations for solutions. The common technique used to conduct key informant interviews was face-to-face interviews.

So as to understand in detail about the occurrence of climate change in the study area and its impact on livelihoods and environments, the researchers were carry out in depth interview with selected kebele

administrators, agricultural professionals of the district and local elders. The elders had been selected by taking in to consideration on the basis of their knowledge and experience in farming and livestock rearing in the area. Based on this from each kebeles eight key informants were interviewed.

Figure 10: Interview with key informant

Focus group discussion

In total four focus group discussions was conducted in this study. Two different group discussions, group one consisting of only females and group two consisting of only males, and the rest groups had been based on age and educational status in each study village. In each group, about 7 individuals have participated in the discussion. The aim of the focus group discussion was intended to strengthen result acquired from household questionnaire survey, field observation and key informants, and triangulate the information collected from various sources.

Figure 11: Focus group discussion with males and females respondents

Household survey

From all selected kebeles 139 respondents were asked questions by selected and trained enumerators at their village home to home questionnaire which includes both sexes and different age categories. The aim of the household survey questionnaire was to understand their perception, major impacts of climate change, and the trends of rainfall and temperature, farmer's adaptation strategies mechanisms and other related issues.

Secondary data

Secondary data had been obtained from different written sources. Recorded climate data of rainfall and temperature trends of Arsi Negele district area for about three decades was collected from the National Meteorological Agency.

Data analysis

Qualitative and Quantitative data

Qualitative data obtained from various sources has been examined and presented in different forms. The qualitative data had been narrated and summarized. Qualitative data was edited, coded and entered into computer using Statistical Package for Social Studies (SPSS) version 20 software and Microsoft Excel spread sheets and analyzed. Descriptive statistics had run to give frequencies and chi square test was conducted.

RESULT AND DISCUSSION

This chapter presents the key findings of the study. The chapter is categorized under four Sub-sections. The first sub-section provides the socio-economic profile of sampled households in Arsi Negele district. The second sub-section deals with farmers' perceptions towards climate change with trends of long term rainfall and Temperature of study site. The third sub-section presents impacts of climate change. The fourth sub section presents the farmers' adaptation strategies to the impacts of climate change as perceived by farmers.

Socio economic characteristics of respondents

Table 1: Respondents Family size, farmland and livestock mean, minimum and maximum

Variables	Mean	Std. Error of Mean	Std. Deviation	Minimum	Maximum
Family size	7.30	.31270	3.68673	1.00	16.00
Farm land size	1.99	.123	1.450	0.75	7
TLU	2.67	.118554	1.397731	0.000	6.202

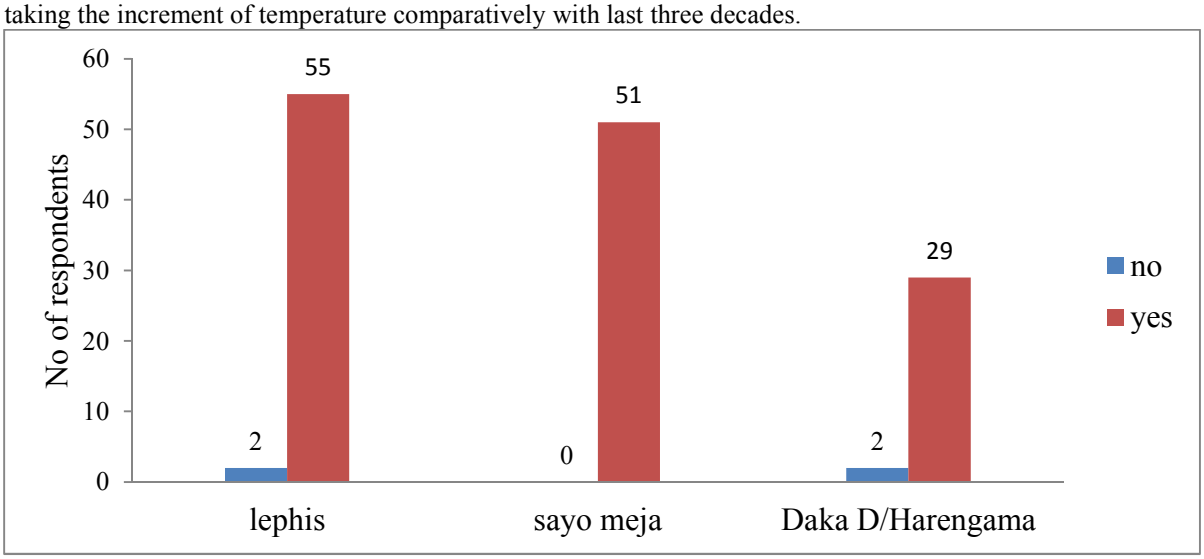
The family size mean of respondent farmers is 7.30 with 1 and 16 minimum and maximum respectively. The overall average farmland size was 1.99 hectares that range between 0.75 to 7 hectares, which is above the national average land holding of 1.02 hectare. The respondents' livestock holding mean measured by TLU (tropical livestock unit) is 2.67 with 0.00 to 6.202 minimum and maximum respectively. As participants in the focus group discussion noted, land size and livestock holding were the most important factors for differences in agricultural production and wealth status and this important in using diversified adaptation mechanisms.

Perceptions of respondents on climate change and variability

Perceptions on the occurrence of climate change

One of the pre requisite to adapt to changes occurring in the climate system is recognition of the change taking place. In cases of climate change, farmers must first perceive that changes are in fact taking place. Respondents were asked whether they perceive changes in climate change.Fig.2 shows that 96.5% of the respondents in Lephis kebele 93.3 respondents of Daka D/Harengema and all respondents of Sayo meja kebele were perceive the occurrence of climate change. It was only 4 (2.9%) of the respondents who were not sure about the occurrence of climate change.

Participants in FGD and key informants were also confirmed the reality of occurrence of climate change by taking the increment of temperature comparatively with last three decades.



Source: Survey, 2016

Figure 12: Farmers' perception on Occurrence of climate change

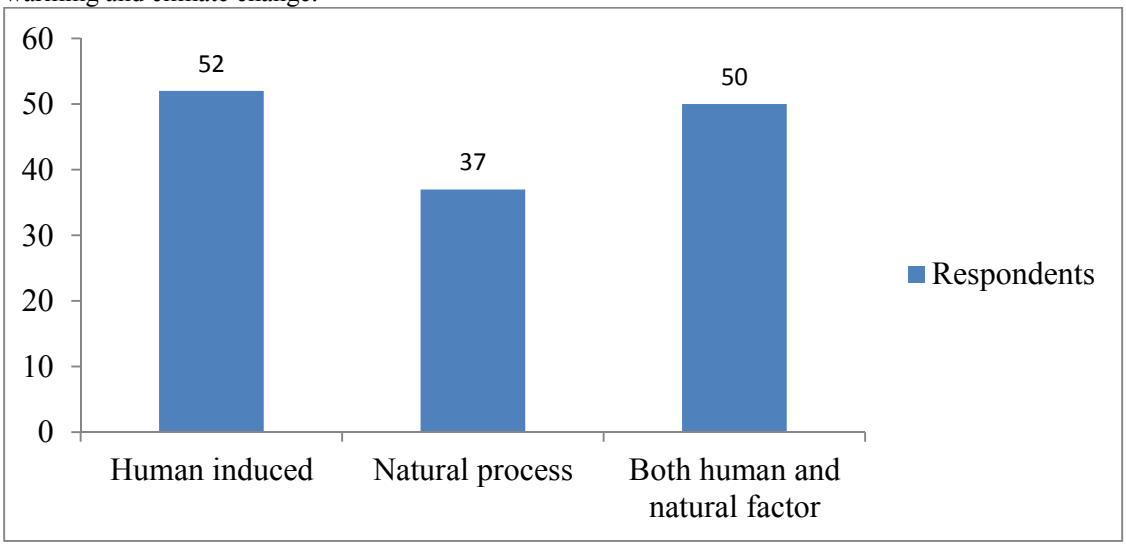
Perception of temperature and rainfall pattern change is prerequisite for any kind of climate change adaptation including agriculture, natural resource management, and health (Maddison, 2006 cited in Demeke,

2010).

The perception of respondents on the causes of climate change

As shown in figure 5, 52(37.41%) respondents indicated that the cause of climate change is anthropogenic due to their unwise use of environmental resources, while 37(26.61%) of respondents states that climate change is naturally occurring phenomena that is out of human control. Likewise 50 (35.97%) of respondents perceived the cause as both human action and natural phenomena.

Many participants of FGD and key informants also recognized deforestation, shortage of land, poverty, and over cultivation as causes of climate change at local level. The result is in line with studies by (Calvin, 2008; Ackerman, 2009; IPCC, 2007) which underlined the significant role of human action on the contemporary global warming and climate change.



Source: Survey, 2016

Figure 13: perception of respondents on the causes of climate change

Perception of rain fall pattern

Sampled households data revealed that 95% of the respondents observed change in precipitation. Out of this 71.2 % noticed a decreasing trend in the amount of precipitation, 10.1 % of the respondents noticed that the change was irregular /altered change (the timing of the rain, with rain season coming either earlier or later than expected); however, there were 6.5 % of interviewed farmers perceived that the precipitation was increasing. Furthermore, the increasing precipitation only concentrated on a short time and precipitation intensity was higher than that of the previous years. They also explained that increasing heavy rain in short period normally causes floods followed by droughts.

Moreover, about 7.2 and 5 percent of the respondents do not perceive any change and they don't know about the change respectively (figure 6).

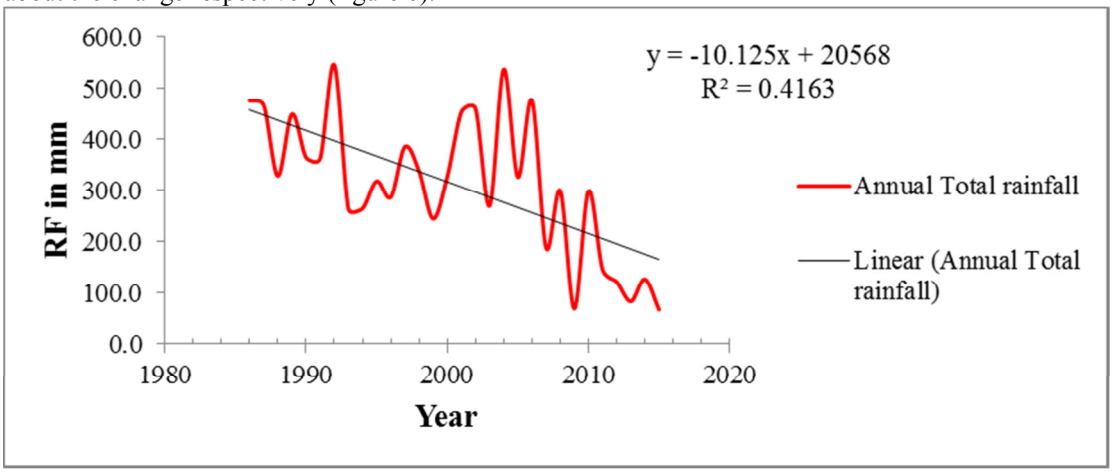


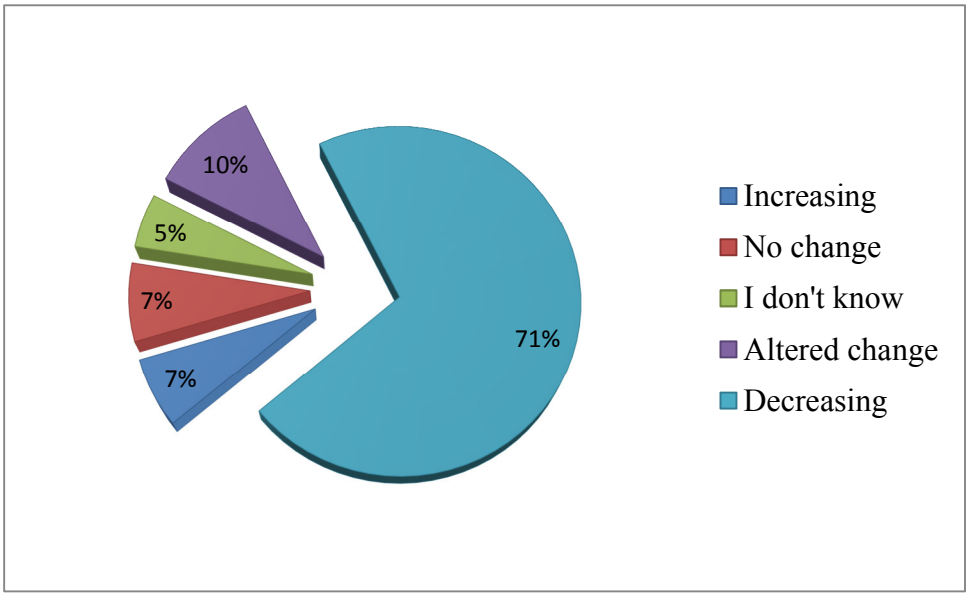
Figure 14: Annual rainfall trends of three decades

The changes in rainfall amount, its timing and distribution in the study are over the past years was verified

by FGD and key informant interview.

For example one key informant said that "Before two decades the rainfall was regular. It rainy at its regular times but especially after a decade there are changes in rainfall. Now it can stop in the middle of the rainy season when it was very necessary time to sow/seed. Other respondents said "rain is not regular as of previous time. It is difficult to know the time when the rainy season starts and stops". This finding supported by Getachew (2009) conducted rainfall trend analysis for Debre Birhan, and Ziway areas using meteorological data covering the period 1979-2009. The results confirmed decreasing and irregular trends of rainfall amount in both areas.

Gbetibouo (2009) also used survey data of farmers' perception on climate change and monthly perception and temperature data from South African Weather Services (SAWS) to understand better about perception of farmers living in Limpopo River Basin of South Africa. His result indicated that farmers' perception was in accordance with the meteorological record. In another study, Hageback et al. (2005) assess small-scale farmers' perceptions of climate change in the Danagou watershed in China by comparing the local precipitation and temperature data trend with the responses given by farmers to the question "Do you feel any changes in the weather now compared to 20 years?" They conclude that farmers' perceptions of climatic change correspond with the climatic data.



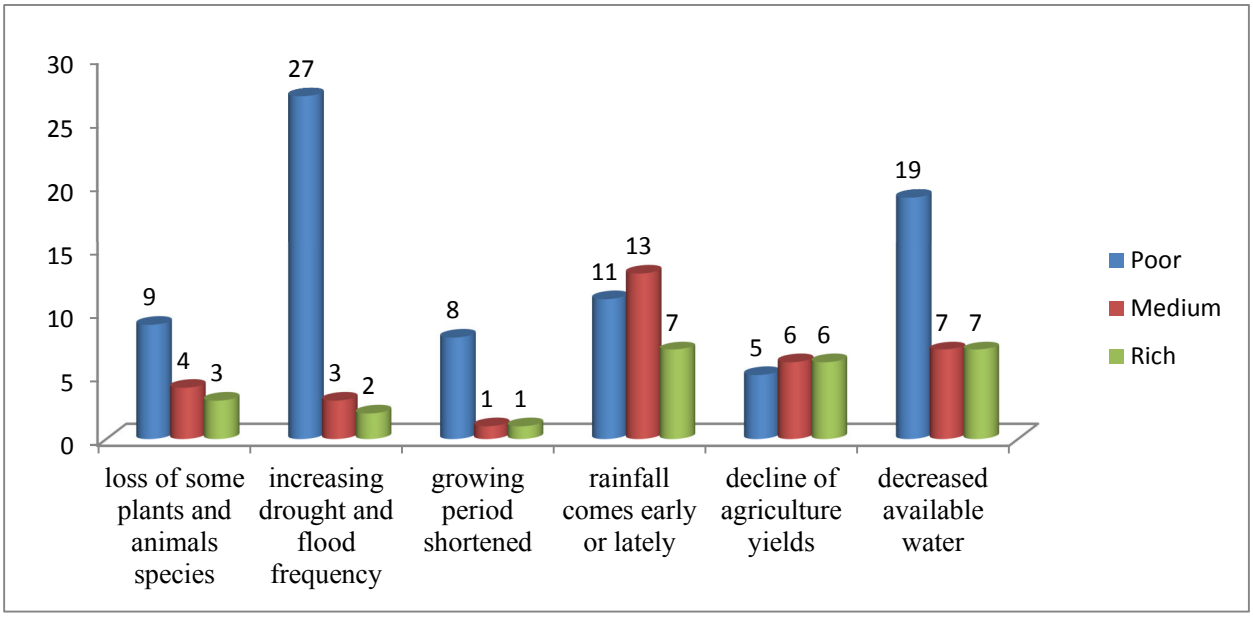
Source: Survey, 2016

Figure 15: Respondents' perception on change in rainfall

Farmer's perception about the rainfall patterns in the study area is confirmed by the national metrology data. Based on the time series analysis, the average yearly rainfall pattern for the past 30 years the amount of rainfall has decreased.

Local indicator used by respondents to evaluate change in rainfall and temperature in the study area

Response of respondents regarding to change in rainfall at community level indicated variation in perception based on wealth categories (poor, medium and rich). Figure 8 revealed that rich respondents were perceived the decline of agricultural production and fluctuation of the time when rain fall starts and ends as indicator to evaluate change in rainfall, And Again the medium respondents were also perceived mainly the time when rain fall comes and ends and declined available waters whereas the poor respondents who were high in numbers were strongly perceived increasing drought and flood frequency and less perceived the decline of agricultural production as indicator to evaluate change in rainfall

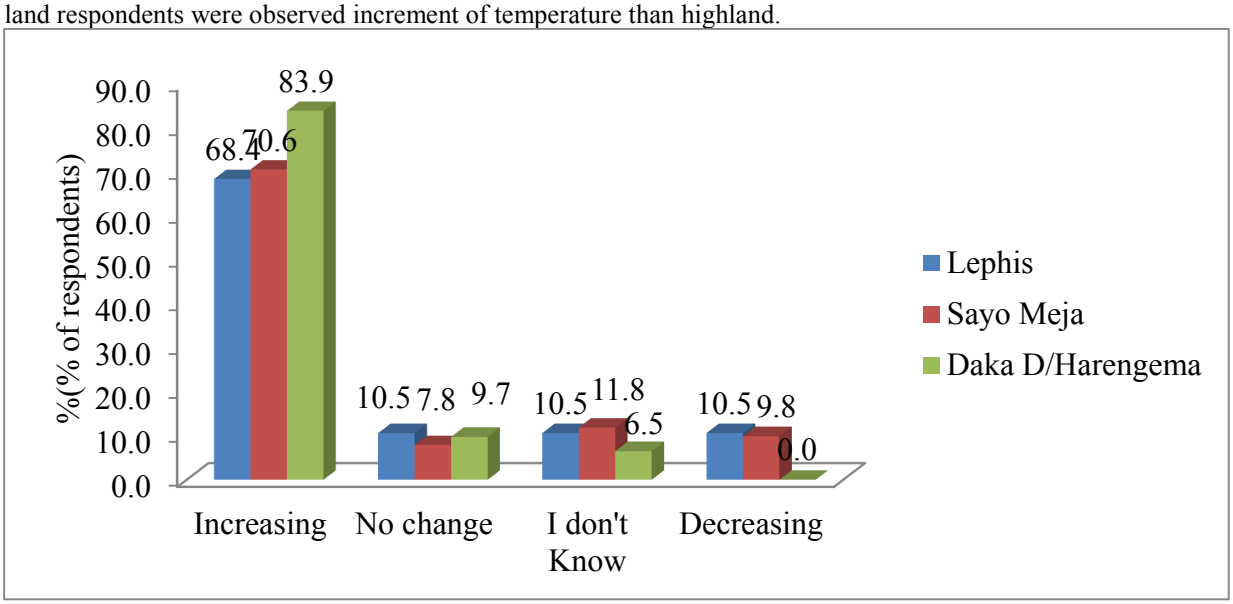


Source: Survey, 2016
Figure 16: Local indicator used to evaluate change in rainfall at study area

Perception of long term temperature change

To know the perception of farmers on temperature questionnaire distributed to three selected kebeles of the district namely Lephis, Sayo meja and Daka dalu Harengema representative farmers. Accordingly, the result revealed about 78.9% sample households respondents perceive an increase in average temperature and 10.5% of the respondents argue a decrease in temperature. The rest (10.5%) respondents were perceived, as a temperature is constant where as 10.5 % respondents were not familiar about change in temperature (figure 9).

Concerning to responses of Respondents within each kebeles 83.9% of respondents from Daka D/Harengema were argued increment of temperature and none of the respondents of this kebeles observed decrease in temperature. Additionally, 70.6% of the Sayo Meja kebeles respondents were observed the increment of temperature whereas 68.4% of respondent of Lephis kebeles stated the increment of temperature. This revealed that respondents from the lowlands were highly observed the increment in temperature whereas the mid land respondents were observed increment of temperature than highland.

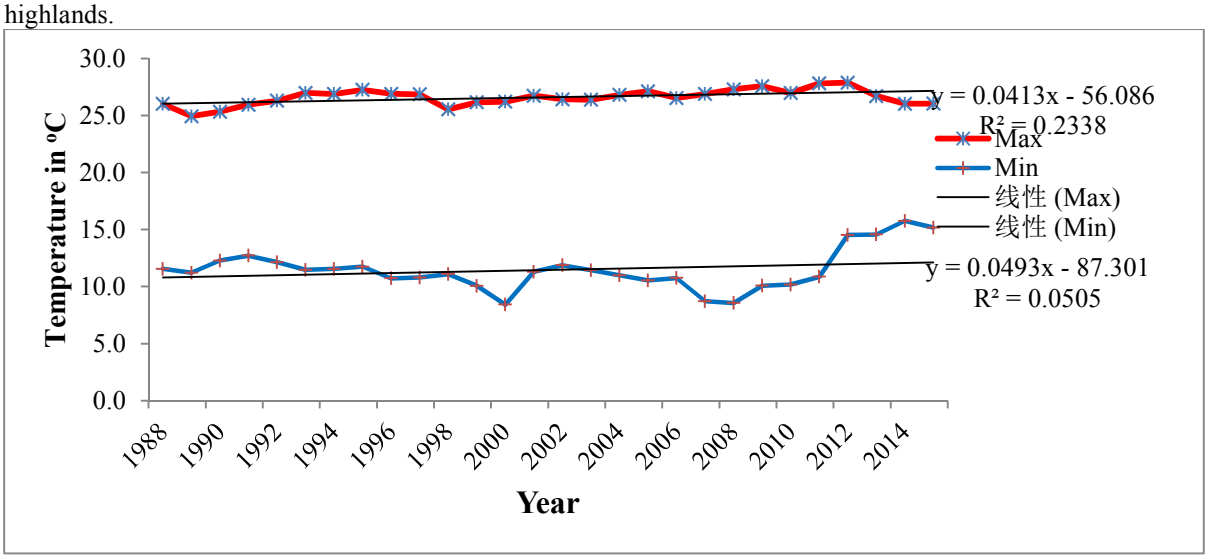


Source: Survey, 2016
Figure 17: Distribution of households' perception about temperature change

The results confirmed that farmers perceived climatic and weather patterns to have changed over the past decade or two, as indicated by erratic rainfall patterns, decreased rainfall and temperature increases, leading to crop productivity decline and increased livestock morbidity and mortality. This research finding is in line with

research undertaken in Zimbabwe by Kunzekwegutaet.al. (2012), on farmers' perception to climate change. The finding is also similar with the result of Yesufet.al. (2008), on the impact of climate change and adaptation on food production in low-income countries, evidence from the Nile Basin, Ethiopia. The results confirmed that the overall, increased temperature and declining precipitation were the predominant perceptions in the study sites. The study is also in line with (Onubuogu and Esiobu, 2014) farmers' perception on climate changes. The result shows that majority of the farmers in the study area perceived an increase in temperature level for over 40 years.

According to NMSA (2001), the average annual minimum temperature over the country has been increasing by about 0.25°c every 10 years, while average annual maximum temperature has been increasing by about 0.1^0c every decade. Arsi Negele has faced the problem of climate change. The mean annual temperature has increased at a rate of 0.038°c per year or 0.38 °c per decade. This finding is consistent with studies of Marye (2009), in which he showed that an increasing trend of average temperature by about 0.3^0c per decade in the Ethiopian highlands.



(Source: computed from NMAS data, (1986- 2016)
Figure 18: Trends in Annual mean minimum and maximum temperature distribution

The perceptions of farmers with respect to changes in temperature and decreasing rainfall amount was in line with empirical analysis of rainfall and temperature trends using the data obtained from meteorological station.

Impacts of climate change

Respondents perceived not only the existence of climate change (irregular rainfall and increasing temperature) but also its impacts. Key informants perceived the adverse impacts of change in temperature and rainfall on the livelihood of the farmers and natural resources.

Impacts of climate change on livelihoods

Respondents were asked about the impacts of climate change in the study area. As shown in table 2, the most commonly mentioned impacts of climate change were decreasing crop productivity (30.21%), decreasing livestock production (29.33%), drought (17.98%), shortage of feed and forage of livestock (11.51%), pest and disease (9.35%), and flood (3.59%). Equally, key informants and group discussants confirmed the negative consequences of climate change on livelihood of farmers.

These findings agree with Bryan et al (2006) and Gurung and Bhandri (2008) who identified that climate change is already being felt and the effects are seen in many ways. Climate 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 (NAPA, 2007).

This implies that climate change is real and it is affecting the major source of livelihood of farmers as agricultural production is naturally tied to climatic condition.

Table 2: Respondents understanding of the impact of climate change

Impacts of climate change	Frequency	Percentage
Decline Crop productivity	42	30.21
Decline Livestock production	38	29.33
Drought	25	17.98
Shortage of Feed and Forage of livestock	16	11.51
Pest and disease	13	9.35
Flood	5	3.59

Source: Survey, 2016

Decline in Crop productivity

According to ANLEP, climate change particularly reoccurrence of drought, early cessation and late onset of rain, heavy and unseasonal rain and pests has caused massive crop failure. Especially temperature and the uneven rainfall distribution have resulted in decline of crop production. One farmer expresses suggested "Before the fall of dergue regime the rain is in normal condition, but currently we suffer a lot due to irregular rain fall, we have not harvesting our crops within a few month as many years ago which reduce our income as we mostly sell our cattle's to purchase crops for consumption and to sow". Respondents ranked cereal crops, cash crops, livestock, vegetables and livestock productivity according to their sensitivity to climate change impacts.

Group discussants also indicated that cereal crops are the most impacted by climate change as they are totally dependent on rainfall.

Drought and shortage of livestock feed and forage

The respondents and key informants noted that because of recurrent drought and degradation of grazing lands, livestock feed resource considered as the major limiting factor for livestock production. Climate change has impacted on feed and water availability for livestock (Biruk, 2003). During drought and delay in the onset of rain land becomes dry and difficult to plough, forage deficit leads to weakness and oxen mortality (engine of subsistent cultivation), and lack of precipitation hinders seed cultivation and germination of cultivated seeds (Abate, 2009).

Pests and diseases

The community representatives and experts indicated that the study area is exposed to human diseases, crop pests and livestock diseases internal and external parasites (cattle and goats),crop pests are a chronic problem in the study area, of which the most hazardous are stalk borer(sorghum and maize) and shoots fly (Teff).

Experts told that human and livestock diseases and crop pests are not new for the study area. However, climate change resulted in an increase in the frequency of occurrence of pests and diseases in recent years. For instance, malaria was not common in the highland and midland becomes a common problem in these areas. Small increase in temperature and change in precipitation can result in measurable impacts on pests and diseases (Haines, *etal*., 2006 cited in Aklilu & Alebachew, 2009).

Flood

Flood is one of climate change induced-hazards in Arsi Negele district. Floods are common among those who live near riverbanks, at bottoms of mountains and on hillside of rugged terrain in the study area. Ethiopia has been affected by flood at different times. Major floods that caused loss of life and property occurred in different parts of the country (NAPA, 2007).

Impacts of climate change on natural resources

Table 3 shows households assessment of the state of environmental resources in the area. About 65% and 67% of the respondent households in the study area indicated that the forest cover and water availability have decreased over time respectively. About 70.6% of the respondents indicated rising problems of soil erosion. Generally, 71% of the respondents show that land degradation is serious problem of the society now a day.

Table 3: Households assessment of the environmental resources

Environmental resources		Frequency	%of respondents
Change in forest cover	Increased	40	29
	No change	9	6
	Decreased	90	65
Problem of soil erosion over time	Increased	98	70.6
	No change	10	7
	Decreased	31	22.4
Change in water availability	Increased	39	27.8
	No change	7	5.2
	Decreased	93	67
Land degradation	Yes	99	71
	No	40	29

Source: Survey, 2016

Focus group discussion participants, community representatives and experts also established existence of environmental degradation due to climate change related hazards. They also outlined supportive factors of the above noted problems, which include population pressure, settlement expansion and collection of firewood and expansion of agricultural land.

Farmers adaptation strategy to perceived climate change

As already discussed in the above section climate change is a real phenomenon and affecting the entire world, people are working to minimize the influence by using different adaptation strategies.

However, the capacity varies from country to country, from region to region and even from district to district. This is because of the nature of the area and development. So far, in Arsi Negele district as one of the exposed areas to climate change, there are different local and institutional adaptation mechanisms.

In the assessment of farmer's perception, it was understood that farmers are aware of the incidence of climate change and the possibility of occurrence of future adverse impacts of climate change. Therefore, farmers were asked whether they have been taking adaptation measures to the long-term climate change or not. Those who said yes were also asked the adaptation measures they took to adjust themselves to the negative impacts of climate change. The actual adaptation measures taken by farmers were presented in Table 4. These were soil and water conservation practices 71 (51.1%), crop and livestockdiversification106 (76.3%), tree planting 39(28.1), livestock management 111(79.9%), drought tolerant crops 79(56.8 %), fertilizer application 30(21.6 %), planting different crop varieties 100(71.9%), changing planting dates 105 (75.5%).

According to Studies of Wit, (2006); Nhemachena *et al*, (2007);Temesgen *et al*., (2008) Gbetibouo (2009);Bryan *et al*, (2010); crop diversification, soil and water conservation practices, and irrigation are widely practiced as a response to climate change impacts in Africa.

Table 4: Respondents distribution of adaptation strategy

Adaptation strategy	Lephis		S/Meja		D/D/H		Over all (%)
	Freq.	%	Freq.	%	Freq.	%	
Changing crop and livestock	41	47.6	25	42.3	22	43.1	44.9
Soil and water conservation	53	61.6	33	55.9	30	58.8	59.1
Change planting dates	37	43.0	23	38.9	24	47	42.9
Drought tolerant crops	29	33.7	37	62.7	20	39.2	43.9
Tree planting	46	53.5	29	49.1	17	33.3	46.9
Crop diversification							
Crop diversification	29	37.7	34	57.6	37	68.6	51.02

Source: Survey 2016

1. **Crop diversification**

Majority of the respondents grow two or more different crop varieties in one season. The farmers in the study area usually use crop diversification; that means that they switch crop type one each plot of land every year. Otherwise, soil fertility would have been decreased if they grow the same type of crop on the same plot of land ever year. Usually they grow a couple of different varieties every year, to reduce risk and vulnerability. If one variety fails, may be another one had survive. So they usually rotate which crop varieties they sow on which plot of land from year to year. Key informants and FGD participants endorse the same.

2. **Soil and water conservation**

Most of the respondents answered that they practiced activities in water and soil conservations. The farmers are encouraged by the government to do these activities, and especially in January each year they often practice this

activity. This is probably done mainly due to soil degradation, but it is even more common practice to do soil and water conservation because climate change because climate changes makes the soil even drier and it is even more important than before to conserve the water in the soil as much as possible.

3. Changing crop and livestock type

Changing crop and livestock type before the past two decades, the area was productive in cereal crops and pulses but now because of fluctuation of rain, the crop types are changed from late maturing. In addition, farmers who Owen livestock indicated that they are changing the type livestock from sheep to goat and chicken as the temperature of the area are increasing.

4. Tree planting

Some of the respondent plant trees on their farm while the rest do not plant trees due to land scarcity and lack of seedling. According to field observation and respondent, the majority of the farmers' option to plant *Eucalyptus* than planting multipurpose trees as a cash source which is more common in Lephis and Sayo meja kebeles whereas *Acacia Albida*, *Moringa Olifera* and *saligena* is planted in Daka Dalu Harengema.

5. Drought tolerant crops

Drought tolerant crops have different susceptibility, some crops are found to be useful in different agro ecologies. The farmers choose for crops such as sorghum, chich pea and haricot bean which have relatively better drought tolerance and water use efficiency. The majority of the farmers eat this for approximately half the year after the cereals have been consumed.

CONCLUSION AND RECOMMENDATION

Conclusion

The findings of this study showed that most of the local people perceived long-term change in pattern of rainfall amount and distribution and an increasing trend of temperature and decreasing trend in rainfall. The climate data analysis showed the same as perceived by the local peoples. This study also found out the impacts of climate change on the livelihood of the communities facing climate related disaster such as decline trends of crop and livestock productivity, drought, intensified occurrence of pest and diseases, flood and environmental degradation.

Farmers adjusted farming practices to counteract long-term climate change impacts or as an adaptation mechanisms such us: - using soil and water conservation, crop diversification, tree planting, changing crop and livestock, drought tolerant crops, fertilizer application and using irrigation. Majority of sample households decide to use farm level adaptation strategies where as some of respondents were not doing any adjustment to adapt the ongoing change in the climate.

The decision to use adaptation strategy significantly influenced by agro ecology, educational level, Age of respondents, family size, farming experience, livestock holding, farm size, credit access and distance from market were significantly related to farmers' adaptation strategy. The implications of these findings implied that year of schooling (level of education) of head, age of respondents, livestock holding, farm size, access to extension contact and its family size strongly influence the adaptation activities. Governmental and non-governmental organizations has played significant role in reducing the local communities vulnerability to climate change. However, the mechanisms they used are mostly emergency aid than preventive adaptive measures.

Recommendation

Based on the findings of the study the following policy oriented recommendations are suggested to minimize the impacts of climate change on rural livelihood communities of Arsi Negele district.

- Enhance all farmers' awareness to have common understanding about climate change and its impact to minimize the vulnerability of climate change through public events, meeting and other local institutions.
- Local governments will have to take action for the decline of crop productivity to minimize the impacts.
- Encourage farmers to have capacity to adapt to climate change through small-scale irrigation.
- Further study is essential to fill the gap of this research.

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