Journal of Environment and Earth Science
ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online)
Vol.8, No.6, 2018
www.iiste.org

Farmers' Perception to Climate Change and Variability: The Case of Mareka District of Dawuro Zone, South Ethiopia

Daniel Assefa Tofu
Department of Disaster Risk Management and Sustainable Development, Institute of Cooperatives and Development Studies, Ambo University

Abstract
Agriculture is the main stay of people in Ethiopia. However, the current change in the main parameters of climate, temperature and precipitation put rain dependent agriculture under serious problem. This coupled with low adaptive capacity of the people make the country highly susceptible to the adverse impact of climate change and variability. The main objective of this study was to assess the perception of farmers to climate change and variability in Mareka District of Dawuro zone, South Ethiopia. A total of 37 kebeles of the wereda were stratified under three dominant agro-ecologies (as highland, midland and lowland).Date collected using semi-structured questionnaire from the total of 384 households of the district was subjected to Statistical Software for Social Science SPSS v.20. Besides data collected employing qualitative tools: Focused group discussion and Key informant interview was coded, categorized and finally narrated. The finding confirmed that most of the interviewed farmers perceived the changes in temperature and precipitation: about 89.6% of farmers believed that temperature has increased and 80.5% of farmers mentioned as the pattern of precipitation have become unpredictable. The perception of farmers on temperature and precipitation was also in line with meteorological data of the area. This indicates a need for the implementation of different strategies in communities across the district to help effectively to manage the consequent future impact of climate change and variability in the area. Therefore, rigorous policy that can effectively work in mitigating the shocking increase of local temperature and change in precipitation, and its resultant impact in the community through building permanently functioning early warning system and local area specific strategies that help them to live with the changing climate is required from the government and institutions working in the area.
Keywords: Climate change, Perception, Variability

1. Introduction

Climate change is becoming the most serious challenges facing the global community. As result of the problem it imposes on the society; different organizations and scholars define and conceptualize it according to their perception and the way it affects the society. The Intergovernmental Panel on Climate Change [14] 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 and/or the variability of its properties and that persists for an extended period, typically decades or longer. Similarly, [19] defined climate change as change in climate over time, whether due to natural variability or as a result of human activity and is widely recognized as the most serious environmental threat facing our planet today.

In this regard one of the threaded elements in this planet is agriculture and its impact is confirmed by different recent studies. This is mainly due to agriculture is one of the most climate-sensitive industries, with outdoor production processes that depend on optimum levels of temperature and precipitation [2]. Besides, the current changes of climate in terms of increases in temperature decrease in rainfall and increased frequency of extreme weather events (i.e. drought and flooding) is suggested as the major challenge for the productivity of the sector of the other [11. Because of these, currently the effects of change in climate place the world agriculture under considerable challenge to meet the demands of alarmingly increasing numbers of global populations [21].

In addition to this, though its consequence is trance boundary, Sub-Saharan Africa is the most vulnerable one. Because majority of their people live under poverty trap and are heavily dependent on low yield rain-fed agriculture for their economic and livelihood sustenance [16]. However, agriculture is also the main stay of the people and it covers the lion's share of the Ethiopian economy by supporting about 85% of population in terms of employment and livelihood; 50% of country's gross domestic product (GDP); 88% of export earnings, 73% of raw material requirement of agro-based domestic industries [6], Ethiopia is also among those countries suffering from climate change in Africa due to different factors [25]. These include subsistence farming because of population growth, land degradation due to inappropriate use of land (i.e., cultivation of steep slopes and overgrazing), weak agricultural research and extension services, lack of agricultural marketing, inadequate transport network, low use of improved seeds, fertilizers and chemicals and the use of traditional farm implements [27].

Moreover, the recorded shock of droughts and flood history makes the country highly vulnerable to the effect of climate related risks [11]. The reason is particularly due to the country's geographical location and topography in combination with low adaptive capacity resulted in the vulnerability of agricultural sector to the

adverse impacts of climate change and variability [29]. This is further aggravated with the current year-to-year climate variability and increase in both temperatures and heavy precipitation [22]. Thus the perception of farmers to climate change and variability is a prerequisite to take any action in the response challenges faced with [17]. This is because their perception is directly the implication of the impact they face on their livings.

Just as any other rural area of Ethiopia, rain dependent agriculture is the main stay of rural people in *Mareka* district. Now such seasonal climate dependent agriculture is facing a great challenge, from climate change and variability. This is evident from climate variability in the area, loss of crop from early or let coming of rain, newly and uncommon pest occurrence and death of animal due to disease, lack of water and grazing pasture in the area; particularly in the low land. From this perspective; understanding the perception of farmers on climate change and variability is prerequisite to take appropriate initiatives that help to mitigate the effect or to live with already changed climate system, hence once they perceive the presence of climate change, they need to identify potentially useful strategies and implement those effectively [8].

Accordingly, there are various studies conducted at the country and regional levels by various researchers on farmers' perception to climate change in the attempt to identify its potential impact, adaptation options and the factors that influence them to adapt the adverse impact of climate change on agriculture [23, 4, and 5]. However, no published study has been made related to farmers' perception to climate change and variability in the area and that would support extension workers, district level experts, development assistant work in the area and policy makers which work to reduce the vulnerability of farming communities to adverse impacts of climate change. Thus to enhance policy towards tackling the challenges that climate change and its variability poses to farmers, it is important to have knowledge of farmers' perception on climate change and variability, thereby to develop area specific adaptation strategies, and to reduce factors that affecting farmers capacity to adapt as well. Accordingly, the specific objectives of the study were: to assess farmers' perception towards climate change and variability over the past 20 years. In this regard this study strives to answer the following three key research questions: 1. what are farmers' views to temperature and precipitation trend over the past 20 years? 2. Does the local farmer perceive the presence of climate change in their area? 3. What major indicators farmers use to perceive the existence of climate change and variability in the locality, *Dawuro* zone, south Ethiopia.

2. Research Methodology

2.1. Description of the Study Area

Dawuro zone is one of 14 zones and 4 special districts in Southern Nation Nationalities Peoples' Regional State (SNNPR). It is situated between 6^0 36' to $7^0$21' N and $36^0$68' to 37^0 52' E. The Omo and Gojeb rivers circumscribe and demarcate Dawuro in north and south, and North-west in a clockwise direction, respectively. Dawuro shares boundaries with Konta special district in west, Jimma zone (Oromia Region) in northwest, Hadiya and Kambata-Tambaro zone in northeast, Wolayita zone in east and Gamo-Gofa zone in southeast. The zone has five districts and one administrative town, namely Isara, Tocha, Mareka, Gena-Bosa and Loma districts, and Tarcha Town Administration, respectively. Tarcha is the capital of Dawuro zone, which is located at about 474 km from Addis Ababa and 326 km from Hawassa (the capital city of SNNPR). Totally Dawuro zone covers about 446,082 hectares of land. In addition the mean annual temperature and rainfall of the district is 22.3^{o}C and 1176mm, respectively. The average value of temperature and precipitation was through calculating 27 years data of two meteorological stations that found in both highland and lowland agro-ecology of the district [10].

2.2. Sampling procedure

The study sought to understand the local farmers' perception to climate change and variability in *Mareka* district. Specifically the researchers hunted to understand if there were any noticeable climatic changes and variability had taken place in *Mareka* district in living memory as far as farmers could tell. Accordingly, the district was selected purposively because of its characteristics of three farming agro-ecology; as highland, midland and lowland. The intention to categorize the district in to different agro-ecologic zone was because the nature of climate, farming practice, reliance on the livelihood, and their perception to climate change and its variability was strongly related with the agro-ecologic condition where they live. Following this 384 farm households were drawn from three stratums to collect primary data on the perception farmers to climate change and variability by employing simple random sampling procedure. Then after the total households in the community were also subjected to categorizing in to three socio-economic groups; poor, medium and better of households. The main purpose of categorizing households in to three stratums was to articulate where farmers with differing socio-economic capacity or resource endowments equally perceive the change climate or not. Finally, primary data that subjected to analysis using SPSS v.20 was collected through employing both quantitative and qualitative data collection such as: household survey, key informant interview and focused group discussion.

2.2.1. Household survey

Quantitative data was collected from the farmers using semi-structured questionnaire. First the questionnaire was pre-tested by five households in each *kebele* before the actual data collection was started. Then after, the

questionnaire was administered face to face with the household head. The household questionnaire contains questions on demographic and socio-economic conditions, perception on long period change in temperature and precipitation, local indicators to perceive such changes and major climate change and variability related impacts.

2.2.2. Key informant interview

Key informants were selected based on the level of expected knowledge on the local conditions related to climate change and variability, farming characteristics and their long residence in the area. Accordingly, a total of 28 key informants that include four experts (each from crop, animal, natural resource and disaster prevention and preparedness work process of the district agricultural office), three extension workers from each *kebele* with crop, animal and natural resource profession, three model and experienced farmers from each *kebele* and two *kebele* level administration leaders from each *kebele* were selected as a key informant. The main importance of experts and extension workers involvement in key informants was to get information on farming characteristics, major climate change and variability related impact events. In addition key informants selected from each *kebele* were required to develop local specific criteria to categorize households in to different wealth classes for the household survey.

2.2.3. Focus group discussion (FGD)

For FGD individuals who had long period of experience in farming were selected to discuss specific issues related to climate change and variability. The issues included as to how farmers characterize the weather of their area in terms of temperature and precipitation, what was the local indicators they use to perceive long term change in climate and the major climate related impacts they experienced in the area over the last two decades. Thus, one FGD that consisted six up to eight persons, were held in each *kebele* (e.g. see the photo below). These make up a total of three FGD for the purpose of triangulating the information from the sources.

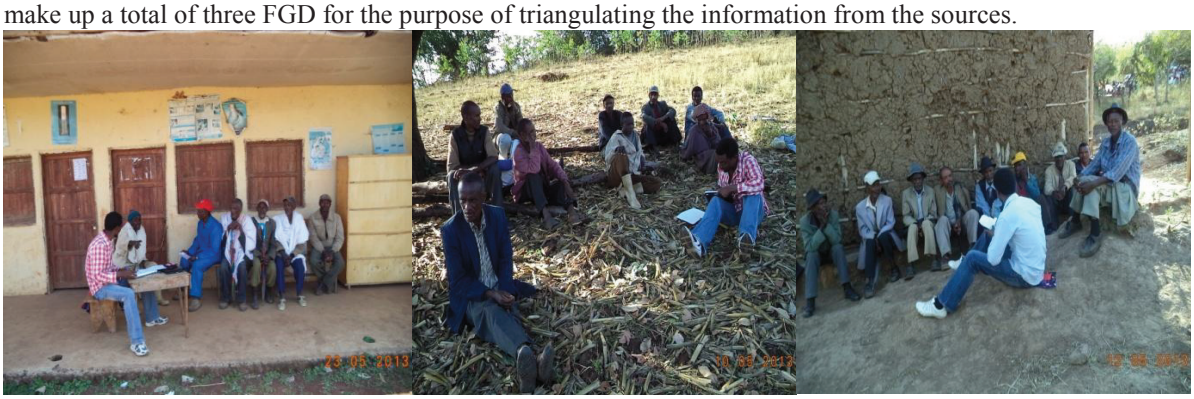

Figure 1: FGD in the highland FGD in the midland FGD in the lowland

Table 1: Local criteria and sample distribution by socio-economic category across the agro-ecologies

Highland (N = 533hh, n = 112hh)		
Poor (N=221hh, n=46hh)	**Medium (N=267hh, n=55hh)**	**Better-off (N=45hh, n=11hh)**
- Less than 0.75 ha of land	- 1-2 ha of land	- More than 2 ha of land
- 1 cow	- 2 oxen	- 3 Oxen and more
- 2 sheep	- 2-3 cows	- 4 cows and more
- Build his house covered with hat	- Build his house with iron corrugated sheet	- Additional income through irrigation or from house rent
- Doesn't able to cover his yearly consumption	- Able to cover yearly consumption	- Able to offer the product in to the market
Midland (N = 849hh, n = 173hh)		
Poor (N=339hh, n=68hh)	**Medium (N=393hh, n=80)**	**Better-off (N=117hh, n=25hh)**
- Less than 0.75 ha of land	- 1-2 ha of land	- More than 2 ha of land
- 2 cows	- 2 oxen	- 4 Oxen and more
- Build his house covered with hat	- 4 cows	- 8 cows and more
- Doesn't able to cover his yearly consumption	- Build his house with iron corrugated sheet	- Additional income through town house rent
	- Able to cover yearly consumption	- Able to offer the product in to the market
Lowland (N = 453hh, n = 99hh)		
Poor (N=265hh, n=57hh)	**Medium (N=158hh, n=34)**	**Better-off (N=30hh, n=8hh)**
- Less than 1 ha of land	- 1-2 ha of land	- More than 3 ha of land
- 1 oxen	- 2 oxen	- 4 Oxen and more
- 1 cow	- 3 cows and more	- 7 cows and more
- Build his house covered with hat	- Build his house with iron corrugated sheet	- Additional income through town house rent
- Doesn't able to cover his yearly consumption	- Able to cover yearly consumption	- Able to offer the product in to the market

3. Major findings of the study

3.1. Farmers' perception to climate change and variability

During the survey farmers in the study area asked as what they fill about current climate and they express by their local language *(Dawurigna) "Woodiyii laametteeda".* Mean they are amazingly express as the current condition of climate is completely changed in comparison to the last 20 years. However, they are responding this along with the long period change in temperature and precipitation. Since climate change was well perceived by farmers through observing changes in temperature, precipitation and related frequent drought [7].

3.2. Farmers' perception to temperature and precipitation change

The perception of farmers to climate change and variability depends on different characteristics. In fact, farmers from different agro-ecologies, age, farming experience and endowed with different resource are expected to perceive the change in climate and its variability differently. This is because, perceptions are context and location specific due to heterogeneity in various factors (i.e. education, age and wealth) [20].

Accordingly, 97.4%, 93.0% and 77.8% of the interviewed in the lowland, midland and highland respectively perceived that the temperature of the area has increased. And the result of chi-square test shows that the existence of significant difference (P=0.035) across the agro-ecology. In the same token perception of farmers on precipitation was significantly different (P=0.016) across the agro-ecology (Table 2). This indicates that the slight increase in temperature on already hot environment resulted in serious impact on rain-fed agriculture and caused frequent occurrence of drought in lowland compared to highland and midland; and this enhanced their perception. Similarly, [3] indicated that lowland areas are drier with higher drought frequency than other areas in Ethiopia. Thus farmers living in lowland areas are more likely to perceive climate change as compared to midland and highlands [24].

A cross tabulation made between age of the household head and the farmers perceptions elucidated that all farmers who perceived increase in the level of temperature were in the age group above 65 years, compared to farmers between 35 and 65 years (90.6%) or below the age of 35 years (63.6%). Regarding precipitation, 81.2% of farmers in the age group above 65 years agreed that they had observed changes in the pattern of rains, compared to 81.1% and 72.7% of farmers in the age group between 35-65 years and below 35 years respectively. Accordingly, the result shows that the existence of statistically significant difference (P=0.037) in perceiving temperature but not in perceiving precipitation among the age category (Table 2). This implies that aged farmers were able to recognize the existence of long period change in temperature and precipitation better than farmers with younger age.

Farmers with long (96.9%), medium (83%) and short (54.5%) period of farming experience have perceived an increase in temperature (Table 2). The analysis also shows the existence of significant (P=000) difference among farmers with different farming experience. This implies that farmers with long period experience were able to recognize better than medium and short period experienced farmers. Regard precipitation, 81.2% of farmers with long period of experience perceived the change in the pattern of rain compared to 80.9% and 72.7% of farmers with the farming experience of medium and short period, respectively (Table 2). The possible explanation is that though farmers with long period experience have better practical knowledge to recognize the long period change in precipitation with its consequences; it was also not difficult for farmers with lower farming experience because of its unpredictability.

100% of farmers with post-secondary education noted increases in temperature. Similarly, 90.9% of primary school, 89.3% of illiterate and 86.4% of farmers who were able to read and write also perceived it. However, there is no statistically significant difference between illiterate and among farmers with different educational level in perceiving the long period change in temperature and precipitation (Table 2). This implies that even though farmers were illiterate they were able to recognize a long period change of temperature and precipitation. This is because its manifestation is observable in the physical environment and on their agriculture. Likewise, [17] noted that people who live and work close to agriculture do experience more and have good knowledge of climate variability.

100% of better-off farmers perceived the increase in temperature. Also 91.2% of medium and 85.5% of poor farmers were perceived it in the same manner. Accordingly, there is no statistically significant difference among farmers with different socio-economic status in perceiving the long period change in temperature and precipitation (Table 2). This indicates, though there is relative difference in socio-economic status among the respondents, all farmers in the study area perceived long period change in temperature and precipitation. Because they face similar variability effect; even though they share differentiated consequence, the poor impacted more than the better-off.

Generally, the result of farmers perception from different agro-ecologic and socio-economic aspect prove that 89.6% of the respondents confirmed increases in temperature, while 100% of the interviewed perceived the existence of considerable change in precipitation amount and distribution in the study area. Few respondents, (7.1%) reported as they did not give enough attention whether there was long period change in temperature,

while 3.2% of informants were indicated there was no change in temperature at all. Similarly, 80.5% of interviewed perceived that precipitation has become more unreliable. Unlike this, 12.3% of farmers noticed the amount of precipitation had increased and the rest, 7.1% of farmers perceived increase in frequent occurrence of drought and flood (Figure 2).

For farmers this implies increased risk of crop failure, due to poor seed germination, washing away of seeds and crops, stunted growth, drying of crops caused by changes in precipitation pattern and amount. Sometimes this leads to re-ploughing and replanting thereby increasing production costs. For livestock, this implies decreased pasture and increased parasites and diseases due to decreased precipitation (drought) and increased precipitation (floods). Intra-seasonal variations in precipitation [26] and optimum precipitation which is well distributed throughout the growing season [1] are prerequisites for the effectiveness and success of farming. The change in precipitation amount and patterns entirely affect soil erosion rates and soil moisture [15]. Therefore, a shift from distinctive risk to covariate risk due to climate variability might have led to a unified local perception instead of multiple perceptions and varying insights among rural households.

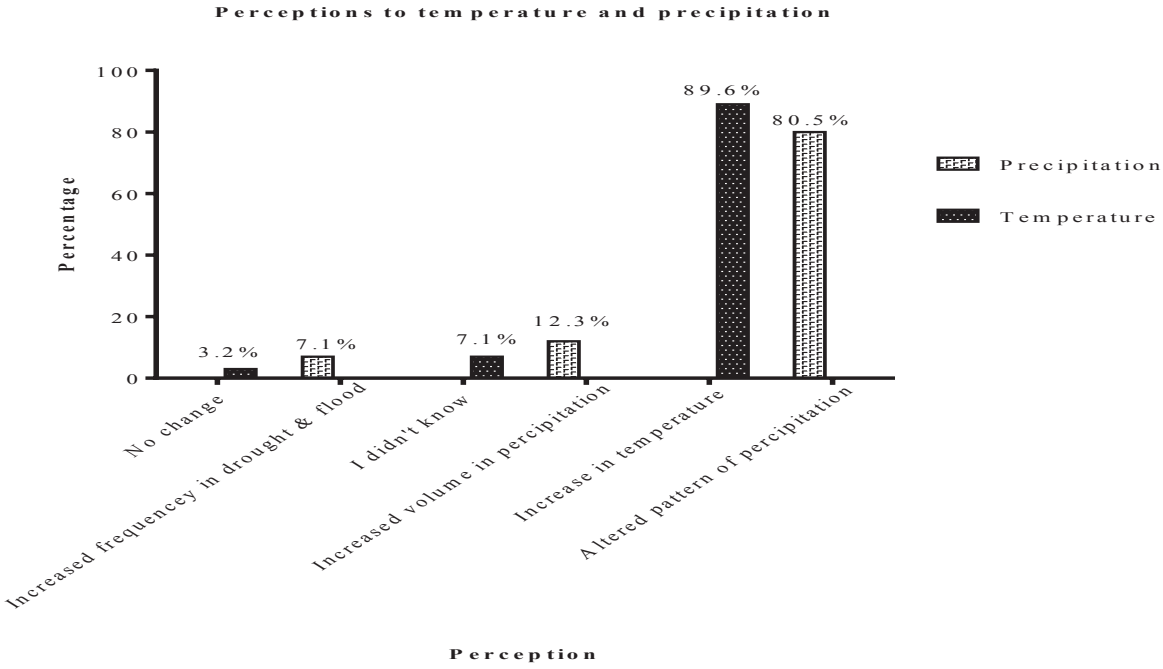

Figure 2: Farmers' perception to temperature and precipitation change in *Mareka* district.
Source: own survey, 2013.

Table 2: Farmers' perception to changes in temperature and precipitation by agro-ecology, age, farming experience, educational level and wealth status (as % of respondents)

	Perception on Temperature				Perception on Precipitation			
Farmers' perceptions	**Increased level in temperature**	**No change**	**Don't know**	**χ^2**	**Increased level in rain**	**Change in the pattern of rain**	**Increased frequency of drought & floods**	**χ^2**
Through agro-ecology								
Highland	77.8	6.7	15.6		8.9	86.7	4.4	
Midland	93.0	2.8	4.2		19.7	76.1	4.2	
Lowland	97.4	0.0	2.6		2.6	81.6	15.8	
Overall	**89.6**	**3.2**	**7.1**	**10.33****	**12.3**	**80.5**	**7.1**	**12.15****
Age								
Below (< 35 years)	63.6	9.1	27.3		18.2	72.7	9.1	
Medium (35-65years)	90.6	3.1	6.3		12.6	81.1	6.3	
Long (>65 years)	100	0.0	0.0		6.2	81.2	12.5	
Overall	**89.6**	**3.2**	**7.1**	**10.22***	**12.3**	**80.5**	**7.1**	**1.71(NS)**
Farm experience								
Short (<10 years)	54.5	9.1	36.4		18.2	72.7	9.1	
Medium (10-30 years)	83.0	6.4	10.6		12.8	80.9	6.4	
Long (>30 years)	96.9	1.0	2.1		11.5	81.2	7.3	
Overall	**89.6**	**3.2**	**7.1**	**23.72*****	**12.3**	**80.5**	**7.1**	**0.56(NS)**
Educational level								
Illiterate	89.3	3.6	7.1		14.3	77.7	8.0	
Read and write	86.4	4.5	9.1		4.5	95.5	0.0	
Primary school	90.9	0.0	9.1		18.2	72.7	9.1	
Secondary school	100	0.0	0.0		0.0	88.9	11.1	
Overall	**89.6**	**3.2**	**7.1**	**1.76 (NS)**	**12.3**	**80.5**	**7.1**	**5.68 (NS)**
Wealth status								
Poor	85.5	5.8	8.7		13.0	79.7	7.2	
Medium	91.2	1.5	7.4		8.8	82.4	8.8	
Better-off	100	0.0	0.0		23.5	76.5	0.0	
Overall	**89.6**	**3.2**	**7.1**	**4.4(NS)**	**12.3**	**80.5**	**7.1**	**3.99 (NS)**

, ** and * Significant at p<0.1, p<0.05and p<0.01respectively and NS = Not significant*

3.3. Empirical results of meteorology station data of temperature and precipitation

A comparison made between farmers' perception with meteorological data are scientifically valid. Since the record data taken between 1985 and 2012 shows that temperature has increased. The annual trend line indicates that the increased trend on temperature by 0.047 ^{o}C over the past 27 year's period (Figure 3). This is lower than the country decadal average of 0.37 ^{o}C [9] and the world, 0.14 + 0.06 ^{o}C over the same period [12].

Similarly, the precipitation pattern; shows the annual total precipitation followed highly variable trend. Besides, the annual trend line implies precipitation was increasing by 11.657 mm over the period (Figure 3). This is in accordance with the perception of most farmers (80.5%). In addition it is not contradicting the perceptions of farmers, who observed an increase in flood and drought frequency (7.1%).This mean that the high variability in precipitation could mean rain-fed agriculture remains unpredictable. Similarly, [17] dictated that 13 years of recorded precipitation was in line with farmers' perception of increase in precipitation (39.3%) and irregular and unpredictable (93%) pattern of rainfall in Ghana. Divergently [13]; the perception of farmers on precipitation volume and distribution in three *kebele*s of different district of *Tigray* region was not in line with meteorological data. However, the result of meteorology data is in line with the present study.

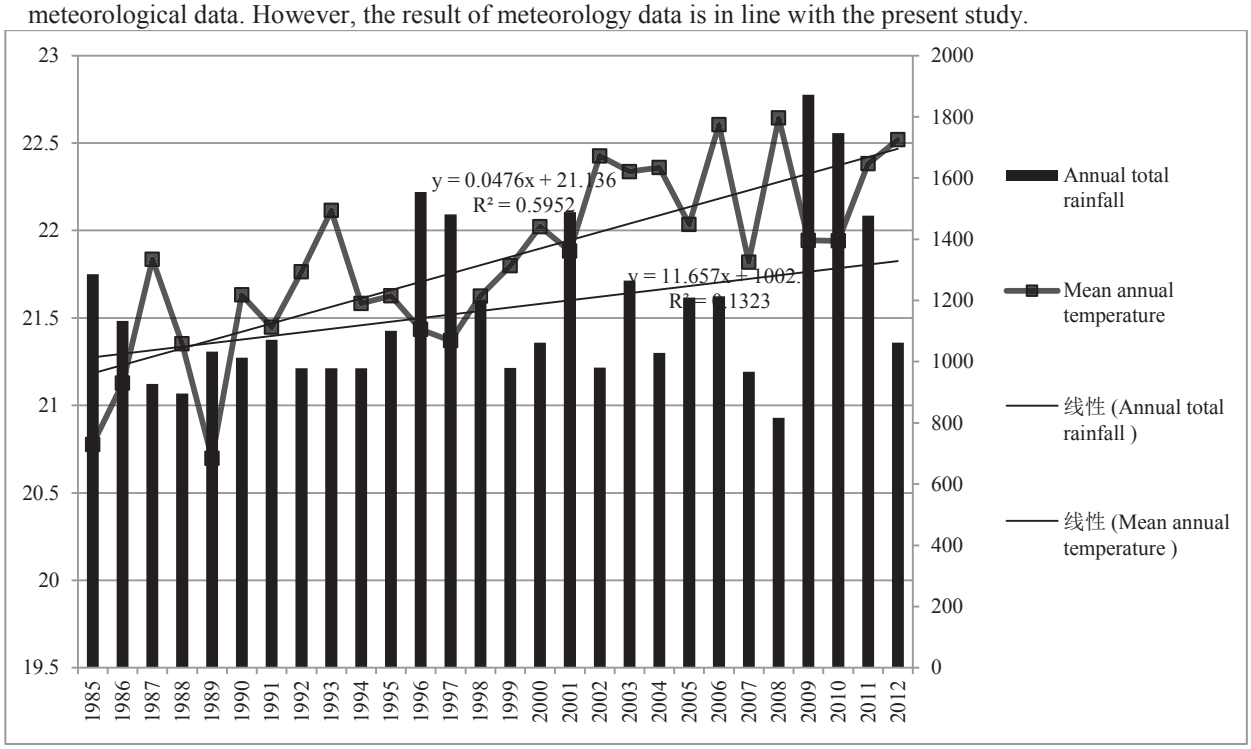

Figure 3: Annual mean temperature and annual total precipitation of *Mareka* District.
Source: Ethiopia Meteorology Agency, Hawassa Branch, 2013.

3.4. Local indicators to perceived change in temperature and precipitation

Farmers living across all the agro-ecologies were asked during the interview and focus group discussion as how they perceived the existence of long period change in temperature and precipitation and what the main indicator for their perception is. Accordingly, 81.6% of the interviewed farmers noticed the introduction of new plant species that were not popular in the area before. For instance, farmers from the highland reported fruits, like Avocado *(Persea americana)* which were only grown in midland are now common in the highland. Similarly, 79.9% of farmer reported the introduction of human, animal and plant diseases that were uncommon in the area now becoming prevalent (i.e. malaria, animal and plant pest and disease). And 66.9% of farmers mentioned the observation of change in physical structure and recognition of agro-ecologic shift in the area is taken as the major local indicators that farmers use to perceive the long period change in temperature (Table 3).

As elder *Abera Hadaro* (from among lowland focus group discussant) stated

> *"The swamp area down in my yard which was very large in size and even no livestock can able to cross it and graze 20 years before, now it is completely dried. This was happen approximately since 2004 and on ward. This was mainly due to the increase in temperature and related climate change in the area in my perception and it is now possible to see the amazing dust in that particular swamp area."*

Table 3: Local indicators to perceive temperature by agro-ecology

	Respondents by agro-ecology (%)				
Indicators	**Highland (n=112)**	**Midland (n = 173)**	**Lowland (n=99)**	**Total (n=384)**	χ^2
Prevalence of human, animal and plant diseases that were uncommon in the area	80.0	74.6	89.5	79.9	3.39 (NS)
Introduction of plant species that were not popular in the area	71.8	81.6	81.6	81.6	10.15***
Observation of change in physical structure and agro-ecologic shift	42.2	73.2	84.2	66.9	18.8***

*** *Significant at p<0.01and NS = Not significant*

All of the interviewed farmers confidently indicated that there was complete change in patterns of precipitation (early or late coming of the rain). On the other hand, 94.2% of informants pointed out that soil productivity are declining, 93.5% of the farmers noticed decline in agricultural yield, and 90.3% of farmers observed increase in frequency of drought occurrence and 84.4% of respondents mentioned shortening of plant growth period (Table 4). These were the most common local indicators used by farmers to perceive the existence of long period change in precipitation across the studied agro-ecologies.

As elder *Lemma Mengesha* (from among highland focus group discussant) stated

> *"Before 20 years the time of raining and its distribution was normal and well known but now it is completely different and it is impossible to predict when it will come and by which direction it comes. Accordingly, in past when the tender or lighting was observed in the eastern; we predict as it will give enough rain for us. In the same token the thunders and lighting that happen in the western part gives the rain for neighbor community. But currently it is not predictable and sometimes the opposite is true."*

Table 4: Local indicator to perceive precipitation by agro-ecology

	Respondents by agro-ecology No (%)				
Indicators	**Highland (n = 112)**	**Midland (n= 173)**	**Lowland (n = 99)**	**Total (n=384)**	χ^2
Loss of some plant and animal species	88.9	70.4	86.8	79.9	3.37**
Increased frequency in drought occurrence	82.2	93.0	94.7	90.3	4.76 (NS)
Rainfall come early or lately	100	100	100	100.0	-
Decline of soil productivity & fertility	93.3	95.8	92.1	94.2	0.68 (NS)
Shortened period in plant growth	80.0	85.9	86.8	84.4	0.96 (NS)
Decline of agriculture yields	93.3	94.4	92.1	93.5	0.21 (NS)

** *Significant at p<0.05 and NS = Not significant*

4. Conclusion and Policy Implication

Climate change is a global phenomenon. Its impact on agricultural activities in the developing countries has been increasing. Higher temperature and decreasing precipitation levels caused by climate change reduces the productivity of the sector particularly the rain fed. This is especially true in low-income countries where adaptive capacities are perceived to be low. The susceptibility of poor countries could be due to weak institutional capacity, limited engagement in environmental and adaptation issues, and lack of validation of local knowledge. A better understanding of the local perception of farmers to climate change and variability is therefore essential to develop any area specific measures that can mitigate these adverse consequences. The main aim of this study was to analyze the farmers' perception to climate change and variability in the *Mareka* district of *Dawuro* zone, South Ethiopia. This was mainly because assessing the perception of farmers is a pre request to investigating climate system of any area in the current condition. Accordingly, farmers interviewed for this study was perceived the existence of increasing trend in temperature, great unpredictability in precipitation as well as increase in frequency of drought and flood. Their perception of change in climate was the implication of their experience of climate induced challenges on their day to day life and livelihood.

In addition to this their perception is also scientifically valid since it was in accordance with the surrounding meteorological data although differences have been observed across the agro-ecologies as well as some socio-economic characteristics. Therefore, it is important to establish early warning system based on meteorology records and farmers training center which due focus on provision of timely and accurate information, and helps to enhance farmers' perception on climate change and variability. This is only possible through designing a sound policy that can further increase the awareness of farmers on the future impacts of climate change and provide sufficient attention to develop local context based strategies to mitigate and live with changing system of the local climate. Therefore, both local and regional or national government is must to take a mandate to

develop such a rigorous policy.

Reference

1. Audu, E.B. 2012. A descriptive analysis of rainfall for agricultural planning in Lokoja local government area of Kogi State, Nigeria. *Science and Technology* 2 (12): 1-6.
2. Ackerman, F. and A. Elizabeth. 2013. Climate impacts on agriculture: A challenge to complacency? Global development and environment institute working paper no. 13-01, Tufts University Medford MA 02155, USA http://ase.tufts.edu/gdae
3. Belay, K., F. Beyene and W. Manig. 2005. Coping with drought among pastoral and agro-pastoral communities in Eastern Ethiopia. *Rural Development* 28: 185–210.
4. Bewket, A.B. 2010. Analysis of farmers' perception and adaptation to climate change and variability: The case of Choke Mountain, East Gojjam. Master of Arts (MA) in Development Studies. MA Thesis. Addis Ababa University, Ethiopia, 1-147.
5. Bewket, A., A. Azemeraw, and D. Andent. 2013. Farmers' perception and adaptive capacity to climate change and variability in the upper catchment of Blue Nile, Ethiopia. *African Technology Policy Studies Network,* 77.
6. Centre for Environmental Economics and Policy in Africa (CEEPA). 2006. Climate change and African agriculture: Policy Note No. 25, University of Pretoria, Room 2-7, Agricultural Annex, 0002 PRETORIA, South Africa. Web address: www.ceepa.co.za
7. Dejene, K.M. 2011. Farmers' perception and knowledge of climate change and their coping strategies to the related hazards. *Agricultural science* 2(2): 138-145.
8. Dhaka, B.L., K. Chayal and M.K. Poonia. 2010. Analysis of farmers' perception and adaptation strategies to climate change. *Libyan Agriculture Research Center* 1(6): 388-390.
9. Emerta, A. A. 2013. Climate, change, growth and poverty in Ethiopia. Climate Change and African Political Stability (CCAPS). Working paper No. 3. The Robert S. Strauss Center. For International Security and Law.
10. Frehiwot Assefa Tofu. 2016. Determenants of Farmers' Adaptation Strategies to Climate Change and Variability: The Case of Mareka District of Dawuro Zone, South Ethiopia. *American Journal of Human Ecology.* Vol. 5, No. 1, 2016, 20-35
11. Food and Agricultural Organization (FAO). 2010. Strengthening capacity for climate change adaptation in the agriculture Sector in Ethiopia.
12. Fyfe, C.J., P. Nathan, Gillett and W.F. Zwiers. 2013. Overestimated global warming over the past 20 years. *Nature climate change* 3: 767-769.
13. Gebre, H., T. Kindie, M. Girma and K. Belay. 2013. Trend and variability of rainfall in Tigray, Northern Ethiopia. *Analysis of meteorological data* 1(8): 159-171.
14. Intergovernmental Panel on Climate Change (IPCC). 2007a. Understanding and attributing climate change. Climate change 2007: Contribution of working group I to the fourth assessment report of the intergovernmental panel on climate change.
15. Intergovernmental Panel on Climate Change (IPCC). 2007b. Climate change 2007: Impacts, adaptation and vulnerability. New York: Cambridge University Press.
16. Juana, S.J., Z. Kahaka and F.N. Okurut. 2013. Farmers' perceptions and adaptations to climate change in Sub-Sahara Africa: A synthesis of empirical studies and implications for public policy in African Agriculture. *Science and Education* 5(4): 121-135.
17. Kemausuor, F., E. Dwamena, A. Bart-Plange and N. Kyei-Baffour. 2011. Farmers' perception of climate change in the Ejura-Sekyedumase District of Ghana. *Asian Research Publishing Network (ARPN)* 10 (6): pp1-12.
18. NAPA. 2007. Climate change National Adaptation Program of Action (NAPA) of Ethiopia Country Report. Addis Ababa, Ethiopia.
19. Ozor, N. 2009. Understanding climate change. Implications for Nigerian Agriculture, policy and Extension.Paper presented at the National conference on climate change and the Nigeria Environment. Organized by the Department of geography, university of Nigeria, sukka, 29 June-2nd July.
20. Posthumus, H., C. Gardebroek and R. Ruerd. 2010. From participation to adoption: Comparing the effectiveness of soil conservation programs in the Peruvian Andes. *Land Economics* 86(4): 645-667.
21. Rosegrant, W.M., M. Ewing, G. Yohe, I. Burton, S. Huq, and R. Valmonte-Santos. 2008. Climate change and agriculture. Threats and Opportunities.
22. Sisay, B. B. 2013. Understanding climate change adaptation mechanisms in agriculture in Sub-Saharan Africa. *Research in Applied, Natural and Social Sciences* 1:71.
23. Temesgen, D., R. M. Hassan, A., Tekie, Y., Mahmud and R., Claudia. 2008. Analyzing the determinants of farmers' choice of adaptation methods and perceptions of climate change in the Nile Basin of Ethiopia. Environment and Production Technology Division.

24. Temesgen, D., R.M. Hsssan, and C. Ringler. 2010. Climate change and agriculture paper Perception of and adaptation to climate change by farmers in the Nile basin of Ethiopia. *Journal of Agricultural Science.* Cambridge University Press 2010.
25. United State Agency for International Development (UNAID), 2011. Climate change and conflict in pastoralist regions of Ethiopia: Mounting Challenges, Emerging Responses. Stark, J., K. Terasawa and M. Ejigu, Washington, DC 20523, 1-64 P.
26. Woldeamlak, B. 2009. Rainfall variability and crop production in Ethiopia Case study in the Amhara region. In: Proceedings of the 16th International Conference of Ethiopian Studies. H. Aspen, S. Ege, B. Teferra, and B. Shiferaw, Trondheim. 1-14.
27. World Bank. 2007. The perception of and adaptation to climate change in Africa. http://www.thefreelibrary.com/The+perception+of+and+adaptation+to+climate+change+in+Africa
28. World Bank. 2009. Response strategies to climate change in agricultural systems in Latin America. Washington, DC 20433, USA.
29. World Bank, 2010. The social dimension of adaptation to climate change in Ethiopia. Economic adaptation to climate change. Ethiopian economic association/economic policy research institute. Washington, DC 20433 U.S.A.
30. World Bank. 2007. The perception of and adaptation to climate change in Africa. http://www.thefreelibrary.com/The+perception+of+and+adaptation+to+climate+change+in+Africa