RESEARCH ARTICLE

Perception of smallholder farmer's and their adaptation strategies to climate change in Sekela district of West Gojjam Zone, Ethiopia

Zemenu Tadesse Ayele[1] and Workineh Tadesse Ayele[2*]

[1] Department of Natural Resource Management in Kebri Dehar University,
Kebir Dehar, Ethiopia
[2] Department of Hydraulic and water resources engineering, Debre Tabor University, Debor Tabor Ethiopia
Corresponding author: workineh2658t@gmail.com;

ABSTRACT

Climate change is expected to have a profound impact on smallholder farmers around the world by causing severe environmental events. The study was conducted to assess the perception of farmers on Climate Change and their Adaptation strategies in the Sekela district, West Gojam, Amahara Region, North West part of Ethiopia. The data for this study were collected from 178 sample households that were selected using systematic random sampling techniques. The data were analyzed using descriptive statistics with the help of STATA version 21. Farmers have perceived an increasing temperature, decreasing rainfall, the shortened cropping calendar; as a result, the majority of the respondents have adjusted their farming practices to offset the impacts of changes in temperature, rainfall patterns, and cropping seasons. Farmers also perceived that the delayed onset and early offset of rainfall, leading to reduce yields and total production of crops. The main adaption strategies practiced in the study area were, using improved crop varieties, soil and water conservations, adjusting planting dates, irrigation, and crop diversification. Across agro-ecological zone, adaptation strategies were more pronounced or practiced in (mid-land/ Weynadega than highland/Dega agro-ecological zones mostly in the case of irrigation and soil and conservation which implied that the Weynadega/midland agro-ecological zone is susceptible to the impact of climate change.

Key words: agro-ecology**,** household, Climate change, perception,

INTRODUCTION

Africa is one of the continents that are hard hit by the impact of climate change due to an increased temperature and water scarcity (Ezra, 2016). Yet Africa represents only 3.6 percent of GHG emissions. There is "very high confidence" that agricultural production and food security in many African countries could be severely affected by climate change. Yields of crops in some countries could be reduced by as much as 50 percent by 2020, with smallholders being the most affected (Abo, 2009). Moreover, different countries throughout the world are the most vulnerable to climate change impacts because they have fewer resources to adapt socially, technologically, and financially (Deressa et al., 2008).

Different hazards have been recorded at different times in the country Ethiopia. Because of dependent on rain-fed agriculture and with a low level of socioeconomic development, Ethiopia is extremely affected and vulnerable to climate change impacts. Thus, understanding farmers' responses to climatic change are crucial in designing appropriate adaptation strategies (Fosu et al., 2012). The vulnerability of poor countries including Ethiopia is due to weak institutional capacity, limited engagement in environmental and adaptation issues, and a lack of substantiation of local knowledge (Smit et al., 2000). Adaptation strategies used by farm households in rural Ethiopia include livestock sales, agricultural employment, certain types of off-farm and non-farm employments, migration to other areas, etc. (Alemayehu, 2017). But, some of these strategies are likely to be implemented only after the possibilities of certain other options have been pursued (Legesse *et al*., 2013).

Adaptation to climate change is a modification in natural or human systems in response to actual or expected climatic stimuli or their effects, which diminishes harm or exploits valuable opportunities (Adger *et al.,* 2007). Adaptation is a two-step process; first, one has to perceive climate change and associated risks; then steps taken to minimize the adverse effects of climate change (Adger et al., 2003).

Farmers' Perception of climate change is giving an idea about climate change based on their experience and observation also depends on its impact on farmers' livelihood, their social, institutional, and economic background *(Mongi et al., 2010).* Perception should be more or less correct; otherwise, steps taken based on the wrong perception could have an adverse effect. Correct perception depends on knowledge and access to information (Tripathi and Mishra, 2017).

People do not respond to perceive climate change separately for different constraints, because of their orientation or beliefs. For instance, farmers are aware of the adverse effects of overuse of groundwater, regardless of this they continue with overuse of water-their focus is on sustaining their income rather than environmental sustainability. Hence, it is important to understand the level of people's perception, its correctness, and how the perception of CC motivates adaptation (Tripathi and Mishra, 2017).

Several studies are conducted to explore the farmers' perception of climate change, for instance, Deressa *et al.* (2011) found that farmers' perceptions of climate change are associated with age, wealth, knowledge of climate change, social capital, and agroecological parameters. Nazmul, (2013) also discovered the link between perceptions of climatic threats and socio-demographic profiles. According to McCarthy et al., (2001), it is important to educate farmers on how to adapt to climate change and variability, mitigate potential damage and manage negative impacts.

However, several studies conducted in a different part of Ethiopia at different time, they haven't been addressed the study area. But the researcher had studied the perception of farmers and their adaptation to climate change at Sekela district. Even though the local community lives under the poverty line, they try to win their life by applying various adaptation methods of climate change. On the ground, those do not respond to the effects of Climate change due to different constraints, including lack of capacity, lack of resources, and lack of information, and weak perception and prediction of farmers.

The achievement of climate change adaptation depends significantly on the availability of essential resources, financial, assets, incentives, and institutional resources as well as the perception of farmers about climate change (Deressa et al., 2009). Implementation of adaptation strategies sustains the environment as safe because nothing is doing out of the environment. As well, many social, economic, technological, and environmental trends were critically shaped the future ability to adapt to climate change. While such factors as increased population and wealth likely increase the potential level of material assets that are exposed to the risks of climate change. Greater wealth and improved technology also make bigger the resources and possibly the capabilities to adapt to climate change (Easterling *et al*., 2004).

When farmers have perceived and understand the environment and change of climate variability and its impact on their livelihood, they use different adaptation strategies to reduce the challenge of climate change (Legesse *et al.,* 2013). Farmers' choice decisions of adaptation strategies to climate change are determined by many factors. Many of these factors affect farmers' choice of adaptation strategies directly. These factors include the household socio-economic (assets, on and off-farm income), demographic characteristics (sex, farming experience, literacy status), and institutional factors (extension service, market distance, credit) in general biotic and biotic factors (Yesuf et al., 2008).

Climate change has influenced the socio-economic and demographic characteristics of the farmers; this impelled them to use different resources, assets, and incentives to reduce their impact. Farmers are the most climate-vulnerable group, therefore, Therefore, to reduce this problem, the researcher of this study had conducted the research on the perception of farmers and their adaptation strategies at Sekela district, West Gojam zone, Amhara region, North West part of Ethiopia, which serve as a relish for future researchers, look for towards this district. The objectives of the study were assessing smallholder farmers' perception towards climate change in the study area, and identifying adaptation strategies used by smallholder farmers in response to adverse effects of climate change in the study area. The most significant variables expected to influence the farmers' choice of adaptation methods to climate change taking into account the specificity of Sekela district, Wast Gojam zone, Amhara region, North West part of Ethiopia.

MATERIAL AND METHOD

Description of the Study Area

Location of the study area

Sekela district is a part of the West Gojjam zone in the Amhara Regional State of Ethiopia. The administrative center of Sekela is Gish Abay town. This district is the uppermost origin of the Abay River (Blue Nile) and flows in the north direction towards Lake Tana. It is located 469 km away from the capital city of the country, Addis Ababa, and 174 km from the regional capital city of Baher dar. Geographically, it is located at 10^0 40′-11^0 10′ north and 37^0 4′- 37^0 20′ 30″ east. Sekela district comprises altitudes ranging between 1999 and 3149 meters above mean sea level (m.a.s.l).

Climate and agro-ecology

The agro-climatic zone of the district can be categorized as 70% high-land (Dega) and 30% woyna Dega. The Weynadega and Dega site is situated in Sekela district with an elevation ranging from 1,999 to 2500m and 2500 to 3,149m above sea level respectively (FAO, 2003). It has an annual rainfall ranging between 1650 and 2537.16mm; while the annual maximum and minimum temperature range between 22.53- 24.86^{0}C and 8.53-16.50 ^{0}C respectively. The distribution of rainfall mostly occurs from June to the end of September (main rainy season), locally known as *Summer*, and November to April, the area receives a small amount of rainfall based on the data taken from the National Metrological Service agency (NMSA, were collected Zeleke Desta and Gish Abay station, as shown (fig 1).

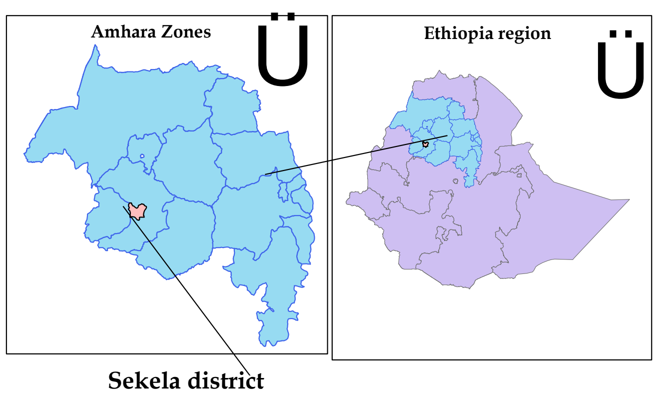

Figure 1. The location of Sekela District, West Gojjam, Amhara region, Ethiopia

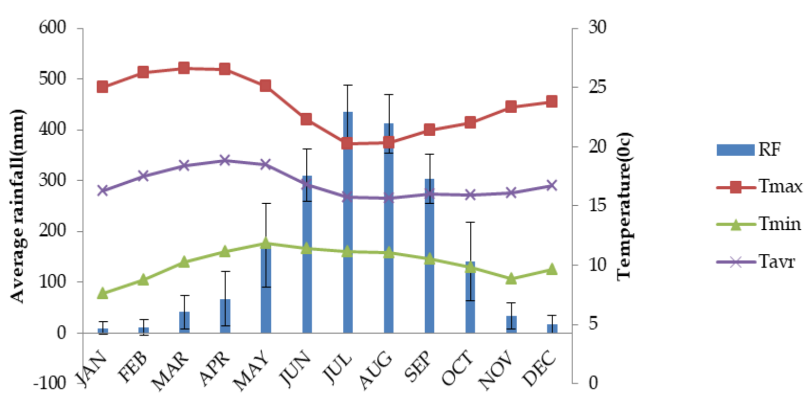

Figure 2. Trend of Average RF, Tmax, and Tmin in Sekela district (1983-2017)

Demographic and socioeconomic situation of the district

Based on the national census conducted by the (CSA, 2007), this district has a total population of 138,691, an increase of 61.36% over the 1994 census, of whom 69,018 are men and 69,673 women; 6,779 or 4.89% are urban inhabitants. With an area of 768.83 square kilometers, Sekela has a population density of 180.39, which is greater than the Zone average of 158.25 persons per square kilometer. A total of 29,908 households were counted in this district, resulting in an average of 4.64 persons to a household, and 29,093 housing units.

The livelihoods of the people in the Sekela district are dependent on both crop production and livestock rearing. Crop production takes nowadays contributed to a minor role in the economic activities of the rural communities. The principal crops are grown in the Sekela district include barley, beans, wheat, peas, and teff. Vegetables like carrots, cabbage, potato, are also grown in this area. The major constraints to crop production in the district include frost, erratic rainfall, rugged topography, and soil erosion (Geremewe, 2019).

Other sources of livelihood in the district include off-farm activities through temporary migration from different regions like Benshangul Gumz, Wolega, Humera, and out of the country, Sudan is the main off-farm activities of Sekela district population and daily labor (human capital). More of this there is no food aid in the form of public works, safety net, and direct support (social capital) in this district. Sekela district is among the most poverty-stricken areas of the country and its population is characterized by chronic and transitory food insecurity problems and highly vulnerable to climate change impacts.

Research Design

A mixed research design was used in this study to provide both qualitative and quantitative evidence and find out the most and best information about this research.

Target Population and Sample Size Determination Procedures

Sekela district was purposively selected for this study because of erratic climate change problems such as in summer that exposed to severe erosion, late-onset and early offset of rain during Belg and Meher season respectively. Devastated vegetation cover, recurrent drought, and erratic rainfall are common during the Belg season. This district incorporates, 27 rural Kebeles and has two agro-ecological zones namely: Dega (highland) and Weynadega (midland). Due to the above reason the researcher initiated to conduct this study that was focused on the farmers' perception towards climate change and adaptation strategies.

Sampling Techniques

Depending on the facts, the researcher had used the following sampling technique which was appropriate in the study area. To see adaptation strategies across the agro-ecological zone, the district has been categorized into two, which are *Dega (highland)* (70 %) and *Weynadega (midland)* (30 %). Each Keble in the same agro-ecological zone is homogeneous, therefore, from that agro-ecological zone, four kebeles were selected proportionally, three from *Dega (highland)* and one from *Weynadega (midland)* respectively with the use of lottery methods. In those selected Kebeles, the total number of men and women households have been lived 2685. After determining the number of respondents, for every four kebeles, respondents were selected in the ways of the household list by the use of systematic random sampling techniques.

.

According to (Watson, 2001) the smallest sample size "n" that gives the desired precision can be computed from the following equation.

$$n = \frac{\left[\dfrac{p(1-p)}{(A^2/Z^2) + P\dfrac{(1-P)}{N}}\right]}{R}$$

Where n, sample size required, N: number of households, A: degree of precision or the desired margin of error, expressed as a decimal: (i.e. 3%, 5%, 6.5%, 8.5%, 10%), Z: based on confidence level: 1.96 for 95% confidence, P: estimated variance in population as a decimal (0.5 for 5-50, 0.3 for 70-300), and R: estimated response rate, as a decimal.

The total number of households considered in Sekela Woreda for selected stratums was 2685, accordingly, for the degree of precision 0.065, z value 1.96, P-value 0.3, confident level 95%, and assuming the response rate is 100%, the total sample size also 178.

Table 1: Sample Kebeles by number of total households and sample size

Sample Kebeles	Total Household Heads	Sample size	Percentage of the total sample
Abay	950	63	35
Gudercany	640	42	24
Lichima	585	39	22
Selsela	510	34	19
Total	2,685	178	100

Data Type and Source

To undertake this research, both primary and secondary data were utilized. Primary data was obtained through a survey questionnaire, field observation, and structured interviews with government officials, households, and local administrative and key informants. And secondary data was collected from government office documents, meteorological data, crop production data, and livestock data as well as books and journals.

Questionnaire

A questionnaire consists of several questions that the respondent had to answer in a set format. A distinction was made between open-ended and closed-ended questions. Open-ended and closed-ended questions had asked the respondent to formulate his/ her answer. However, questionnaire provided standardized answers may frustrate users. Questionnaires were also sharply limited by the fact that respondents must be able to read the questions and respond to them. Thus, for some demographic groups surveying by questionnaire might not be concrete. Therefore, in addition to the questionnaire, the researcher would like to conduct structured interviews and observation.

Structured Interview

Structured interviews are a means of collecting data for a statistical_survey. In this case, the data is collected by an interviewer rather than through a self-administered questionnaire. Interviewers read the questions exactly as they appear on the questionnaire. The researcher also conducted an in-depth interview on 4 DAs, and 4 local elders among four kebeles administrators to gather information regarding biophysical and socioeconomic status and agro-ecological conditions, on the livelihood. The reason why the researcher had used structured interview, it is a standardized method of evaluating job candidates with pre-test questions focused on the knowledge, skill, and characteristics required for the job. Asking the same questions across all candidates, and using a standardized method for scoring responses, expected to ensure hiring decisions, were based on job-relevant information and not on irrelevant details.

Method of data analysis

The data was gathered and analyzed in terms of the study objectives already have been designed. The descriptive statistics method of data analysis was used to organize and analyze data that have been collected from sample household heads of the study area.

This study employed both quantitative and qualitative analysis techniques. The qualitative analyses used interpretations, comparisons, and arguments which should be supported with figures. The quantitative analysis method uses descriptive statistics. Both farmers' perception and adaptation to climate change analysis were subjected to descriptive statistics tools such as mean, standard deviations, frequency, and percentages were utilized to analyzed data.

Computer systems such as Microsoft excel system for statistical analysis, STATA version 21 were used to examine and understand the socioeconomic and demographic characteristics of the household heads.

RESULTS AND DISCUSSION

Perceptions of Smallholder Farmers to Climate Change in the study area

Based on the questionnaire, smallholder farmers were asked whether they have perceived changes in the temperature, and precipitation in their locality. Most of the respondents perceived that the occurrence of long-term changes in precipitation. In the study area, about 73 % of the respondents perceived that a "reduction" in the amount of rainfall, 10.1% of respondents perceived an "increment" amount of rainfall. About 7.3% of respondents claimed that no change in the level of rainfall and also 9.6 % of respondents had not felt any idea about the change in precipitation.

Out of the total survey respondents, the dominant number of smallholder farmers perceived the occurrence of long-term temperature changes. About 86 % of respondents perceived that "increase" in temperature, 6.2 % of respondents perceived "no change" in temperature, 3.4 % of respondents perceived "decrease" in temperature, and about 4.5 % of respondents did not have any idea about the trend of temperature in the area shown (table 3).

The majority of respondents perceived the duration of heat intensity in the study area. In (fig 3) indicated that about 45% of respondents perceived that there is heat change in the area and heat intensity extended in a longer period, 23% of respondents perceived there exist heat change and heat intensity extended shorter in a period, and about 32% of respondents did not confirm about heat change and felt any response about the duration of heat intensity.

Table 2. Farmers' Perception of long –term Changes in Rainfall

Changes	Frequency	Percent
Increased	18	10.1
Decreased	130	73
No change	13	7.3
I don't know	17	9.6
Total	178	100

Table 3. Farmers' Perception of Long –term Change in Temperature

Changes	Frequency	Percent
Increased	153	86
Decreased	6	3.4
No change	11	6.2
I don't know	8	4.5
Total	178	100

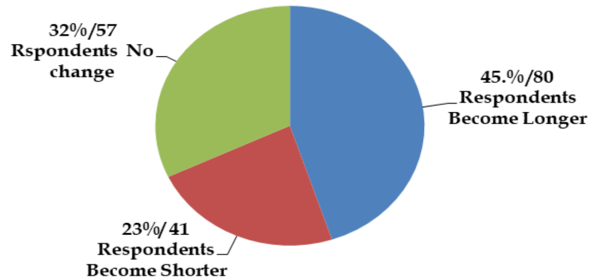

Figure 3. Farmers' observation on climate change indicators and variability.

Out of the total survey (178 respondents), each of the respondents was observed more than one climate change indicator variable, therefore; they gave more than one indicator among the above climate change indicator options to the researcher. Based on the information obtained from the respondents, about 85 numbers of respondents recognized the duration of rainfall was late-onset and early offset. 76 respondents perceived there was a frost hazard, 65 numbers of respondents confirm the existence of insufficient rainfall. The remaining 53, 47, and 35 numbers of respondents recognized the occurrence of drought, heavy rainfall, and flooding respectably. Besides, by considering the past events farmers revealed that the cause of change of climate variability we are human beings in different ways.

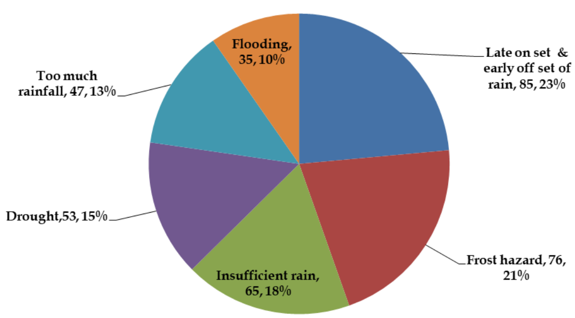

Figure 4. Farmer's response about the observation of indicators of climate change variability.

Perception of smallholder farmers on shifting of agricultural calendar

In the household survey, respondent smallholder farmers were interviewed to assess the current cropping calendar beside the cropping calendar that was between 1983-2003 G.C years ago. Almost all respondents shifted the sowing and harvesting dates of their crops as an adjustment to the changing climate especially rainfall variability. Key informants also declared that the onset and offset periods for both seasons have become highly variable in recent years, especially with notable delays in the onset times. The key informant interview responses also indicated that the current agricultural calendar of most crops is shorter than that was between 1983-2003 G.C years ago based on crop production row data and cropping period that found in the agricultural office. As a result, they reported that they adjusted cropping and planting dates. The interview result was corresponding with questionnaire responses and observation of the researcher in the area. As a result, climate change indicators, such as late-onset and early offset of rain, insufficient rain, drought, frost hazard, too much rainfall in a short period, and flooding were understood by survey respondents, key informants, and the researcher almost similarly.

Furthermore, changes in the frequency of plowing reduction time to time were reported due to changes in the timing of rainfall, which had a negative impact on the production of crops and occurrence of weeds because plowing keeping the right season has a positive impact on the production and negative impact on weeds growth. Land preparation and sowing dates are adjusted following the start of reliable rainfall. This result implies that crops were harvested before completing their life cycle or before reaching their maturity period due to rainfall pattern change. This in turn results in a low grain filling period, and thereby low yield. Farmers shorten the growing length of the crops knowing the side effect on their production. The benefit of this strategy is highly diminished unless drought resistance or early maturing varieties are used.

The result implicitly explained a tendency towards a shorter growing season, indicating that most crops are planted today during the mid-to end of June, and are often harvested some weeks earlier as well (fig 5) For instance, the planting and harvesting period of wheat, barley, bean/pea, and tef has shortened by 2-3 weeks now compared to the earlier period. Currently, potatoes are planted 2-3 weeks later and harvested a week earlier as well as maize planted and harvested a month later and earlier respectively than those were between1983-2003 G.C. The delayed onset and early offset of rainfall, leading to reduce yields and total production of crops. The result agrees with the finding of Amdu et al. (2013) and Alemayehu & Bewket (2017) where crops were harvested before completing their life cycle or reaching maturity period due to rainfall pattern change decrease, as well as Land preparation and planting dates are adjusted following the start of reliable rainfall.

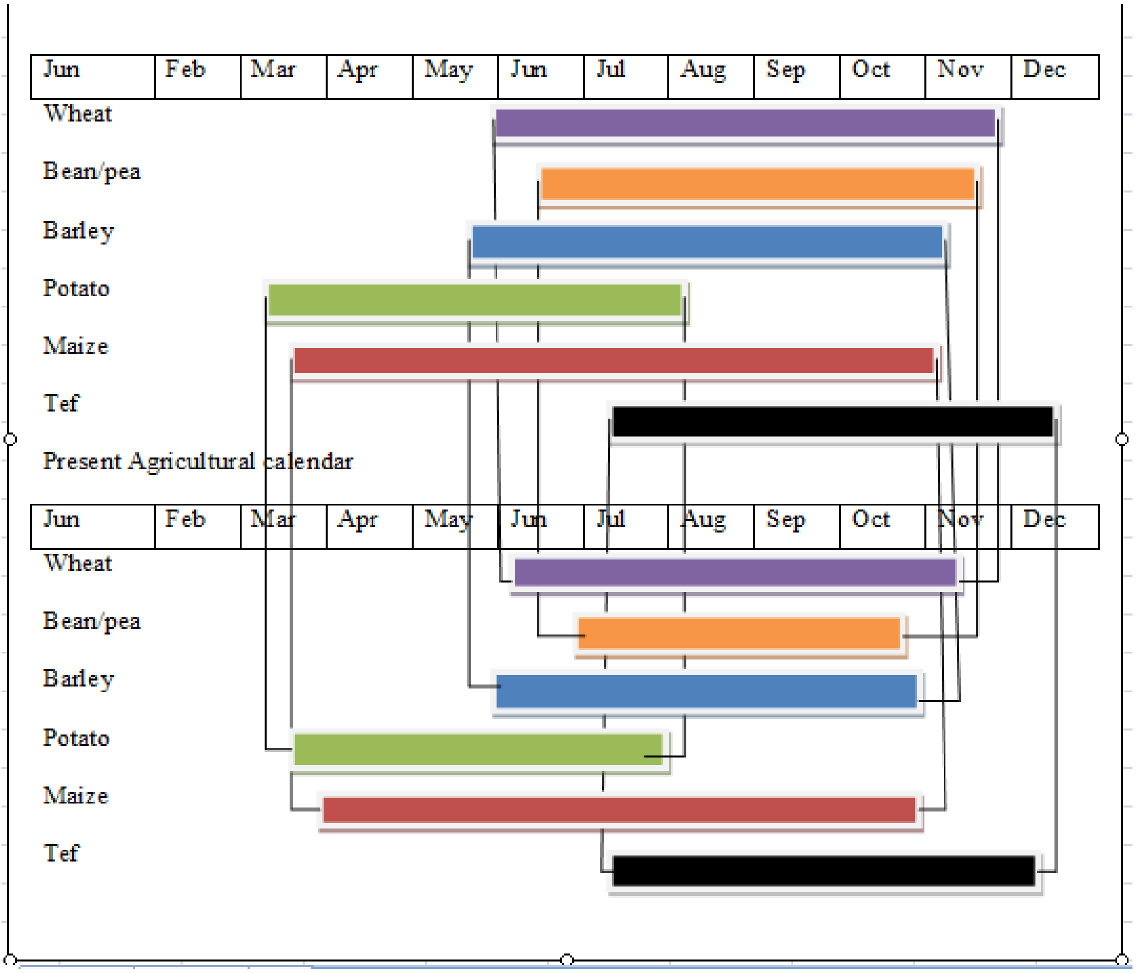

Figure 5. Cropping calendar between 1983-2003 G.C and at the present in the study area. Source: key informants interview result, 2018

Adaptation strategies to climate change across agro-Ecology

Based on the data collected from questionnaires, observation, and interviews, farmers have been practiced climate change adaptation mechanisms across agroecology to survive the impact of climate change. The result revealed in (table 4), irrigation and soil and water conservation was the dominant adaptation strategies in Weynadega (midland) zone, which counted about 25.6 % and 18.6% respectively, while, in Dega (highland) zone, only soil and water conservation practices were the common adaptation strategies which count 25.2%. Using improved crop verities was carried out in Dega (highland) and Weynadega (midland) zones as adaptation strategies to diminish the impact of climatic change which implies 23% and 9.3% respectively. Crop diversification and adjusting planting dates were practiced as adaptation mechanisms in both Dega (highland) and Weynadega (midland) agro-ecological zones which implied 14.8% and 7.4%, 16.3%, and 11.6% respectively.

In both agro-ecological zones, the total adaptation strategies, such as, soil and water conservation measure have taken the major contribution, which was 23.6%; whereas using improved crop varieties and crop diversification have been highly preferred next to the soil and water conservation which are both 15.2%. In the case of irrigation and adjusting planting dates farmers have been practiced about 12.4% and 8.4% respectively. However, about 25.3% of respondents did not take any adaptation measures to replay climate change-related impacts.

Based on the result, adaptation strategies were more pronounced or practiced in Weynadega (midland) than Dega (highland) mostly in the case of irrigation and soil and water conservation which implied that the Weynadega (midland) zone is susceptible to the impact of climate change or this proportion leads to conclude that there is high intensity of climatic problems from Weynadega (midland) than Dega (highland) zone. Adaptation strategies, where the researcher observed in both agro-ecological zones were similar to as from respondents' information collected. This result line with the finding of Gutu, Bezabih, & Mengistu (2012) stated that farming in Weynadega (midland) increases the probability of using soil and water conservation and water harvesting practices as adaptation options, compared to Dega (highland).

Table 4. Agroecology * Climate Change Adaptation Strategies Cross tabulation

		Climate change adaptation strategies					
		Use improved crop varieties	SWC	Adjusting planting date	Irrigation	Crop diversification	No adaptation strategies
Dega	Frequency	23	34	10	11	20	37
	%	17	25.2	7.4	8.1	14.8	27.4
Weynadega	Frequency	4	8	5	11	7	8
	%	9.3	18.6	11.6	25.6	16.3	18.6
Total	Frequency	27	42	15	22	27	45
	%	15.2	23.6	8.4	12.4	15.2	25.3

CONCLUSION

In the study area farmers provide their perception about climate change and employed different adaptation strategies to withstand its impact. They were able to recognize that temperature has increased, but the rainfall pattern had decreased. In the fact, farmers perceived climate change is reflected in the adjustment of the agricultural calendar and adoption of different adaptation strategies. Survey results inveterate that farmers have shortened the cropping calendar, and the majority of the respondents have adjusted their farming practices to offset the impacts of changes in temperature and rainfall patterns. According to respondents, across the agro-ecological zone, adaptation strategies were more practiced in Weynadega (midland) than Dega (highland) mostly in the case of irrigation and soil and water conservation which implied that the Weynadega (midland) zone is susceptible to the impact of climate change. The common adaptation strategies of farmers have improved crop variety; soil and water conservation practices; adjusting planting dates; irrigation; and crop diversification. In general, there is a real climate change in the study area; therefore, it is imperative to adjust the agricultural activity with climate change situations and design planned climate change adaptation strategies to enhance the adaptive capacity and resilience of rained dependent smallholder farmers.

The farmers in the study area were completely lived under the poverty line as the researcher observed and based on the information obtained from the survey, key informants, and interview, therefore; private scholars, governmental and nongovernmental organization should have to look for and conduct research on agricultural activities to minimize the negative effects resulting from climate change.

Based on the result indicated on climate variability, nowadays, climate change becomes a serious problem on crop production in the study area therefore, the community and government have to integrate and introduce new adaptation strategies to minimize climate change impacts.

ACKNOWLEDGMENT

We would like to thank Sekela Woreda's Agriculture offices that have given and support us to get valuable information and legal permission to get information in Kebele agricultural office, respondents from each kebeles, and who helps us to achieve this work.

REFERENCES

Abo, Hadid, A. (2009). Future climate change and its impact on the agriculture sector in Egypt and how to face it. Agriculture Research Center, Ministry of Agriculture and Land Reclamation, pp 1-17.

Adger, W.N., S. Agrawala, M. M. Mirza, C. Conde, K. O'Brien, J. Pulhin, R. Pulwarty, B. Smit, and K. Takahashi, (2007). Assessment climate change impacts, adaptation, and vulnerability, Contribution of working group II to the fourth assessment report of the intergovernmental panel on climate change.

Adger, W. N., Huq, S., Brown, K., Conway, D., & Hulme, M. (2003). Adaptation to climate change in the developing world. Progress in development studies, 3(3), 179-195.

Alemayehu, A., & Bewket, W. (2017). Smallholder farmers' coping and adaptation strategies to climate change and variability in the central highlands of Ethiopia. Local Environment, 22(7), 825-839.

Amdu, B., Ayehu, A., & Deressa, A. (2013). Farmers' Perception and Adaptive Capacity to Climate Change and Variability in the Upper Catchment of Blue Nile, Ethiopia.

Central Statistical Agency of Ethiopia (2007), national census system: unpublished organized data.

Deressa, T. T., Hassan, R. M., Ringler, C., Alemu, T., & Yesuf, M. (2008). Analysis of the determinants of farmers' choice of adaptation methods and perceptions of climate change in the Nile Basin of Ethiopia [in Amharic] (No. 15 (9) AMH).

International Food Policy Research Institute (IFPRI).

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(2), 248-255.

Deressa, T. T., Hassan, R. M., & Ringler, C. (2011). Perception of and adaptation to climate change by farmers in the Nile basin of Ethiopia. The Journal of Agricultural Science, 149(1), 23-31.

Easterling, W. E., Hurd, B. H., & Smith, J. B. (2004). Coping with global climate change: the role of adaptation in the United States (Vol. 40). Arlington: Pew Center on Global Climate Change.

Ezra, C. A. (2016). Climate change vulnerability assessment in the agriculture sector: Typhoon Santi experience. Procedia-Social and Behavioral Sciences, 216, 440-451.

FAO/Food and Agricultural Organization (2003), Integrated Natural Resources Management to Enhance Food Security: the Case for Community-Baesd Approaches in Ethiopia. Rome: FAO.

Fosu-Mensah, B. Y., Vlek, P. L., & MacCarthy, D. S. (2012). Farmers' perception and adaptation to climate change: a case study of Sekyedumase district in Ghana. Environment, Development and Sustainability, 14(4), 495-505.

Gutu, T., Bezabih, E., & Mengistu, K. (2012). Econometric analysis of local level perception, adaptation and coping strategies to climate change induced shocks in North Shewa, Ethiopia. International Research Journal of Agricultural Science and Soil Science, 2(8), 347-363.

Legesse, B., Ayele, Y., & Bewket, W. (2013). Smallholder farmers' perceptions and adaptation to climate variability and climate change in Doba district, west Hararghe, Ethiopia. Asian Journal of Empirical Research, 3(3), 251-265.

McCarthy, J. J., Canziani, O. F., Leary, N. A., Dokken, D. J., & White, K. S. (Eds.). (2001). Climate change 2001: impacts, adaptation, and vulnerability: contribution of Working Group II to the third assessment report of the Intergovernmental Panel on Climate Change (Vol. 2). Cambridge University Press.

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(6).

NAZMUL HUDA, M. (2013). Understanding indigenous people's perception on climate change and climatic hazards: a case study of Chakma indigenous communities in Rangamati Sadar Upazila of Rangamati District, Bangladesh. Natural hazards (Dordrecht), 65(3), 2147-2159.

Smit, B., Burton, I., Klein, R. J., & Wandel, J. (2000). An anatomy of adaptation to climate change and variability. In Societal adaptation to climate variability and change (pp. 223-251). Springer, Dordrecht.

Geremewe, Y. T., Tegegne, B., & Gelaw, F. (2019). Determinants of Potato (Solanum Tuberosum L.) Producers Market Outlet Choices in the Case of Sekela District, West Gojjam Zone, Amhara National Regional State, Ethiopia. Journal of Agricultural Economics, 5(1), 535-541.

Tripathi, A., & Mishra, A. K. (2017). Knowledge and passive adaptation to climate change: An example from Indian farmers. Climate Risk Management, 16, 195-207.

Watson, Jeff. (2001). How to determine a sample size: Tipsheet# 60. University Park, PA: Penn State Cooperative Extension.

Yesuf, M., Di Falco, S., Deressa, T., Ringler, C., & Kohlin, G. (2008). The impact of climate change and adaptation on food production in low-income countries: evidence from the Nile Basin, Ethiopia. Intl Food Policy Res Inst.

ISSN 2220-9325 (Online), ISSN 2203-5802(Print)