Asian Journal of Agriculture and Rural Development
Volume 7, Issue 5(2017): 102-114

http://aessweb.com/journal-detail.php?id=5005

Rural communities' perception of climate change and its determinants in Dejen district, Nile basin of Ethiopia

Zerihun Yohannes Amare[a*], Johnson O. Ayoade[b], Ibidun O. Adelekan[b], Menberu Teshome Zeleke[c]

[a*] Life and Earth Sciences Institute (Including Health and Agriculture), PAULESI, Pan African University of Ibadan, Ibadan, Nigeria
Email address: zerihun.yohannes19@gmail.com *(Corresponding Author)*
[b] Department of Geography, Faculty of the Social Sciences, University of Ibadan, Ibadan, Nigeria
[c] Department of Geography and Environmental Studies, Debre Tabor University, Debre Tabor, Ethiopia

Corresponding Author

ARTICLE HISTORY:

Received: 18-Nov-2017
Accepted: 06-Jan-2018
Online available: 19-Jan-2018

Keywords:
Climate change and variability,
perception,
Determinants,
Nile Basin of Ethiopia

ABSTRACT

Communities' perception of climate change must be integrated with research information to improve their adaptive capacity successfully. Thus, to propose appropriate adaptation options to the specific localities, understanding the levels of perception of rural communities to climate change and variability is crucial. This study aims to capture the rural communities' perception of climate change and its determinants in Dejen district, Nile basin of Ethiopia. Cross-sectional socio-economic and time series climatic data were used. Stratified and snowball sampling techniques were employed to select a sample of 398 households. Chi-square analysis was carried out at $p \leq 0.05$. The majority (65.7%) of households had information about climate change before this study survey. Age, farming experience, income, the number of relatives, access to weather information, farmer to farmer access, and government experts' extension services had a significant effect on the majority of climatic variables perception of households. The households' perception of climate change was in line with results of climate data analysis. The chi-square analysis test of hypothesis shows gender has no significant effect on the perception of climate change. The implication is that all social groups in the study area perceived that there are changes in climate.

Contribution/ Originality

This article "as opposed to majority of previous studies, gender has no significant effect on the perception of climate change. This unified local perception could be an indicator to say the impacts of climate change is at the community level (covariate risk)". Contribute to the field of gender and climate change studies.

DOI: 10.18488/journal.1005/2017.7.5/1005.5.102.114
ISSN (P): 2304-1455/ISSN (E):2224-4433

Citation: Zerihun Yohannes Amare, Johnson O. Ayoade, Ibidun O. Adelekan, and Menberu Teshome Zeleke (2017). Rural communities' perception of climate change and its determinants in Dejen district, Nile basin of Ethiopia. Asian Journal of Agriculture and Rural Development, 7(5), 102-114.

1. INTRODUCTION

Climate change is a change in climate that usually takes place over a long period of time at least 150 years with clear and permanent impact on the ecosystem (Ayoade, 2002 cited in Ayoade, 2016). Like most of developing countries, Ethiopia is one of the countries that are exstremely affected by climate change. Menberu and Aberra (2014) argue that water shortage and soil erosion are the major problems in Amhara Regional State of Ethiopia. The solution is partly depending on how rural communities perceive climate change and variability. According to Aberra (2012), scientific evidence now abounds about the inevitability of climate change and what measures should be taken to combat it. In spite of this, people of the world, from policy-makers down to the individual, are bogged down in an awkward of conflicting mind-sets of urgency, disbelief, and indecision about the extent of the climate change impact and the responses to it. To combat the problem, understanding the perception of all that have a stake in it provides the stronger ground for the decision-making process. Therefore, for this reason, perception research on climate change becomes extremely crucial to increase the adaptive capacity of rural communities to climate change impacts.

Perception research is the study of how individuals or communities perceive their environment. Humans' decisions and actions concerning their environment are based not only on objective factors but also on subjective ones. This is the underlying principle of environmental perception research (Whyte, 1997). Perception is more complex process by which people select, organize and interpret sensory stimulation into a meaningful and coherent picture of the world. As a result, farmers learn and adopt innovations in different ways. Rural communities tend to update and try to adapt to the adverse effects of weather changes based on their perception and observations from neighbours, success stories and practices (Boissière *et al.*, 2013). In the case of climate change, it refers to whether farmers understand the changing temperature and rainfall patterns over time and respond to the negative impact through adaptation (Madison, 2006). Experience with local weather may also influence global warming beliefs (Joireman *et al.*, 2010; Li *et al.*, 2011).

Most perception of climate change is simply based on human expectations (e. g. Snow in winter, the sunshine in summer) which are little related to observational evidence from instrumental records (Aberra, 2012). The reliance on short-term signs to interpret climate change is quite expected because weather events have a more significant association with the time horizon of people's everyday life rather than climate change which occurs on a longer timescale. Rural communities may be unable to accommodate the thought of a global climate change impact causing the gradual extinction of their agricultural production attached the incidence to spiritual dimension (Madison, 2006; Mertz *et al.*, 2009). Climate change Perception researchers concluded that perception decides over resource allocation. Without perceiving the risk adequately, all other determinants seem meaningless (Falaki *et al.*, 2013). Therefore, assessing households' perception of climate change could be a pre-condition for adaptation.

Meteorological data are often used to confirm villagers' assessments (Deressa *et al.*, 2009; Fisher *et al.*, 2010; Orlove *et al.*, 2010; Boissière *et al.*, 2013) and local knowledge in forecasting weather and adapting to climate (Orlove *et al.*, 2010). To guide future adaptation, we need an understanding of past and current coping strategies, to better understand what is acceptable to rural communities. This information in combination with communities' perception of climate change and variability is a key to prioritize measures to address and prepare for its consequences (Richard *et al.*, 2012). In addition to the scientific analysis of historical and current climatic condition, the importance of combining indigenous knowledge of the communities for climate change adaptation was analysed by Adelekan and Fregene (2015). Therefore, this study aims to capture the rural communities' perception of climate change and its determinants in Dejen district, Nile Basin of Ethiopia.

2. METHODOLOGY

2.1. Study area

The household survey data was collected from 398 households in the period between March 2016 and October 2016 in the Nile basin of Ethiopia. Dejen district is located in West central Ethiopia (Figure 1) at a road distance of 335km south of the regional state capital, Bahir Dar, and 230 km North-west of the capital city of Ethiopia, Addis Ababa, at the edge of the canyon of the Blue Nile. The district lies between longitude 38° 6' E and 38° 10' E, and between latitude 10° 7' N 10° 11' N, with an elevation of 1071 and 3000 meters above sea level (m.a.s.l). The same to most parts of Ethiopia; it is a mixed production system with both crop and livestock rearing. In the lowland parts of the district, the combination of moisture stress and poor soil fertility is the limiting factor for agricultural production (DDARDO, 2016).

The climate of the district is traditionally classified based on altitude and temperature. The annual average temperature and total annual rainfall of the district range between 20°C and 24°C and 800 mm and 1200 mm, respectively. The district has been categorised into three traditional climatic zones, 41% highland(2500-3000 meters above sea level), 31 % midland (1500-2500) and 28 % lowland (1071-1500) meters above sea level (DDARDO, 2016; DDEPO, 2016).

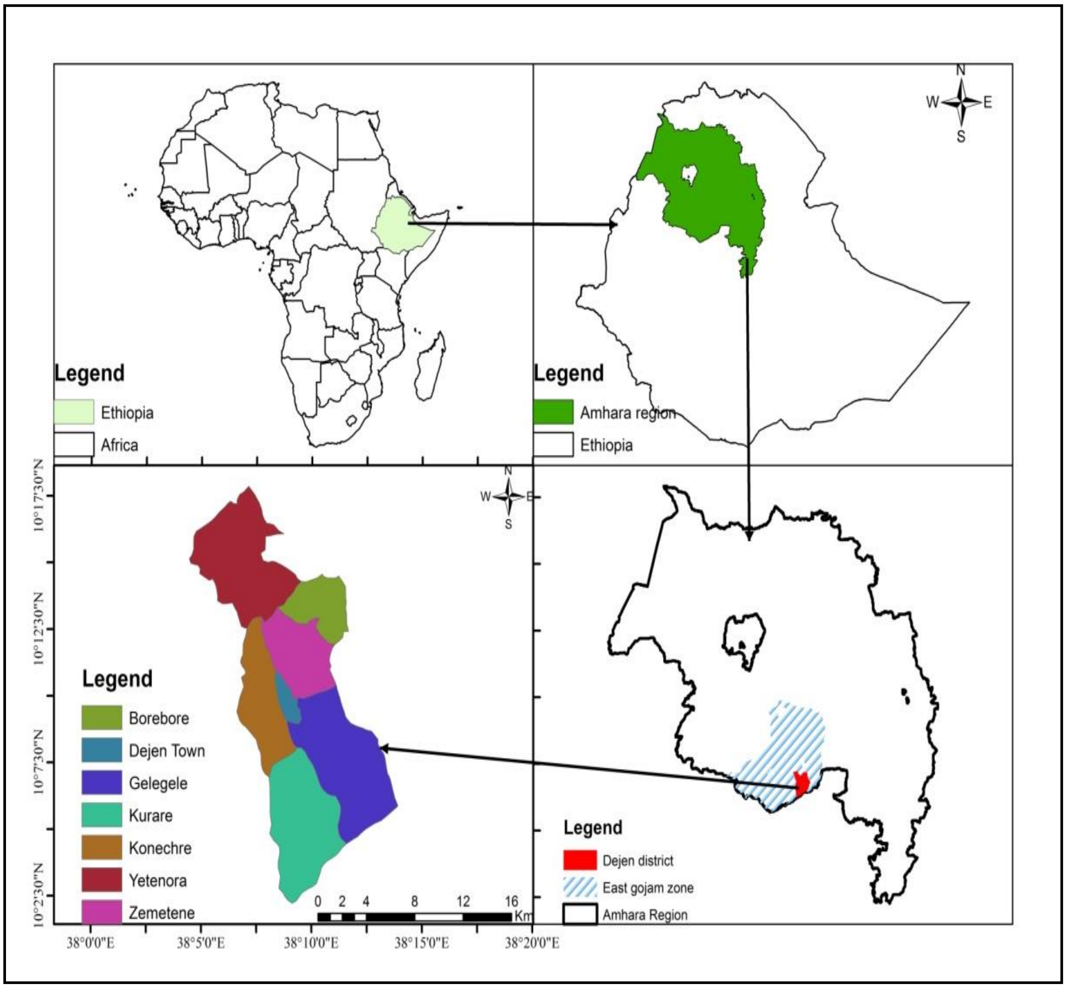

Figure 1: The study area

2.2. Research design and sampling

This study used cross-sectional research design with both quantitative and qualitative research methods. Multi-stage stratified sampling was used to select sampled households. At the first stage, among the East Gojjam zones of districts, Dejen district of the Nile Basin was purposely selected. This was based on the availability of climate data, its location to the valley of the Blue Nile with highly undulated topography and frequent susceptibility to climate-related problems such as erratic rains, crop pests, livestock disease and malaria outbreaks, its ideal representativeness of highland; midland and lowland areas where mixed farming exists. In the second stage, six *Kebeles* (lower administrative unit next to district) were selected from the total 21 *Kebeles* using purposive sampling based on: Its location to the highly undulated topography, frequent susceptibility to climate-related problems, and agro-ecological location. Since the area is vast and is difficult to undertake a survey in all villages of *Kebeles*, about 50 villages were selected using simple random sampling techniques.

Households were selected based on stratified sampling. The study population was stratified into male and female-headed households that are more homogeneous than the total population (the different sub-populations are called strata) and then the sample was selected from each male and female-headed household to constitute a representative sample. Based on Kothari (2014), in stratified sampling, the method of proportional allocation under which the size of the sample from the different strata was kept proportional to the sizes of the strata. However, in case the purpose happens to compare the differences between the strata, then equal sample selection from each stratum would be more efficient even if the strata differ in sizes.

Thus, this study was selected an equal number of male and female-headed households to analyze the perception difference of gender to climate change and variability. In Ethiopia context, female-headed households are those who do not have husband due to either being divorced, widowed or separated. In Ethiopia, in some of the rural communities but not all, disclosing of the marital status of older females is culturally not allowed, or they will not have a good feeling. Thus, to get female-headed households, snowball sampling was employed. This strategy could be viewed as a response to overcoming the problems associated with sampling hidden populations such as the criminal and the isolated (Faugier and Sargeant, 1997). The sample size was determined from each agro-ecology kebeles using probability proportional to size method to make an equal representation of households in each Kebele based on the formula provided by Yemane (1967) at the 95 % confidence interval and 5%, level of precision. Sample households were selected using simple random sampling technique. At the six *Kebeles* and 50 villages of the district, 398 households were selected. The formula is defined as:

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

Where;
n = Sample size, N = the population size
e = the level of precision.
$n = \frac{102{,}478}{1+102{,}478(.05)^2} = 398$

The sample size of 398 was distributed into the six sampled *Kebeles* based on the number of households reside in the sampled *Kebeles*.

2.3. Data collection

The study used three main data sources to analyze the rural communities' perception of climate change and its determinant factors. The first was aspects of the literature on theories, methods, methodological approaches, and empirical findings which helped to gain initial insights into the study. The second source was meteorological records of temperature and rainfall data which helps to triangulate the households' perception of climate change. The third data source was the socio-economic data collected through household survey supplemented with focus group discussions.

2.3.1. Secondary and primary data sources

The data sources were both secondary and primary quantitative and qualitative sources. The secondary data source was climate data such as temperature and rainfall data. Whereas the primary data sources were; household survey and focus group discussions.

2.3.2. Climate data

Temperature and rainfall data over the period 1979-2014 was extracted from Global weather data for soil and water assessment tool (SWAT) to analyze the trends over the past 36 years. These climate data analysis results were used to triangulate the perception of households to climate change and variability.

2.3.3. Household survey

The household questionnaire survey was the main source of data for this study. The household survey was used to collect quantitative data on households' perception of climate change and variability. The survey questions were organized into close-ended supplemented with open-ended forms. The survey questions were prepared in English and thoroughly reviewed to maintain the validity and reliability of the households' data. It was translated into local language-Amharic and then encoded into English during data processing and analysis. To assess whether the instruments were suited and appropriate to the study, the pretest of questionnaires to 10% of the sampled households from both male and female headed households in the three agro-ecological zones were selected. Pretested *Kebeles* and participants were not involved in the actual survey. After pretesting, ambiguous words and, inappropriate questions were deleted and replaced. Besides, the culture of communities in disclosing of marital status was also considered and then snowball sampling was employed. The author trained data collectors concerning the survey techniques and confidentiality protocol. After the training, the data collectors acquired practical experience while the author made a face- to -face interview in the actual data collection in the field. The data was collected by the trained data collectors under the close supervision of the author.

2.3.4. Focus group discussions (FGDs)

The main purpose of the FGDs was to triangulate households' perception and to assess impacts of climate in the rural community groups. Focus group discussions were carried out using guiding questions. The survey data was cross checked through focus group discussions with rural communities of homogeneous groups. The participants were carefully selected in consultation with the district officials, *Kebeles* level Agriculture and Rural Development officials, and data collectors. The number of participants in each focus group discussion was range from eight to twelve members from the three agro-ecological zones.

The participants of FGDs was selected based on criteria; the same age group (age >40 years), the same livelihood type, those who live in the rural community more than 20 years, those who did not have political involvement (those who are in the politics is assumed to be more active than others, and it affects discussion of the group), those who did not have higher educational level, and the same sex. The number of focus groups was six in the three agro-ecological zones of the study area. The duration to conduct one focus group was 1 to 1 and1/$_2$hours.

2.4. Data Analysis

2.4.1. Simple linear regression

Temperature and rainfall trends over the period 1979-2014 were analyzed using simple linear regression. The parametric test considers the simple linear regression of the random variable Y on time X. The regression coefficient of the interpolated regression line slope coefficient was computed from the climate data based on Mongi *et al.* (2010). This type of trend line used the following linear equations to calculate the least square fit for a line using MS Excel:

$$Y = \beta x + c \qquad \text{.............................. (1)}$$

Where Y is physical factor (separately computed for change in temperature and rainfall) B is slope of the regression equation, X is number of years from 1979-2014(36 years), C is regression constant

2.4.2. Standardised precipitation anomaly index (SPI) over the period 1979-2014

The procedure of standardization was used to transform rainfall and temperature data to come up with standardised anomalies. It used to determine periods of anomalously dry and wet events. The temperature and rainfall data were standardized using the following equation as used by McKee *et al.* (1993) and Svoboda *et al.* (2012).

$$SPI = \frac{X - \bar{X}}{\sigma} \qquad \text{.............................. (2)}$$

Where;

SPI refers to rainfall anomaly (irregularity and precipitation deficit) over the period 1979-2014

X is the observed rainfall over the period 1979-2014

$\bar{X}$, refers the mean annual rainfall over the period 1979-2014

σ, refers the standard deviation of rainfall over period 1979-2014

2.4.3. Chi-square (χ^2) and descriptive statistics

The numbers of perceived responses of the perceptible variables was used as measurement for perception of households. These variables were temperature, rainfall, and drought change over the period 1979-2014. The factors that influence households perception of climate change and variability is described (Table1). Descriptive statistical tools such as percentages and frequencies were used to summarise and categorize the information gathered from different sources. The scientific analysis results of temperature, rainfall and drought change over the period 1979-2014 were compared with households' responses on these climatic variables.

Table 1: Variables description that affect households' perception of climate change and variability

Explanatory variables	Description
Sex	Dummy, 1=male,2=female
Age	Discrete, (years), 18-30, 31-59, >59
Educational level	Discrete, (years), <Cannot read and write, primary school, secondary school, TVET
Farming experience	Continuous, (years), <10, 10-20, 21-30, 31-50, >50
Income	Continuous, (ETB), <10,000, 10,001-30,000, 30,001-50,000, > 50,000
Family size	Discrete, (number), <5, 5-7, >8
Number of relatives	Discreet, (number), <5, 5-10, 11-16, >16
Access to weather information	Dichotomous, 1= yes, 2=No
Access to extension service	Dichotomous, 1=yes, 2= No

Source: Author based on aspects of the literature, personal judgment, and availability of household survey data, March-October (2016), Ethiopian Birr (ETB) is Ethiopian Currency (1$=22.3Ethipian Birr), (NBE, 2016)

3. RESULTS AND DISCUSSION

3.1. Climate change and weather information of households

The majority (65.7%) of the rural communities heard about the word "climate change" before this study. The remaining (34.4 %) of the household heads did not hear about climate change before this survey. Information sources were evaluated by presenting a list of sources to respondents compiled from the aspects of the literature and asking them to indicate which one, they regularly use.

Households receive climate change information from the radio and television (49.8%), development agents (18%), friends/neighbours who have access to information (17%), educated family members (19%) and only some (1.5%) from *Kebele* leaders. Just a few (0.8%) farmers who have experience and education have their own knowledge about climate change either from school education or from reading. Studies in Sub-Saharan Africa by Hansen *et al.* (2011) and Tanzania by Mahoo *et al.* (2015) indicates relative importance that various forms of media vary significantly by region and country. But radio receives most attention as the key means for delivering climate change and weather information to rural communities.

The majority (62.3%) of communities do not have access to weather information, and only 37.7% have access to weather information from different sources. Among the sources of weather information, the majority (68.2%) was from the radio. The share of agricultural office experts in providing weather information is only 19.2%. Knowledge of a problem, such as a climate change impacts, and of possible solutions can enable people to take adaptive measures by helping them to determine which actions are most likely to produce the desired outcome and to build the sense of self-effectiveness required to take those actions (Williams *et al.*, 2015).

The sources of weather information for development agents were the National Meteorological Agency through the channel from district agricultural office. Households who did not have radio or contact with development agents use their friends (5.3%) and educated family members (7.3%) as sources of information. Only a few (0.7%) farmers received weather information from *Kebele* leaders.

Agricultural office experts in Ethiopia are assigned in the rural areas to promote modern agricultural practices with close technical guidance and convincing rural communities to adopt technologies. However, the roles of Agricultural office experts' in providing climate change, and weather information is not as expected as the standards. Based on study by Belay and Abebaw (2004), lack of training, lack of facilities, working conditions, and the salaries paid to them were among the vital impediment factors which affect their performance. Thus, the study findings imply, there are commitment problems on agricultural office experts in providing weather information to the rural communities.

The study areas of rural communities have more or less diversified sources of information. Luk (2011) stated that information available from different sources helps farming households to be aware of their vulnerability in the face of climate change and variability. For example, access to weather information is crucial for the day-to-day planning of farming activities. When farmers are harvesting, and threshing crops, dry conditions are vital. However, the study area communities did not get weather information regularly and intentionally. As a result, weather forecast in the study area cannot be helpful in decision making. This implies having diversified sources of information alone does not mean it can increase households' adaptive capacity unless the knowledge accessed regularly and applied practically for decision making purpose. For example, IPCC (2014) rightly noted that access to information about climate change and weather does not, by itself expand adaptive capacity.

3.2. Climate change and variability

In the study area the mean annual temperature has been increased by 1.66 ^{O}C. The maximum and minimum temperatures also increased by 2.16 ^{O}C and 1.91 ^{O}C respectively. The annual rainfall declined by 399.96 mm. From 36 years of observation, 2002 and 2012 received below the long-term average rainfall and characterized by extremely dry years while 2008, 2011, 2013, 2014 years characterized by moderately dry. The year 1983, 1986,1987,1996,1998, and 2010 were moderately wet. Among these negative patterns, the year 2002 and 2012 were extreme drought years.

Majority of the respondents perceived an increase in temperature (96.5%) and decreased in rainfall (79.9%) over the past ten years or so. Besides, the majority of respondents perceived an increase in drought (84.4%) (Table 2). As a result, majority of the households' perception are in line with the estimated climate data analysis results. For example, the temperature trend line has a positive slope (Tmax = y = 0.060x + 26.07, Tmin = y = 0.053x + 17.76, Tmean = y = 0.046x + 9.453) which shows as time increases, there is an increase in temperature. On the other hand, rainfall trend analysis indicates a decreasing trend over the period 1979-2014. Nearly, male and female headed households perceived equally an increase in temperature and drought and a decrease in rainfall**.** This implies that rural households could be highly valuable key informants on climate change studies, and their indigenous knowledge could also be used for weather forecasting.

Table 2: Households' perception of climatic variables (%)

	Temperature	Rainfall	Drought
Increase	96.5	7.5	84.4
Decrease	0.8	79.9	8.5
No change	2.8	12.6	7

Source: Household Survey data, March-October (2016)

3.3. Determinants of households' perception of climate change and variability

Gender, age, educational level, farming experience, household income, family size, number of relatives, access to weather information, and access to extension services were determinant factors of households' perception of climate change and variability (Table 3).

3.3.1. Gender of the head of household

Gender has no significant effect on the perception of climate change variables such as temperature, rainfall, and drought. The male and female-headed households perceived equally.

The implication is that all social groups in the study area understood there are changes in climate. This has emanated from the existence of widespread covariate risks in the area as a direct result of climate change and variability. Households in developing countries are frequently hit by severe idiosyncratic shocks (i.e. household-level shocks, such as death, injury, and unemployment) and covariate shocks (i.e. community level shocks, such as natural disasters or epidemics), resulting in high-income volatility (Günther and Harttgen, 2006). Therefore, the possible explanation for this result is that, a shift from idiosyncratic risk to covariate risk due to climate change might have led to a uniform local perception instead of multiple perceptions and varying insights among rural communities.

Table 3: **Summary of chi-square result for households' perception of climate change and variability**

Explanatory variables	Temperature p-value	Rainfall p-value	Drought p-value
Sex	0.070	0.731	0.594
Age	0.045*	0.465	0.047*
Educational level	0.228	0.101	0.058
Farming experience	0.213	0.310	0.006*
Income	0.000*	0.013*	0.003*
Family size	0.228	0.673	0.096
Number of relatives	0.148	0.148	0.031*
Weather information	0.084	0.055	0.008*
Farmer to farmer extension services	0.058	0.000*	0.259
Government experts' extension service	0.058	0.000*	0.259

Source: Computed based on household survey, March-October (2016),
Note: *, signify levels of significance at 0.05

Study by Yirgu *et al.* (2013) in Ethiopia; men are more responsible for agricultural activities and females are responsible for household activities. This implies males are more likely access to information about climate change. Women also have limited access to the outside activities. As a result, in this study, males perceived slightly more than female-headed households in terms of an increase in temperature and decrease in rainfall. Both sexes perceived the same percentage of an increase in drought (84.4%). This similar perception of drought is due to; male headed households were experienced in their crop failure and productivity during drought and women were responsible for fetching water, firewood collection, and child care. This was confirmed during focus group discussions.

3.3.2. Age of the household head

Age has a significant effect on the perception of climate change such as an increase in temperature ($p = 0.045$), and drought ($p = 0.047$). Adult headed households perceived an increase in temperature, and an increase in drought. The age of the household head is considered as a proxy indicator of the farming experience. This is expected to have a positive and significant effect on the perception of their locality in terms of change in temperature, rainfall, and drought over the past 10 years or so.

3.3.3. Education

Head of the households with a higher level of education were more likely to be aware of climate change than those with lower educational levels. As we move from not educated to who attended Technical Vocational Education and Training levels (TVET), the respondents had not any doubt about the change in climate in terms of the three climatic variables. Increasing educational levels of the head of households can increase their understanding of climate change and variability in their locality. This implies, strengthening the education sector in the rural community could be one of the key human capitals for building climate change resilience of the households. Based on educational levels of the head of households, households who perceived in line with the results of the climate data analysis were in between 77.8% to 100% in the four educational levels with no significant difference. This implies, for those who did not attend formal education, age has a vital role in perceiving nearly equal to educated household heads.

3.3.4. Farming experience

Farming experience of head of households has a significant effect on perception of an increase in drought($p = 0.006$) in their locality**.** Head of households who have farming experience of <10 years, the majority of households perceived an increase in temperature (95.2%), a decrease in rainfall (83.3%), and an increase in drought (69%) over the years in their locality. Households having farming experience of 21-30 years, the majority of households perceived an increase in temperature (97.4%), decrease in rainfall (76.3%), and increase in drought (86.6%) over the years. Drought affects mainly the farming households. As a result, farmers with more farming experience feels the impacts of climate change extremes like drought. Farming experience improves awareness of potential benefits and willingness to participate in local natural resources management and conservation activities.

3.3.5. Income

The study found income has a significant effect on the perception of climate change and variability in all climate change variables (Table 3). As we move from low-income groups to rich households, the perception of households increased in line with the results of meteorological data analysis. This implies income increases access to weather and climate information in that, rich people have access to meet experts, government leaders, and have money to buy radio and television.

3.3.6. Number of relatives (next of kin)

The more the number of relatives near to households' village, the more likely they have access to weather information. As a result, households having more than 16 relatives had no doubt on the increase in temperature (100%) and a decrease in rainfall (88.9%), and an increase in drought (88.9%) which is in agreement with the climate data analysis results. Number of relatives have a significant effect in terms of drought ($P = 0.031$). Therefore, this implies as the number of relatives increase households could have the possibility of access to weather information.

3.3.7. Access to weather information

Among household heads who had access to weather information, the majority perceived an increase in temperature (98.7%) & decrease in rainfall (74%) and an increase in drought (91.3%). Therefore, households in terms of access to weather information have slightly different in their perception of climate change and variability. Households who have weather information perceived parallel to the analyzed climate data results than those who did not have access to weather information. Access to weather information has a significant effect in terms of an increase in drought ($P = 0.008$). However, due to the irregularity of weather information; access to weather information has no significant effect on the change in temperature and rainfall. This is because the forecast is not area specific and can't help them in decision making process.

3.3.8. Farmer to farmer extension services

Among households who had access to extension services from model farmers, the majority perceived an increase in temperature (96%), a decrease in rainfall (71.2%), and an increase in drought (86.4%). Theoretically, access to extension services from model farmers increases the perception of households in climate change and variability. However, in this study, access to extension services has a negative effect on the perception of rainfall variability. This implies farmer to farmer extension services has not a contribution in the decision making of climate change impacts on rural communities.

3.3.9. Government experts' extension services

Households who had access to government experts' extension services, the majority of households perceived an increase in temperature (96%), decrease in rainfall (71.2%) and, increase in drought (86.4%). Surprisingly, households who had not extension services have slightly perceived more than those who had access to extension services which is reversed from expected. The extension services provided in the study area was inadequate, and it has no role in decision making of rural communities. This implies the extension message would need to be broad and call for a range of management services such as provision of information, pest and weed control mechanism and related issues that are more basic for rural communities.

Access to extension services has a significant effect on the perception of a decrease in rainfall (P = 0.000). Previous study in Ethiopia by Elias *et al.* (2016), farmers overall satisfaction with agricultural extension services contribute to the understanding of their locality. Elias *et al.* (2016) found that among those who got extension services only 55% of them were satisfied. Whereas, 45% of farmers were not satisfied with the extension services provided by government experts. Their satisfaction levels could be measured in terms of prior fulfillment of certain priority expectations such as methods of extension service, skills of the service providers, and related issues. This implies, a mere access to extension services could not be an asset for climate change perception. Therefore, the quality, type, and adequacy of extension services should be considered rather than counting the number of contact hours between rural communities and extension service providers.

4. CONCLUSIONS AND POLICY IMPLICATIONS

Both the scientific results of climatic variables and households' perception indicated that the climate is changing over the period 1979-2014. The majority of the surveyed rural households replied that they had observed an increase in temperature and drought, and a decrease in rainfall. This implies, the climate change impact in the study area is at the community level. This study can help prove the non-existence of significant gender imbalance in climate change perception between male and female-headed households of rural community in the study area. However, to avoid conflict, if any, with findings from other studies on gender issues, this study would like to note that, the gender balance this study found is in the understanding of climate change variables and perception instead of general socio-economic issues between genders.

In the study area, access to weather information was found limited. Age, farming experience, income, the number of relatives, and access to weather information has a significant effect on the perception of an increase in drought. Households with access to extension services from model farmers, and government experts had an inverse and a significant effect on the perception of climate variables. The possible reason for poor performance of extension services was inappropriate extension systems, lack of trained experts, the low satisfaction of government experts on their job due to low salary, and poor working conditions. This implies the extension services were inadequate and leads the households to the low level of satisfaction with the extension services provided by experts. Regarding policy, weather information and appropriate adaptation strategies should be made available to the rural communities. As part of this effort, communication between policymakers, the academia, non-governmental organizations, the media, and other stakeholders should collaborate to ensure the dissemination of accurate information to the rural communities.

Funding: This study was sponsored by the Pan African University (PAU) a continental initiative of the African Union Commission (AU), Addis Ababa, Ethiopia
Competing Interests: The authors declared that they have no competing interests
Authors' contributions:
ZA[1] designed the data collection tools, conducted fieldwork and data analysis, and developed the manuscript. JA[2] and IA[2] contributed in commenting the data collection tools, recommending data analysis methods, reviewed, and made editorial comments on the draft manuscript. MZ[3] contributed in developing the data collection tools, commenting data analysis methods, reviewed, and made editorial comments on the draft manuscript.
Acknowledgments: The authors would like to thank the Pan African University (PAU) a continental initiative of the African Union Commission (AU), Addis Ababa, Ethiopia. Further, authors would like to thank the University of Ibadan for hosting the programme. The authors would like to acknowledge the data collectors and field assistants for their effective coordination, support, and time spent in organizing and conducting successful households' interview and focus group discussions.

References

Aberra, Y. (2012). Perceptions of climate change among members of the house of peoples' Representatives, Ethiopia. *Journal of Risk Research, 15,* 771-785. view at Google scholar / view at publisher

Adelekan, I., & Fregene, T. (2015). Vulnerability of artisanal fishing communities to flood risks in coastal southwest Nigeria. *Climate and Development, 7,* 322-338. view at Google scholar

Ayoade, J.O. (2002). *Is our climate change?* Seminar paper, Departmentof Geography, University of Ibadan, Ibadan, Nigeria.

Ayoade, J. (2016). *Climate change: a synopsis of its nature, causes, effects and management*. Second edition, Agbo Areo Publishers, Ibadan, Nigeria.

Belay, K., & Abebaw, D. (2004). Challenges facing agricultural extension agents: A Case Study from South-western Ethiopia. *African Development Review, 16,* 139-168. view at Google scholar / view at publisher

Boissière, M., Locatelli, B., Sheil, D., Padmanaba, M., & Sadjudin, E. (2013). Local perceptions of climate variability and change in tropical forests of Papua, Indonesia. *Ecology and Society, 18*, 13-28. view at Google scholar / view at publisher

DDARDO (2016). *Dejen district agricultural and rural development office (DDRDO).* Annual Report, East Gojjam zone, Dejen, Ethiopia.

DDEPO (2016). *Dejen district environmental protection office (DDEPO).* East Gojjam zone, Dejen, Ethiopia.

Deressa, T. T., Hassan, R. M., Ringler, C., Alemu, T., & Yesuf, M. (2009). Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. *Global environmental change, 19*, 248-255. view at Google scholar / view at publisher

Elias, A., Nohmi, M., Yasunobu, K., & Ishida, A. (2016). Farmers' satisfaction with agricultural extension service and its influencing factors: a case study in North West Ethiopia. *Journal of Agricultural Science and Technology, 18*, 39-53. view at Google scholar

Falaki, A., Akangbe, J., & Ayinde, O. (2013). Analysis of climate change and rural farmers' perception in North Central Nigeria. *Journal of Human Ecology, 43*, 133-140. view at Google scholar / view at publisher

Faugier, J., & Sargeant, M. (1997). Sampling hard to reach populations. *Journal of advanced nursing, 26*, 790-797. view at Google scholar / view at publisher

Fisher, M., Chaudhury, M., & McCusker, B. (2010). Do forests help rural households adapt to climate variability? Evidence from Southern Malawi. *World Development, 38*, 1241-1250. view at Google scholar / view at publisher

Günther, I., & Harttgen, K. (2006). *Estimating vulnerability to covariate and idiosyncratic shocks*. Discussion papers//Ibero America Institute for Economic Research. No 154. view at Google scholar

Hansen, J. W., Mason, S. J., Sun, L., & Tall, A. (2011). Review of seasonal climate forecasting for agriculture in sub-Saharan Africa. *Experimental Agriculture, 47*, 205-240. view at Google scholar / view at publisher

IPCC (2014). *Climate change 2014–impacts, adaptation and vulnerability: regional aspects.* Cambridge University Press. view at Google scholar

Joireman, J., Truelove, H. B., & Duell, B. (2010). Effect of outdoor temperature, heat primes and anchoring on belief in global warming. *Journal of Environmental Psychology, 30*, 358-367. view at Google scholar / view at publisher

Kothari, G. G. (2014). *Research methodology*. Third Edition, New Age International Publishers, New Delhi.

Li, Y., Johnson, E. J., & Zaval, L. (2011). Local warming: daily variation in temperature affects beliefs and concern about climate change. *Psychol Sci, 22*, 454-459. view at Google scholar

Luk, K. Y. (2011). *Vulnerability assessment of rural communities in southern Saskatchewan.* University of Waterloo. view at Google scholar

Madison, D. (2006). *The perception and adaptation to climate change in Africa.* Policy Research Working Paper 4308. University of Pretoria: Centre for Environmental Economics and Policy in Africa. *view at Google scholar*

Mahoo, H., Mbungu, W., Yonah, I., Radeny, M., Kimeli, P., & Kinyangi, J. (2015). *Integrating indigenous knowledge with scientific seasonal forecasts for climate risk management in Lushoto district in Tanzania*. CCAFS Working Paper no. 103. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. *view at Google scholar*

McKee, T. B., Doesken, N. J., & Kleist, J. (1993). *The relationship of drought frequency and duration to time scales*. Proceedings of the 8th Conference on Applied Climatology. American Meteorological Society Boston, MA, 179-183. *view at Google scholar*

Menberu, T. Z., & Aberra, Y. (2014). Determinants of the adoption of land management strategies against climate change in Northwest Ethiopia. *Ethiopian Renaissance Journal of Social Sciences and the Humanities, 1*, 93-118. *view at Google scholar*

Mertz, O., Mbow, C., Reenberg, A., & Diouf, A. (2009). Farmers' perceptions of climate change and agricultural adaptation strategies in rural Sahel. *Environmental Management, 43*, 804-816. *view at Google scholar / view at publisher*

Mongi, H., Majule, A. E., & Lyimo, J. G. (2010). Vulnerability and adaptation of rain fed agriculture to climate change and variability in semi-arid Tanzania. *African Journal of Environmental Science and Technology, 4*, 371-381. *view at Google scholar / view at publisher*

NBE (2016). *National bank of Ethiopia, commercial banks' exchange rate*. Available: https://www.nbe.gov.et/market/banksexchange.html.

Orlove, B., Roncoli, C., Kabugo, M., & Majugu, A. (2010). Indigenous climate knowledge in southern Uganda: the multiple components of a dynamic regional system. *Climatic Change, 100*, 243-265. *view at Google scholar / view at publisher*

Richard, K. T. K., Onyango, N. O. C., Mbuvi, J. P., & Kironchi, G. (2012). Climate change and variability: farmers' perception, experience and adaptation strategies in makueni county, Kenya. *Asian Journal of Agriculture and Rural Development, 2*, 411-421. *view at Google scholar*

Svoboda, M., Hayes, M., & Wood, D. (2012). *Standardized precipitation index user guide*. World Meteorological Organization Geneva, Switzerland. *view at Google scholar*

Whyte (1997). *Guideline for field studies in environmental management perception.* MBA technical notes UNESCO, Paris.

Williams, C., Fenton, A., & Huq, S. (2015). Knowledge and adaptive capacity. *Nature Climate Change, 5*, 82-83. *view at Google scholar / view at publisher*

Yemane (1967). *Statistics: an introductory analysis*. 2nd Ed., Harper and Row. New York. *view at Google scholar*

Yirgu, L., Nicol, A., & Srinivasan, S. (2013). *Warming to change? climate policy and agricultural development in Ethiopia.* Working paper 071. Future Agricultures consortium, Addis Ababa, Ethiopia. *view at Google scholar*