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Original article

Perceptions and practices of climate change adaptation and mitigation strategies among farmers in the Konta Special District, Ethiopia

Nega Abera, Dereje Tesema*

Department of Sociology, Jimma University, Jimma, Ethiopia
*E–mail address (*corresponding author): derejetesema2011@gmail.com*
ORCID iD: Nega Abera: https://orcid.org/0000-0001-7855-0270; Dereje Tesema: https://orcid.org/0000-0002-4460-2690

ABSTRACT

Nowadays climate change is amongst the most critical problems affecting the wellbeing of human beings. In Ethiopia, where the majority of the population rely on agriculture, climate change has adverse effects. In rural areas, low resilient capacity to shocks exacerbates the impacts of climate change such as production failure, which in turn enormously contributed to food insecurity. In view of this fact, this study assessed the perceptions and practices of climate change and related adaptation and mitigation strategies among farmers in the Konta Special District, Southern Ethiopia, by using a mixed research approach involving a concurrent method of data collection and analysis. Quantitative data for this study was generated from 296 randomly selected survey households; while, qualitative data was collected through focus group discussions, key informant interviews, and in-depth interviews. The findings of this study revealed that sample respondents recognized the occurrence climate change and its increasing adverse effects. Regarding its cause, a substantial proportion (46.8%) of the respondents perceived climate change as the wrath of God and a natural phenomenon rather than attributing it to human activities. Participants also acknowledged that anthropogenic factors such as deforestation are the major driving factors for climate change. The study found that farmers affirmatively perceive the feasibility of the majority of the strategies embraced in the Climate Resilient Green Economy initiative endorsed at national level. Understanding that climate change effects are less reversible, farmers were found to practice mitigation strategies such as afforestation, agroforestry and agricultural intensification more than adaptation strategies. Adaptation strategies such as fuel conservation technologies were perceived costly and complex given the economic capacity and skill of farmers. Hence, rural and agricultural development policies should initiate context sensitive adaptation and mitigation strategies to enhance the capability of smallholders to deal with the effects of climate change.

KEY WORDS: adaptation, climate change, mitigation, perception, vulnerability

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1. Background of the study

Climate change is one of the most critical environmental issues and among the serious natural dangers confronting humanity around the world in the twenty-first century (ARBUCKLE ET AL., 2013; HARUN ET AL., 2014). Despite some reservations, there is a growing consensus among scholars that climate change is occurring, and is largely induced by human activities such as deforestation and pollution among others (AJUANG ET AL., 2016). Notwithstanding a few skeptical views, scientists are unequivocal that climate change is happening due to anthropogenic activities such as burning of fossil fuels, industrial pollution, deforestation, and land use changes (IPCC, 2014). Shreds of evidence indicate that the earth's climate is rapidly changing, owing to increases in Green House Gas emissions (GHG), which has raised the average temperature and altered the amount and distribution of rainfall (KIBUE ET AL., 2015). Anthropogenic greenhouse gas emissions have increased since the pre-industrial era. These are driven largely by economic and population growth, and are now higher than ever (IPCC, 2014).

This change in climate results in major adverse consequences for the world's ecosystems and societies worldwide (BEWKET, 2015). Although a global phenomenon, the severity of the adverse effects of climate change differs significantly across regions, countries and socioeconomic groups. In this regard, developing countries suffer more, with the poorest segment of the population likely to suffer most (AJUANG ET AL., 2016). Africa is one of the most vulnerable continents to the impacts of climate change due to its dependence on agriculture (IPCC, 2007). This is mainly because agriculture, which is the main source of food, income, and employment for the majority of the population, is the most vulnerable sector for its dependence on a fluctuating climate (TEMESGEN ET AL., 2014).

Surface temperature increases since the mid-20th century over every continental region except Antarctica where observations are uncertain regarding the fluctuations (IPCC, 2014). Higher temperatures and decreasing precipitation levels caused by climate change depress crop yields (IPCC, 2007). This exacerbates the food insecurity of smallholders who are entirely dependent on the climate for making their livelihood (TAZEZE ET AL., 2012). Among the critical challenges to agriculture in the twenty-first century is the need to feed an increasing population while at the same time maintaining environmental resources and responding to climate change (ARBUCKLE ET AL., 2013). Indeed, agriculture is not only a basic livelihood strategy at risk from climate change, but it is also a major driver of environmental and climate change itself due to its impact on land and water (ALAM ET AL., 2017). The impact of climate change is worrisome in Ethiopia, where its agricultural systems have largely relied on rain that has been closely associated with climate (AMARE & SIMANE, 2018). The ecological crises resulting from climate variability, uncertainty and change have constrained the development of Ethiopia for a long time (EPCC, 2015), and all of these are expected to increase in the future. Climate change threats are serious for poor nations, like Ethiopia, due to their high vulnerability and low adaptive capacity (ADEM, 2017).

Greenhouse gas (GHG) emissions are projected to continue and will induce many changes in the global climate system during the twenty-first century. Cognizant of these pressing effects of climate change, responce mechanisms have been given a due attention (ALAM ET AL., 2017). The United Nations Framework Convention on climate change (UNFCCC, 2007) highlights two fundamental response strategies to the climate change effects: mitigation and adaptation. These concepts represent strategies to tackle the effects of climate change by reducing the emissions of GHG and adjusting responses to adverse impacts of climate change respectively. Adaptation is defined as adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts (FENG ET AL., 2017). Mitigation is an intervention to reduce emissions at sources or to enhance the sinks of greenhouse gases (ELUM ET AL., 2016; LOCATELLI, 2011). Studies have predicted that the current rate of environmental degradation and climate change in Africa will contribute to a faster rise in temperature in the 21st century unless it can be mitigated timely (FAGARIBA ET AL., 2018). In Ethiopia too, the climate is changing and a number of projections have emphasized that further changes are on the way. This has necessitated the implementation of mitigation and adaptation strategies (ABRHA & IMHADRI, 2015).

At the macro level, Ethiopia has adopted policies, laws, programs, and institutions, which have bearings on climate change mitigation and adaptation strategies (BEWKET, 2015). Among others, the Climate Resilient Green Economy (CRGE) initiative, which was adopted in 2011, articulates responses to climate change and highlights different mitigation and adaptation strategies that should be implemented by different actors (EPCC, 2015). Soil and water conservation practices are the most widely used adaptation strategies in response to climate change (ASRAT & SIMANE, 2018). Crop diversification and improved crop varieties are also dominant strategies which are pursued by smallholder farmers in order to adapt to the negative effects of climate variability (AMARE & SIMANE, 2017). Despite the general agreement in regarding the need for timely response against climate change risks, the implementation of strategies at the grass root level is not sufficiently enhanced. As a result, environmental resources have continued to deteriorate and people's vulnerability to climate change is increasing (LEMMA, 2016). This is partly due to the farmers' poor awareness and their attitudes towards the strategies (TEKLESILASSIE, 2015).

Adaptation strategies are not put directly into action by farmers because climate change adaptation measures are context specific (WAKO ET AL., 2017). Micro-level barriers challenges farmers' efforts to implement adaptation strategies. Among others, the perception of farmers about climate change is very important (DERESSA ET AL., 2009). The perception of people about climate change influences the strategies they design to reduce the possible impacts of those changes on

their livelihoods. Although the perception of climate change may not necessarily be consistent with any certainty, it could be a useful part of a solution (FAGARIBA ET AL., 2018). Yet, farmers' perception and adaptation practices to climate change are not uniform across geographical settings or ecological conditions (ABRHA & SIMHADRI, 2015).

Several studies have been done on factors affecting farmers' adaptations to climate change in the various areas of Ethiopia (BERHANU & BEYENE, 2015; DERESSA ET AL., 2010; TESFAY, 2014; ERENA & GEMECHU, 2016; BELAY ET AL., 2017; AMARE & SIMANE, 2018; TESSEMA ET AL., 2013; TAZEZE ET AL., 2012). Although various climate change response strategies are rigorously researched, the extent of the practice of each adaptation and mitigation strategy adapted from the CRGE initiatives in rural areas and farmers' perception towards these strategies are not well addressed. While many recognize that it is important to understand farmers' attitudes toward responses to climate change, very little research effort has been focused on this area (DERESSA ET AL., 2009). Moreover, WOUTERSE, (2017) asserted that empirical evidence is lacking on the role that climate change perception plays in adaptation and on the importance of a broader concept of human capital in the decision to adapt to climate change. A significant proportion of rural people externalize the cause of climate change to natural factors and divine thought, however, understanding climate change as a function of human activity is undeniably growing (ARBUCKLE ET AL., 2013).

Perception towards the adaptation and mitigation strategies influences the extent to which farmers practice various climate change response strategies. Adaptation at farm- level involves two stages: 1) perceiving the change in climate and deciding whether to adapt or not, or 2) which adaptation strategy to choose (TEMESGEN ET AL., 2014; TESSEMA ET AL., 2013). It is the perception of the decision makers that plays an important role in the final decision of whether to adopt the strategies or not (BEWKET, 2015). Therefore, farmers' perception of climate change adaptation and mitigation strategies influence their readiness to implement the strategies in an effort to reduce the complex effects of climate change.

More pertinently, studies conducted in Ethiopia have rarely unveiled the perceptions and practices of climate change adaptation and mitigation strategies adapted from CRGE initiatives among farmers. This is not an exception in this study area; rather studies largely focus on the socio economic factors affecting adaptation strategies. Hence, previous studies have given less attention to the subjective understanding of farmers about climate change and its ramification, which could be of paramount importance in designating strategies that are deemed effective and friendly to farmers. Mitigation is a proactive response and thus precedes adaptation in reducing climate change. Nevertheless, both strategies are practically complementary. Studies, however, treat mitigation and adaptation distinctly. In view of this, this study examined the adaptation and mitigation strategies farmers were pursuing at the same point in time. Such an approach help us compare the differential ability and preference of farmers to practice different strategies and their subjective reasons underpinning their choice.

2. Aim of the study

The general objective of this study was to assess the views and practices of climate change adaptation and mitigation strategies among farmers in Konta Special District, Ethiopia. Based on this, the following specific aims were formulated: 1) To assess perceptions of farmers about climate change in the study area; 2) To examine the views farmers in the study area about climate change adaptation and mitigation strategies; 3) To identify adaptation strategies adopted by farmers as a consequence of climate change in the study area; 4) To scrutinize mitigation strategies practiced by farmers to reduce the negative impacts of climate change in the study area.

3. Methodology

3.1. Description of the study area

Konta Special District is one of the fourteen zones and four special Districts in the South Nations Nationalities and Peoples Region (SNNPR). It is located between 6º, 46'-7', 27'' North and 36º, 32'-36', 87'' East, and South Western part of Ethiopia. This area shares a boundary with Oromia Region in the North, Kaffa zone in the West, Dawro zone in the East, South Omo zone in the South and Gamo-Gofa zone in the Southeast. According to the CSA (2013) population projection, the total population of Konta special District was 115,898, of which 56,656 were male and 59,242 were female. Of this total figure, the rural inhabitants are 98,314 (84.8%) and the urban population make up 15.2%. The district has 4 towns and 42 rural kebeles. The livelihood strategy of rural people of Konta Special District is predominantly mixed agriculture (crop production and animal husbandry). In addition to this, farmers also engage

in activities such as petty trading, daily labour in agriculture, and handicrafts as a source of income (KDFED, 2016). Regarding the topographic conditions, 65% of the total area is mountainous, 15% is undulating and the rest (20%) is plain or flat. In relation to the agro-ecological conditions, Konta Special District is classified as wet Kolla (low altitude), Weyna Dega (mid-altitude) and Dega (high altitude) which accounts for 40%, 54% and 6% of the total area respectively. Data from Konta Special District early warning and food security division shows that the average annual rainfall and temperature of Konta Special District in 2017 was 1583 mm and 20°C respectively. However, it was 1749 mm, 18.95°C in the year 2009, which shows that rainfall, is decreasing, and the temperature is increasing.

3.2. Research design

This study employed a mixed research approach inorder to comprehensively address the main aim. The quantitative data collected include the socio-economic profile of respondents, the perceived factors of climate change, and the climate change adaptation mechanisms practiced by farmers in the study. The qualitative information gathered included the subjective experience and vulnerability to climate change of the framers, the likely perceived changes in climate change over time and the feasibility of the strategies to respond to climate change. Data was collected and analyzed concurrently. This study employed a cross-sectional research design to examine the views and practices of respondents regarding climate change adaptation and mitigation strategies. It examined the perception of farmers about climate change as well as the adaptation and mitigation strategies employed by farmers in 2018. However, in order to understand the change in climate, retrospective information regarding the trend in climate change was collected from elders and district officials.

3.3. Sampling and data collection methods

Since there was no single document, which contained all of the names of all of Konta District special zone farmers, multistage cluster sampling was used to select the sample. Since the livelihood activities and strategies adopted to respond to climate change are agro-ecologically sensitive in Ethiopia, agro-ecology is considered in the kebele[1] sample selection. Hence, kebeles in the District were classified into three based on agro ecology. Three kebeles were selected namely Cheka Bocha, Mareka Godi, and Konta Koysha. The sample was drawn from the total households of the three selected kebeles, which was 1219. Purposive sampling was used to select participants for the Focus Group Discussion (FGDs) and Key Informant Interviews (KII).

Using a sample size determination formula, the sample size of this study was set to be 301 farmers. The unit of analysis in this study was households and the respondents were household heads. The researchers administered the household survey questionnaire for 301 farmers but 5 questionnaires were incomplete. Therefore, information collected form 296 farmers was considered for this study. Purposive sampling was used to select participants for qualitative research. Judgmental sampling was used in order to select participants, which were considered knowledgeable about the issue under investigation. Accordingly, 5 key informants and 30 focus group participants were recruited. In addition to this, elders and household heads that have experienced climate change effects were interviewed.

3.4. Method of data collection

Methods of data collection involved a household survey, FGDs, key informant interviews and in-depth interviews. The survey was conducted with 296 heads of households regarding the perceived cause and consequences of the impacts of climate change and the practices of climate change adaptation and mitigation strategies. Structured questions were used to elicit the required information. Focus group discussion was employed to elaborate issues, which were not elicited from the survey. In addition to this, FGDs were used to understand the convergence and divergence of perceptions and personal experiences about climate change in the area. Experience of climate change effects, perception about climate change and its effects and possible strategies perceived to be effective were discussed. Three FGDs were conducted (one per each kebele sampled). The average number of participants was ten. On average, FGDs lasted for an hour. Data from respondents, key informants and FGDs were collected concurrently. Rural development and environmental protection experts, agricultural extension workers and kebele chairpersons were purposively selected as key informants for this study in order to reveal the practices and effectiveness of climate change adaptation strategies.

[1] Kebele is the lowest administrative unit in Ethiopia.

3.5. Method of data analysis

Quantitative data gathered from the sample households were analyzed by using descriptive statistics such as frequency, percentage, mean, and standard deviation, while, qualitative data were analyzed through content analysis. Data collected were categorized into some predefined codes such as perception of climate change, perceived consequences, and adaptation and mitigation strategies. Quantitative findings were triangulated with qualitative data. Quantitative data gathered from survey respondents were analyzed by using the Statistical Package for Social Science (SPSS) software version 20.0. A pretest was conducted to test the questionnaire before the actual data collection to check the consistency and logical flow as well as connections among the questions**.** This helped in refining questions that were found to be complex and less relevant. In addition, the instrument was shared among faculty members who are assumed knowledgeable about the research issue.

4. Results and discussions

4.1. Demographic and socio-economic characteristics of respondents

In this study 87.2% of respondents were male and 12.8% were female. The age of 27.7% of the heads of household was between 21 and 34 years, those aged between 34 and 60 years accounted for 65.9% of the respondents, and 6.4% were over 60. Regarding marital status, 89.9% were married, 6.1% were widowed, 2% were divorced and the remaining 2 % had never married (Table 1). Of the total sample, 42.2% of the household heads did not attend any formal education. Only 8% of the respondents stated that they can read and write. Some, 36.55% of the respondents attended primary education, 11.1% completed secondary education; while only 2.4% of the respondent attended education beyond the level of secondary.

Table 1. Demographic characteristics of the respondents (Source: Survey, April 2018)

Socio-demographic characteristics	Frequency (N=296)	Percentage
Sex of the respondents		
• Male	258	87.2
• Female	38	12.8
Age of respondents		
• Between 21-34	82	27.7
• Between 35-60	195	65.9
• Over 60	19	6.4
Marital status of respondents		
• Married	266	89.9
• Never married	6	2.0
• Divorced	6	2.0
• Widowed	18	6.1
Educational status of respondents		
• Cannot read and write	123	42.0
• Can read and write only	110	37.0
• Attended primary level (1-8)	33	11.0
• Attended secondary level (9-12)	24	8.0
• Above secondary	6	2.0

With regard to the livelihood strategies, all the respondents pursue mixed agriculture (crop production and animal husbandry); while, making handicrafts as a livelihood was used by only 5.5% and petty trading by 4.4%. Table 2, shows that only 3% of the respondents made their living from daily labor as an optional source of income in addition to agriculture. This result shows the limited possibilities for livelihood diversification among households in the study area. Diversification, if any, is within the types of agriculture practiced. Multiple response coding was computed for the various agricultural activities pursued by the respondents. Thus, 99.3% of the respondents indicated that they cultivated annual crops; while 94.3% grew a perennial crop and 91.6% of the respondents indicated that they practiced animal husbandry.

Use of the District report and qualitative data generated from FGDs revealed that the annual crops grow in the study area included *teff*[2], maize, wheat, barley, bean, and potato. Perennial crops produced in the area included, but were not limited to avocado, mango, banana, *enset*[3], and cassava.

[2]Also called eragrostis tef is a fine grain and staple grain in Ethiopia.

[3]It is a drought resistant herbaceous flower plant (also called Ethiopian banana).

Moreover, crops grown by irrigation were tomatoes, onion, and cabbage.

These results showed that the majority of the households in the study area practiced agricultural diversification rather than spreading their livelihood activities away from agriculture. Rain-fed agriculture was the dominant practice of rural households in which 67.6% of respondents used this; while the rest (31.8%) used both irrigation and rain-fed agriculture. Limited diversification across the sector (e.g. between farm and non-farm sectors) and dependence on a single factor and the vagaries of the climate, put farmers in developing countries at risk of the effects of climate change (BERHE ET AL., 2017). Since the majority of farmers depend on natural resources for their livelihood, a change in the climate adversely, affect their production pattern according to environmental protection experts.

Table 2. Economic activities of the respondents (Source: survey result, April 2018)

Socio-economic characteristics	Frequency (N=296)	Percentage
Livelihood activities*		
• Agriculture	296	100
• Petty trading	13	4.4
• Daily labour	9	3.0
• Handicrafts	17	5.7
Agricultural activities*		
• Annual crop	291	99.3
• Perennial crop	279	94.3
• Animal husbandry	271	91.6
Main agricultural practice		
• Rain-fed agriculture	200	67.6
• Irrigation agriculture	2	0.7
• Both rain fed and irrigation	94	31.8

* signifies multiple responses

4.2. Perceptions of farmers about climate change manifestations and consequences

The perceptions people have about climate change and its effects is important. Thus it is necessary to examine preparedness to mitigate for them and to reduce these impact. As indicated in Table 3, most (97.6%) of the surveyed farmers perceived that the climate is changing in their locality. When comparing the situation with the recent past, the majority of the respondents (69%) also perceived that climate was changing drastically. This point was supported by FGD participants who unanimously asserted that the change in climate is accelerating faster than ever. Respondents identified different indicators signifying climate change. Key informants mentioned that inter-generational climate variability is huge and significant. Participants identified change in rainfall pattern, increase in temperature, climatic zone change and consequent change in patterns of agricultural activities as manifestations of climate change.

Table 3. Perceptions of farmers about the occurrence and trends of climate change (Source: survey, April 2018)

	Question	Response	Frequency	Percent
1	Do you think the climate is changing in your locality?	Yes	289	97.6
		No	7	2.4
2	How do you perceive the extent of climatic change over the last ten years in the area?	I don't know	7	2.4
		Little change	90	30.4
		Significant change	199	68.9

Respondents indicated not only a change in climate but also mentioned that the change is significant. An elder (Age 62) said, "*We are witnessing a green desert*" indicating that temperature is increasing despite the vegetation cover in the area. Substantiating this assertion, 69% of survey respondents indicated that the pace of climate change is significant. As indicated in Table 4, a substantial percentage of respondents (97%) perceived the change of climate in terms of erratic rainfall distribution; while 96.3% of the respondents identified climate change by increasing temperature. Some 82.8% of the respondents perceived that climatic zone and consequent agricultural activities were due to changes in climate. A male FGD participant (Age 47) from Mareka Godi kebele

echoed this perception and articulated it as: *Climate is changing at a higher pace in our area. Before some ten years, we were more or less certain about the seasonal characteristics. We used to know what happens during the autumn; the winter, summer, and spring. Accordingly, we allocate our resources to make a living. However, nowadays, unexpected events are emerging and thus we are not certain about seasons. The vagaries of change in climate has affected the cropping calendar and labour allocation among farming communities the majority of which pursue rain-fed agriculture.*

This quote implies that distorted rainfall distribution directly affects the production plan according to extension workers. When analyzing meteorological data, DANG (2014) concluded that increased concentration of GHG due to climate change had raised the average temperature and altered the amount and distribution of rainfall, which was seriously affecting smallholder farming in developing countries. Similarly, ALAM ET AL. (2017) found that climatic change, such as a decline in the amount and abnormal distribution of rainfall, high temperatures and desiccating winds affect the productivity of farmers. FGD participants reported the ever-increasing temperature and associated occurrences of diseases such as malaria, maize fall armyworms, wheat rusts, expansion of the ecological niche of annual crops such as *teff*, haricot bean. According to the Konta district rural development expert, these crops were commonly identified with lowland agro ecology some ten years ago. In the past, crops grown in different agro-ecology were easily identified. Nowadays crops grown across agro-ecological conditions are changing due to climate change. Crops, which used to be grown only in lowland areas such as teff are also becoming common in the midland. Due to unpredictable climatic condition, participants were also reported to change their closing style frequently between warm and cold weather conditions, which become unusually, occur one after the other.

Table 4. Indicators of climate change manifestations (Source: Survey, April 2018)

Indicators*	Response	Frequency	Percent
Erratic Distribution of rainfall	Yes	287	97.0
	No	9	3.0
Increasing temperature	Yes	285	96.3
	No	11	3.7
Change in climate zone and consequent agricultural activities	Yes	245	82.8
	No	51	17.2

* signifies multiple responses

4.3. Perceived impacts of climate change in the study area

Respondents asserted that climate change induced problems are evident in their area. FGD participants stated that climate change is causing unbearable threats to human beings over time. As shown in Table 5, almost all (97.3 %) of the respondents believe climate change is exacerbating the vulnerability of the livelihoods of rural people. Hence, an increasing intensity of floods and landslides, drying of rivers and streams, the manifestations of new diseases and pests and recurrent drought were among the major threats of climate change mentioned by the respondents.

Key informants from the district environmental protection office mentioned that the study area is increasingly facing floods and landslides. Of the total sample, 82.8% perceived that frequent floods and landslides occurred in the area due to climate change; 77% of the respondents mentioned the drying of rivers and streams; 95% stated manifestations of new animal, human and plant diseases and pests, while 57.4% of the respondents witnessed recurrent droughts occurring in the last ten years due to climate change. The findings are consistent with the work of WAKO ET AL., (2017) who indicate that due to unfavorable changes in the patterns of climate a number of hazards are occurring and exposing people to the risks of livelihood vulnerabilities. This result is also in line with the discussions of AMARE & SIMANE (2018) which state that rural people are increasingly affected by climate change-induced hazards such as droughts, floods, pests, and diseases, landslides, erratic and heavy rainfall that affects the environment and their livelihoods.

Women FGD participants reported that decreasing availability of surface water not only affects the crop production and livestock development but it also compromises labour which otherwise could be deployed to livelihood activities. Women informants further asserted

that the distance to walk to fetch water is increasing because streams are drying. Most critically, different plants, animals and human diseases and pests including maize fall armyworms, wheat rusts, and tsetse flies are adversely affecting crops and animal production according to key informants. According to FGD participants, malaria, previously a commonly known disease of lowland area is now prevalent in middle altitude agro-ecology regions.

Table 5. Consequences of climate change (Source: Survey, April 2018)

Consequences of climate change*		Response	Frequency	Percent
1	Increased floods and landslides	Yes No	245 51	82.8 17.2
2	Drying of streams and rivers	Yes No	228 68	77.0 23.0
3	The occurrence of new diseases and pests	Yes No	284 12	95.9 4.1
4	Recurrent drought	Yes No	170 126	57.4 43.6

* signifies multiple responses

4.4. Farmers' opinions about causes of climate change in the study area

Belief about the causes of climate change plays a crucial role when adopting and practicing adaptation and mitigation measures to respond to climate change catastrophes. However, respondents unanimously asserted the occurrence of climate change, their arguments for the possible causes of the changing climate is not uniform. Fig. 1 presents the causes of climate change perceived by respondents. Accordingly, a substantial number (35.8%) of respondents considered climate change to be a curse from God or suffering from sin. Informants emphasized that the bad doings of the community were because nature was retaliating. About 27% of the respondents perceived that human beings were mostly responsible for the changing climatic conditions. Moreover, 26% and 11% of the respondents perceived that both human activities and natural changes were responsible for climate change respectively.

In recognition of the above data, most people in the study area considered climate change as the wrath of God or punishment for peoples' wrongdoings and human activity. This finding is not unique to this study. FENTAW (2013) found that most people in Ethiopia consider climate change to be a reaction of God to wrongdoings and a few people associated climate change with anthropogenic factors – such as deforestation, and the increased use of coal in industry. Regarding attributing climate change to God, FGD participants from Mareka Godi kebele loudly stated: 'Climate change is an act of God. The change of climate we are suffering is the Wrath of God which is due to our exploitative use of natural resources'. However, such perceptions are not part of the scientific explanations of the causes of climate change. On the other hand, Rural development experts and agricultural extension workers asserted that the understanding of climate change as a function of anthropogenic factors is growing.

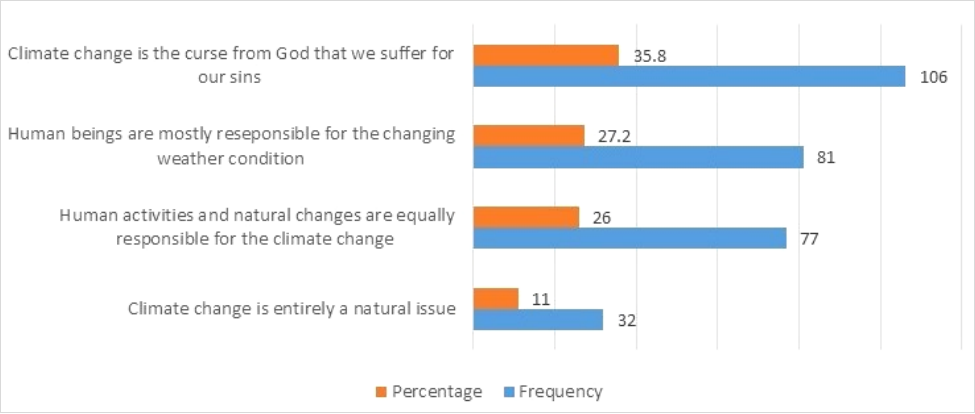

Fig. 1. Respondents' perceptions about the causes of climate change (Source: Survey, April 2018)

Other participants held the view that climate change is induced by anthropogenic factors. With reference to deforestation, one participant from Konta Koysha stated that: '… the mistake is ours; we human beings exploited our environment especially the natural forests without any limit. All of us want to maximize our benefit at the expense of the environmental gift'. In general, climate change is widely perceived to be a reality by different groups; various mixed causes were indicated some of which were different from the scientific explanation.

4.5. Ecological value perceived by respondents

Individuals' perceptions of the ecology are very important factors that influence climate change adaptation and mitigation strategies. Respondents' perceptions about the relationships between human beings and the environment were assessed. Table 6 presents the ecological views of the respondents. Thus, 77% of the respondents strongly perceived that humans are severely exploiting the environment to maximize their own ends. Moreover, 72% of the respondents strongly perceived that the population is increasing and has gone beyond the carrying capacity of the area. In support of the above data, 71.3% of the respondents believed that the balance of nature has been disturbed due to human intervention. Also, 70.3% of the respondents also believed that humans must live in harmony with nature in order to survive. In contrast, 96.6% of the respondents perceived that plants and animals exist primarily to be used by humans. In other words, this latter group of respondents supported the human centered paradigm, which puts human beings at the center of the analysis when considering the use of environmental resources.

Table 6. Ecological value perceived by respondents (Source: survey, April 2018)
5 Point Likert scale indicates 1= strongly disagree to 5= strongly agree

Statement	% Distribution					Mean	SD
	Strongly Disagree	Disagree	Un-decided	Agree	Strongly Agree		
Humans are severely exploiting the environment to maximize their earnings	4.1	9.1	9.8	59.5	29.7	3.8	0.98
The size of the human population is beyond the carrying capacity of the area	2.7	18.6	5.7	52.0	20.9	3.7	1.08
Humans must live in harmony with nature in order to survive	4.4	3.4	2.7	59.8	29.7	4.1	0.92
Human interference has affected the balance of nature	2.7	17.2	8.8	51.7	19.6	3.7	1.06
Plants and animals exist primarily to be used by humans	0	0	3.4	65.7	30.7	4.3	0.52

A key informant, an environmental protection expert, from the environmental protection and forest development office supported the positive ecological value of farmers: *The people of Konta have a strong attachment to the natural environment (for instance, they have a high value for the forest). Most people's livelihoods depend on the forest and forest products. However, due to factors such as population growth, people are forced to clear forests to expand farmland. Deforestation did not only cause environmental degradation but also removed the socio-economic, cultural and ecological importance of forest resources. The pro-environmental view would have complemented our efforts to conserve environmental resources through community mobilization.*

Table 6 shows that most of the respondents have pro-environmental views and they believe in the fact that human interference has endangered the balance of nature; 30% of the respondents asserted that human intervention was affecting the environment. On the other hand, a significant proportion of the respondents had the idea that nature exists primarily for human use and has no inherent value of its own. Because of this view, they did not acknowledge the independent existence of plants and animals. This indicates that utilizing resources is normal but people should respect the carrying capacity of nature. A woman (Age 59) from Cheka Bocha kebele indicated the outcome of the over-exploitation of natural resources over the last some decades as

follows: *Human beings have exploited forests and forest products unwisely. In our kebele, the land which was covered by forest during the Derg regime was changed to farmland. In addition to this, previously mountainous areas covered by vegetation were changed to farmland growing an annual crop. As a result, landslides and flooding have become frequent environmental problems: nature is retaliating for our previous actions. However, people have recognized these problems very late and are currently undertaking natural conservation activities such as terracing, planting trees and protecting natural forests.*

The views of farmers in the study area subscribe to the New Ecological Paradigm (NEP) which asserts that humans are only one of many species inhabiting the earth (HANNIGAN, 2006). NEP acknowledges the interdependency between environment and human society. In this regard, agricultural extension workers who were interviewed suggested a limit to population growth to keep the carrying capacity of the earth and to keep the balance of nature. FGD participants further asserted that human interference is endangering the balance of nature. In general, the result of this study on the ecological worldview of an individual shows a stronger pro-ecological worldview and stronger beliefs about human-nature interdependency in the study communities.

4.6. Perception of respondents about climate change adaptation and mitigation strategies

Prevailing climate change and its severe effects necessitates efforts to reduce the consequences globally. Not only do perceptions of climate change occurrence vary but also so do the views on the ways to deal with the change, with mitigation and adaptation. Perception of farmers towards climate change adaptation and mitigation strategies have paramount importance when practicing the strategies. With this in mind, the perceptions of rural people in the study area of the viability of the adaptation and mitigation strategies adapted from CRGE initiatives were assessed. Respondents were asked whether they believed the nationally initiated strategies were practical when responding to climate change induced problems.

Table 7. Perceptions of respondent towards climate change adaptation strategies (Source: survey, April 2018)

R. No	Do you think that the following strategies are feasible for responding to climate change effects in your area?	Response	Frequency*	Percent	Rank
1	Increased use of small scale irrigation	Yes No	215 81	72.6 27.4	3rd
2	Changing the cropping calendar of agricultural activities	Yes No	202 93	68.2 31.4	4th
3	Adoption of drought tolerant and early maturing crop varieties	Yes No	253 43	85.5 14.5	2nd
4	Diversification of off-farm (trade, daily labour, migrate to urban…) activities	Yes No	102 194	34.5 65.5	5th
5	Increased use of soil and water conservation (terracing, water harvesting, area closure, and etc.) technologies	Yes No	282 60	95.3 4.7	1st

* signifies multiple responses

As shown in Tables 7 and 8, most of the climate change response strategies presented for the respondents were perceived positively, though not uniformly. Strategies such as diversification of off-farm (trade, daily labour, migrate to urban…) activities and using fuel wood conservation (stove, solar panels and biogas) technologies are considered less viable strategies when compared to others. Diversification of off-farm (petty trade, daily labour, temporary migration to urban …) activities were perceived positively by only 34.5% of respondents. Key informants and FGD participants noted that diversification to off farm activities and using renewable energy sources demand financial and human capital which most smallholder farmers lack. In contrast, soil and water conservation (terracing, water harvesting, area closure, and etc.) strategies as an adaptation and/or mitigation strategy to climate change effects was perceived positively by 95.3% of the respondents. Among survey households, soil and water conservation was the most adopted adaptation strategy followed by expansion of agro-forestry.

Table 8. Perceptions of respondent towards climate change mitigation strategies (Source: survey, April 2018)

R. No	Do you think that the following strategies are feasible for respond to climate change effects in your area?	Response	Frequency*	Percent	Rank
1	Reducing expansion of agricultural land through agricultural intensification (conservation agriculture, compost usage, using productivity enhancement technologies)	Yes No	236 60	79.7 20.3	3rd
2	Improving animal productivity through breeding (reducing the local cattle population)	Yes No	194 102	65.5 34.5	6th
3	Diversification of small ruminant (sheep, goat, poultry) animals	Yes No	202 95	67.9 32.9	5th
4	Afforestation/reforestation (planting trees on communal and farm land)	Yes No	276 20	93.2 6.8	1st
5	Expansion of agro-forestry (mango, avocado, apple, development	Yes No	268 28	90.5 9.5	2nd
6	Increased use of fuel wood conservation (stove, solar panels, and bio-gas) technologies (mitigation)	Yes No	129 167	43.6 56.4	7th
7	Enhancing participatory forest management (using forest products efficiently, and expansion of economic activities in the forest)	Yes No	217 79	73.3 26.7	4th

* signifies multiple responses

Climate change adaptation and mitigation strategies are sensitive to resource availability. A model farmer said, "strategies suggested from government are helpful provided that we have resources and expert knowledge to implement them. However, smallholder farmers are pursuing survival livelihoods. Agricultural intensification, drought-tolerant crop varieties, improved animal breeding, and fuel wood conservation technologies require resources in terms of money but we have a shortage of these resources. As a result, we adopt strategies such as soil and water conservation that demand only our labour." Qualitative data elicited from FGDs and key informant interviews indicated that even though, people perceive small-scale irrigation as a crucial strategy to reduce the impact of climate change, their practice is minimal. According to participants, irrigation practices have been hampered due to the rugged topography of the study area. Corroborating this, rural development and environmental protection experts noted that though the district has many rivers and water springs, they were not yet developed for irrigation, which could have relieved the rural people from rain-fed agriculture.

4.7. Practices of climate change adaptation and mitigation strategies

In the previous section, the perceptions of farmers on the significance of each climate change adaptation and mitigation strategy in reducing climate change threats were assessed. Table 9 and 10 present the practice of each climate change adaptation and mitigation strategy by sample households. Similar to the perceived feasibility (Table 7 and 8), practicing soil and water conservation (terracing, water harvesting, area closure, and etc.) technologies was the most widely (94.6%) practiced strategy pursued by respondents (Table 9). The Ethiopian government has initiated soil and water conservation through community mobilization since 2011. On the other hand, fuel wood conservation (stove, solar panel, and biogas) technologies, was practiced by a smaller proportion of survey respondents (30.9%). In addition, 85.5% of respondents practice reducing the expansion of agricultural land through agricultural intensification such as conservation agriculture, compost usage, and use of productivity enhancement technologies. In fact, extensification, according to extension workers, was found less feasible in the study area due to high population density. Thus, cultivated land was used to the utmost according to agricultural extension workers. About 84.8% of respondents undertake agro-forestry like planting mangoes, avocadoes and apples in addition to annual crops.

Table 10 portrays that almost three quarters of respondents practiced afforestation/reforestation (planting trees on communal and farm land); while 59% practiced diversification of small ruminant animals. Regarding agro-ecological variations, all strategies presented in Table 8 (except diversification of off-farm activities and expansion of agroforestry development) were highly practiced in highland

(*Dega*) agro-ecology than in *Woyna dega* (midland) and *kola* (lowland). However, diversification of off-farm activities as an adaptation to the effects of climate change was practiced more in midland (*Woyna Dega*) kebele of the study area. Midland agro-ecology uses the advantages of both lowland and highland agro-ecologies according to key informants. Activities that were more feasible in highland areas such as diversification, and those pursued in lowland were commonly pursued in the midland agro-ecology. Soil and water conservation technologies, agricultural intensification, adopting new breeding and expansion of small ruminant animals were all practiced more in highland agro ecology compared to the midland and lowland areas. However, expansion of agroforestry development was practiced more in lowland agroecology due to climate suitability. Agricultural extension workers and the use of secondary data confirmed that lowland agro-ecological zones were more suitable for agroforestry plants such as mangoes and avocadoes than other agro-ecologies.

Table 9. Practice of climate change adaptation strategies (Source: Survey, April 2018)

R. No	Do you practice the following adaptation strategies on your farmland?	Response	Frequency	Percent	Rank
1	Increased use of small scale irrigation	Practice Do not practice	96 200	32.4 67.6	4th
2	Changing the cropping calendar of agricultural activities	Practice Do not practice	146 150	49.3 50.7	3rd
3	Adoption of drought tolerant and early maturing crop varieties	Practice Do not practice	169 127	57.1 42.9	2nd
4	Diversification of off-farm (trade, daily labour, migrate to urban …) activities	Practice Do not practice	57 239	19.3 80.7	5th
5	Increased use of soil and water conservation (terracing, water harvesting, area closure, and etc.) technologies	Practice Do not practice	280 16	94.6 5.4	1st

* signifies multiple responses

Table 10. Practice of mitigation strategies in the study area (Source: Survey, April 2018)

R. No	Do you practice the following mitigation strategies on your farmland?	Response	Frequency*	Percent	Rank
1	Reducing expansion of agricultural land through agricultural intensification (conservation agriculture, compost usage, using productivity enhancement technologies) (Mitigation)	Practice Do not practice	253 43	85.5 14.5	1st
2	Improving animal productivity through breeding (reducing local cattle population) (mitigation)	Practice Do not practice	112 184	37.8 62.2	5th
3	Diversification of small ruminant (sheep, goat, poultry) animals (mitigation)	Practice Do not practice	175 121	59.0 41.0	4th
4	Afforestation/ reforestation (planting trees on communal and farm land) (mitigation)	Yes Do not practice	219 77	74.0 26.0	3rd
5	Expansion of agro-forestry (mango, avocado, apple, development (mitigation)	Practice Do not practice	251 45	84.8 15.2	2nd
6	Increased use of fuel wood conservation (stove, solar panel, and bio-gas) technologies(mitigation)	Practice Do not practice	70 226	30.9 69.1	6th
7	Enhancing participatory forest management (using forest products efficiently, and expansion of economic activities in the forest) (mitigation)	Practice Do not practice	70 226	30.9 69.1	6th

* signifies multiple responses

Even though a large number of farmers who were surveyed noticed changes in climate and its impacts on their livelihoods, as mentioned earlier, the above results show that on average 66.9% of the respondents practiced less than three adaptation strategies from the list of adaptation strategies recommended by CRGE. On the other hand, the majority of farmers (67.6%) employed more than three mitigation strategies from the list. Nevertheless, the above result contradicts the

finding of ARBUCKLE ET AL. (2015) who stated that the majority of farmers pursue adaptation strategies rather than activities to reduce GHG, mitigation. Thus, farmers practice mitigation more than adaptation. A male household head (Age 42) from Cheka Bocha in FGD corroborated this finding by saying that: *We are living in the mountainous area, which is not favorable for cultivation. We have suffered from frequent erosion and landslides each year. We cannot recover from the devastation of climate change such as drought unless we took care before it happened. To mitigate this, we are planting trees on the hillside, undertaking soil and water conservation strategies on our farmland and enclosing hillsides for maintaining natural vegetation.*

This quotation shows that farmers were inclined to use mitigation strategies due to the topographic challenges of the area. Nearly 80% of the study area is mountainous and undulating (BoANRD, 2016). Complementing the survey results discussed above, qualitative data collected from FGD and key informant interviews picked some adaptation and mitigation strategies that farmers in the rural area locally employ as responses to climate change. More importantly, planting of *'Enset'*, a drought tolerant plant serves as food for humans and animals in times of drought, is considered an adaptation mechanism by the people of Konta as well as increasing the cultivation of root crops, including 'cassava' and practicing intercropping by the local community to adapt to the effects of climate change.

From the results of the practice of climate change adaptation and mitigation strategies, it is reasonable to conclude that positive intensions towards the strategies does not always mean putting the strategy into practice. Different factors, such as the ability to perform the intended activity, the perceived effectiveness of the suggested activity, in addressing the problem and the cost of performing an intended activity, may constrain the practice. Likewise, the mitigation of, and adaptation to, climate change is a two-step process which requires that a farmer's perception of climate change, its vulnerability and severity, is the first step followed by a response to the changes.

5. Discussion

The growing body of evidence shows the inevitability of climate change and its effects. The consequences of climate change are more pressing for communities who live on a livelihood activity which is sensitive to climate change effects and with low adaptation capacity (RAHMAN ET AL, 2010). The increasing scales of climate change impacts is worrying. This has necessitated adaptation and mitigation strategies (IPCC, 2014). However, farmers do not resort to practicing climate change adaptation and mitigation strategies. ASRAT & SIMANE (2018) argued that adaptation to climate change depends on a farmer's perception of climate change. In this study, farmers acknowledged the accelerating change in climate overtime and enunciated the adverse effects of climate change. Thought there is a difference in the respondents' subjective perception in the extent of the change in climate; respondents commonly asserted that that climate change has negatively affected their livelihood. The occurrence of diseases and the manifestation of pests were reported as the main indicators of climate change. A comparative study conducted in Ethiopia, Kenya, Tanzania and Uganda revealed that the perception of delayed rainfall, and observation of higher incidences of pests, and diseases are the main indicators of climate change in Eastern Africa (SHIKUKU ET AL., 2017). These factors make it difficult to eradicate poverty and compromise the ability to achieve food security.

Farmers who perceive the potential consequences of climate change are more likely to support policies and programs that aim to address it (ALAM ET AL., 2017). Belief about the causes of climate change play a crucial role in adopting and practicing adaptation and mitigation measures to respond to climate change catastrophes. Farmers who believe that climate change is occurring and due in large part to human activity are significantly more likely to support both adaptation and mitigation actions. Those who believe that climate change is happening and is mostly, or equally, anthropogenic in nature are associated with higher levels of agreement with the adaptation statements (ARBUCKLE ET AL. 2015). The perception of farmers about the causes of climate change is vital to the design of context specific strategies. In the study area, a significant proportion of the respondents attribute climate change to the wrath of God whilst equally recognizing the contribution of anthropogenic factors.

The findings of this study revealed that almost all of the respondents believe that climate change is happening and a substantial amount of respondents attach the causes of climate change with natural issues and as a curse from God. Importantly, when explaining the causes of climate change as a 'Wrath of God' farmers in the study area believe that the Curse of God is the

result of farmers wrong use of natural resources. The majority of the respondents asserted that they were over-exploiting natural resources. This implies that localities in the study area attach the causes of climate change indirectly to anthropogenic factors. Similarly, studies show that indigenous people with limited access to climate information are more likely to attribute changing climatic conditions, particularly extreme weather events, to a change in their rituals and cultural practices (DEBELA ET AL., 2015).

Not all strategies endorsed by governments are perceived feasible and practical. In addition to perceptions about climate change, several factors affect the practices of climate change adaptation strategies at grass root level. Among others, human capital and financial resources are vital (SHIKUKU ET AL., 2017). In the study area, farmers consider soil and water conservation as the most feasible strategy and is the most widely practiced. This might be due to a strong commitment by the government to initiate a green economy, which while mitigating the risks of climate change would increase the productivity of smallholder farmers. Farmers do not practice strategies, which they perceive were financially demanding and complex relative to their level of knowledge. Fuel wood conservation (stove, solar panel, and biogas) technologies were not applicable in the study areas because of the costs and complexity. In this regard ERENA & GEMECHU (2016) stated that the participation of farmers in the planning and application of adaptation options with a bottom-up approach is vital to achieve better climate change adaptation. Study households have adopted local adaptation strategies such as cultivating drought tolerant crops in order to reduce the effect of climate change.

6. Conclusion and recommendation

6.1. Conclusion

This study was conducted to assess the views and practices of climate change adaptation and mitigation strategies among farmers. The analysis of farmers' perceptions of climate change indicated that most of the farmers were aware of the manifestations of climate change and its consequent threats. Farmers perceived that the hazards of climate change have been adversely affecting their livelihoods. This is due to the case that, their livelihood activities heavily depend on rain- fed agriculture. Moreover, low occupational diversification has also exposed them to the risks of climate change. Additionally, the lack of access to non-farm and off-farm activities in the study areas seems to have constrained their capacity to have better livelihoods and has weakened the adaptive and mitigation capacities of smallholder farmers in times of erratic rainfall which triggers crop failure and poor performance of livestock production.

Even though farmers recognize climate change and its effect on a human being, their explanations of the causes of climate change are in contrast with the scientific explanation of the problem. They hardly associated climate change with global warming or greenhouse gas emissions, but did state deforestation as a cause. Almost 46.8% of respondents attributed climate change to a natural phenomenon and to the curse of God. These beliefs in the causes of climate change would have had negative effects in their engagement in adaptation and mitigation strategies. Hence, farmers who attribute climate change to natural phenomena and to the wrath of God are less likely to practice mitigation actions.

In the study localities, farmers have tried to avert the adverse effects of climate change and their variability by using different adaptation and mitigation strategies. Among the strategies, almost all of the sampled households mentioned that they practiced soil and water conservation technologies in communal areas, farmland and agricultural intensification. This might be due to the fact that the government of Ethiopia has undertaken environmental conservation awareness campaigns and rural community mobilization for soil and water conservation in the last eight years. This is believed to have enhanced productivity. Mitigation strategies are preferred and implemented in the study area. This is due to the fact that, farmers implement mitigation strategies such as raising small ruminants, agroforestry and agricultural intensification as common agricultural activities in addition to their responses to climate change. The positive ecological worldview of farmers towards human nature interdependency has its own contribution to peoples' mitigation strategies.

6.2. Recommendations:

The recommendations included here are presented as suggestions as to how initiatives on climate change could be more effective, particularly in the study area and generally in the country. Thus:

1) The study identified gaps that have policy implications. In terms of the perceptions of climate change, a need exists to narrow the

gap between scientific knowledge of climate change and farmers' understanding of the causes of climate change. So that, enhancing public awareness about the anthropogenic causes of climate change will open the way to address these gaps.

2) The findings of this study confirmed that the income of rural households is largely dependent on agriculture. Diversification of household income sources is also necessary to minimize exposure to the shocks of climate variability and change. Moreover, the findings revealed that farmers in the study area were inclined towards mitigation strategies. However, due to the cross boundary nature of climate change and its effects, synergies between adaptation to climate change and mitigation should, therefore, be actively promoted.
3) Lastly, the perceptions and practices of climate change adaptations and mitigation strategies were determined by socioeconomic factors. Some strategies are not affordable to farmers financial capacity and skills. So that, considering the socio-cultural feasibilities of the strategies with local people should be considered for better outcome.

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