ORIGINAL ARTICLE

PERCEPTION OF CLIMATE CHANGE AND ASSOCIATED FACTORS AMONG RURAL DWELLERS OF GONDAR ZURIA DISTRICT, NORTHWEST ETHIOPIA

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ABSTRACT

Introduction: *Climate change affects all countries, but the poorest countries of Africa are more vulnerable. Understanding the climate change perception of a community is vital for decision and policy makers to learn how and where to enhance the adaptation and mitigation capacity of peoples. Therefore, this study aimed to assess the perception of climate change and associated factors among households in Gondar Zuria district, northwest Ethiopia.*
Methods: *A community based cross sectional study was conducted from March 23- April 27, 2015. A total of 427 household heads were selected using the systematic random sampling method. An interviewer-administrated questionnaire was used for collecting data. Bi-variable and multivariable binary logistic regressions were used to identify factors associated with the perception of climate change.*
Result: *Of the 427 participants, 58.5% (95% CI: 54%, 63%) perceived the causes and effects of climate change. Those who had good knowledge about the cause and effects of change (AOR 1.8, 95%CI: 1.04-3.20), could access information about it (AOR 6.80, 95%CI: 4.1-11.9), and people engaged in mixed occupation (AOR 2.9, 95%CI: 1.22-7.13) were positively associated with the perception of the change. Besides, better wealth index and farming experience also had a positive association with the perception of climate change.*
Conclusion*: More than half of the household heads had the perception that climate was changing over time. Knowledge about climate change, farming experience, wealth index, access to climate change information and occupation had a significant association with perception. Public enlightenment should be raised vigorously on climate change using the mass media.*

Keywords: *Associated factors, climate change, perception, northwest Ethiopia.*

INTRODUCTION

Climate change refers to any change in climate over time due to natural variability or human activities (1-3). The main indicators of climate change are changes in rainfall patterns and the temperature (4, 5). Climate change influences human health through the impacts of climate on water, food security, human settlements and population movements. The impacts of climate change will change the occurrence and spatial patterns of vector- and water-borne diseases. (6).

Climate change has emerged as a major scientific, developmental and political issue globally. It affects all countries, but the poorest countries of Africa are more vulnerable (7). The world Health organization (WHO) estimated that more than 60,000 deaths globally were due to climate-related natural disasters every year (8). Ethiopia is one of the countries vulnerable to climate change with losses of human lives (1, 9). The average annual mean minimum temperature throughout the country indicates an increase of 0.37^{o}C every decade with a projected increase of

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between 0.9 and 1.1 °C by the year 2030(9). As a result of such climatic changes, increasing frequency and intensity of drought has been presenting a serious threat to rural farming communities (10).

Studies indicate that unless adequate measures are taken to cope with the impacts of climate change, there will be a predicted loss of 2-7% of the gross domestic product (GDP) by 2020 in parts of Sub-sahara Africa, 2-4% in west and central Africa, and 0.4-1.3% in northern and southern Africa (11).Understanding the climate change perceptions of communities is vital for decision and policy makers to learn how and where to enhance the adaptation and mitigation capacity of peoples (12).

Various studies conducted abroad and in Ethiopia on the perception of the various indicators of climate change showed different figures. Accordingly, studies conducted in Kenya and India showed that 100% of the farmers were aware (4) and 73% had perception of(13)climate change, respectively. Studies in Bangladesh and Nigeria revealed that 89% and 58% of the respondents, respectively, perceived decreasing rainfall over time(14, 15). Furthermore, 91% in Bangladesh (14), 53.4% in Nigeria (15), a large number in Pakistan (16), and 86.7% in the upper catchment of the Blue Nile, Ethiopia,(17) perceived increasing temperature.

Different factors were identified as associated with the perception of climate change. These include age, sex, education, occupation, monthly family income, accesses to climate change information, and farming experience (18-20).

Though some studies have been conducted on climate change perception in various parts of Ethiopia, (1, 17,21),there has been only limited evidence on the perception of the causes and effects of the change of the country. Hence, this study aimed to assess the perception of climate change and associated factors among rural household heads in Gondar Zuria district, northwest Ethiopia.

METHODS

Study setting and population: A community-based cross sectional study was conducted from March to April 2015 in Gondar Zuria district, northwest Ethiopia. The district had 236,612 projected population in the year 2015. The average annual rainfall ranged between 840 and 1220 mm with the average annual temperature between 20 and 26°C.

All heads of households permanently living in Gondar Zuria district were the source population. Heads of households in the selected kebeles were the study population. Head of households who were permanently living for 10 or more years in the kebeles were included in the study. Households whose heads were aged <18 years were excluded.

Sample size and sampling procedure: A total of 427 heads of households were computed using the single population proportion formula with an assumption of 85.2% of perception on climate change (17), 95% level of confidence, 5% margin of error, a design effect of 2 and 10% non-response rate. Two stage sampling methods were employed. Firstly, seven of the 38 *kebeles* were selected randomly. Secondly, households in such kebeles were selected using the systematic random sampling procedure. Finally, samples were proportionally allocated to the selected *kebeles* in proportion to their inhabitants.

Data collection methods: A pre-tested and interviewer-administered structured questionnaire was used. The interview was conducted by trained data collectors. Household perception of climate change was assessed based on five scale responses of 24 (3 general perception of the climate, 6 on causes of climate change, 13 on effects of climate change and 2 on adaptation to climate change) items. The items

were weighted 1 to 5 where 1 = strongly disagree and 5 = strongly agree.

Variables in the study: The dependent variable was perception of climate change (had perception versus had no perception) about climate change, whereas independent variables were socio-demographic (sex, age, educational status, farming experience, wealth index, occupation, access to climate change information, knowledge about climate change, and access to climate change information (presence and absence of television, radio).

Data management and analysis: Data were entered using Epi- info version 7 and exported to SPSS version 16 for analysis. The "no opinion" responses rated "3" on the Likert scale were rerated "zero". Respondents with scores greater than or equal to the mean were taken as having perception of climate change, while those who scored below the mean were regarded as having no perception (22).

A score of "1" was given to "Yes" and "zero" to "No" with14 questions of knowledge. Household heads scoring greater than or equal to the mean were regarded as having "good knowledge" while those who scored below the mean were classified as having "poor knowledge" about climate changes (1). Wealth status of respondents was determined by different assets data using the principal component analysis.

Both bi-variable and multivariable binary logistic regressions were applied to determine the associations of different independent factors. Variables which had associations with the dependent variable at p-values < 0.2 were entered into the multivariable logistic regression for controlling possible confounding effects. Finally, the variables were taken as significant by considering a 5% level of significance. Adjusted odds ratio (AOR) with its respective 95% CI was reported to measure the strength of the association.

Ethical considerations: Ethical approval was obtained from the University of Gondar Institutional Review Board (IRB). Oral informed consent was obtained from each respondent after explaining the rationale of the study to respondents.

RESULT

Characteristics of participants: Out of the 427 household heads, 407 completed the questionnaire with a 95.3% response rate. The median age of the participants,317 (77.8%) of whom were male, was 45 (IQR: 35-53) years. About 348 (85.5%) of the participants were married; 367(90.2%) were Orthodox Christian; 289(72.0%) were literate; 330(81.1%) were farmers, and 324(80%) had more than 15 years of farming experience **(Table 1).**

Knowledge and source of information on climate change: Of the respondents, 288 (70.2%) had good overall knowledge about climate changes; 372 (91.4%) knew drought could have relations with deforestation, and 330 (81.1%) knew that climate changes could cause diseases to humans (Table 2).The radio was reported as the major source of climate change information for 267(65.6%) of the participants (Figure 1).

Table 1: Socio-demographic characteristics of participants in Gondar Zuria district, northwest Ethiopia, 2015

Characteristics	Frequency	%
Age (years)		
18 – 30	55	13.5
31 – 40	117	28.7
41 – 50	116	28.5
51 - 60	70	17.2
> 60	49	12.1
Sex		
Male	317	77.8
Female	90	22.2
Religion		
Orthodox	367	90.2
Muslim	39	9.6
Protestant	1	0.2
Marital status		
Single	30	7.4
Married	348	85.5
Divorced	16	3.9
Widowed	13	3.2
Educational status		
Cannot read and write	111	27.8
Can read and write	214	53.5
Primary and above	75	18.7
Occupation		
Farmer	330	81.1
Mixed*	77	18.9
Farming experience (years)		
1 – 15	83	20.4
16 – 30	146	35.9
31 –45	64	15.7
46 - 60	39	9.6
> 60	75	18.4
Wealth status		
Very poor	110	27.5
Poor	122	30.5
Rich	90	22.5
Very rich	78	19.5

** -merchant and farmer*

Table 2: Knowledge of household heads about climate changes in Gondar zuria district, Northwest Ethiopia, 2015 (n=407)

Knowledge variables	Frequency (%)	
	Yes	No
Have you heard of the word "climate changes" before?	348(85.5)	59(14.5)
Do you know what "climate changes" mean?	328(80.6)	79(19.4)
Do you know the cause of climate changes?	318(78.1)	89(21.9)
Do you know the effect of climate changes?	321(78.9)	86(21.1)
Do you know environmental laws and regulations?	291(71.5)	116(28.5)
Do you know that drought is related to deforestation?	372(91.4)	35(8.6)
Do you know that temperature is related to air pollution?	350(86.0)	57(14.0)
Do you know that rainfall is related to climate changes?	349(85.7)	58(14.3)
Do you know that flooding is related to worth of God?	325(79.9)	82(20.1)
Do you know that human disease is related to climate changes?	330(81.1)	77(18.9)
Do you know that agricultural productivity is related to climate changes?	363(89.2)	44(10.8)
Do you know that river drying is related to climate changes?	363(89.2)	44(10.8)

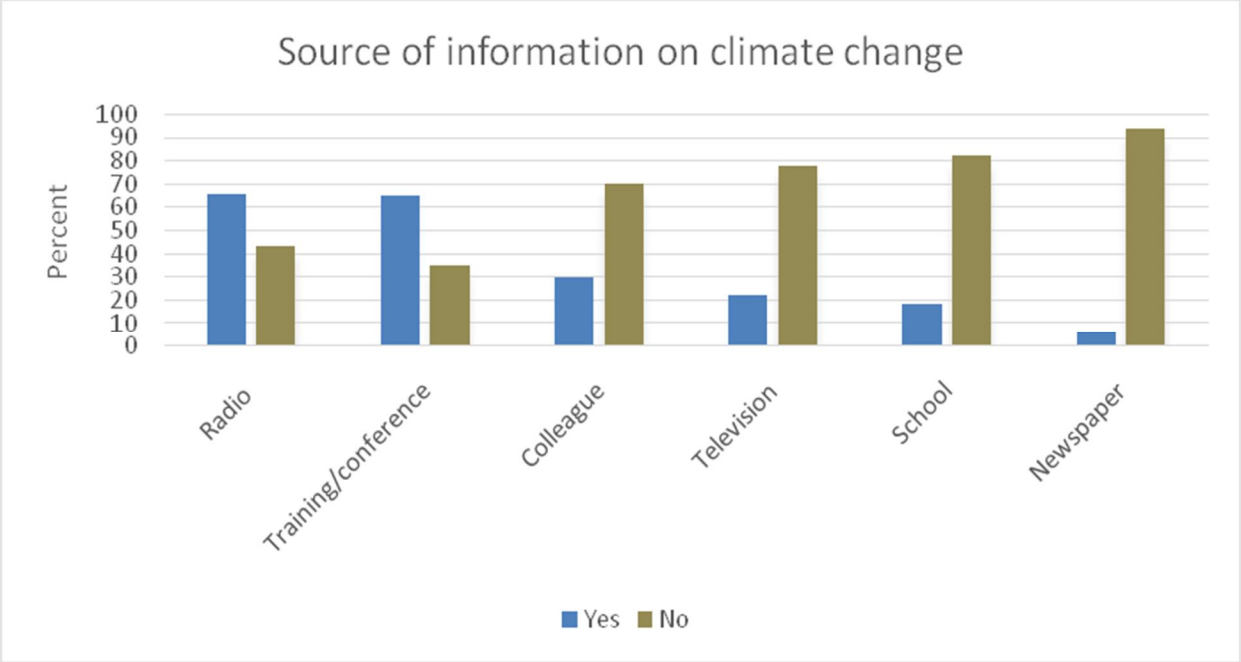

Figure 1: *Source of information about climate changes among Households in Gondar Zuria district, northwest Ethiopia,*

Overall perception about climate changes: About 58.5% (95% CI: 54%, 63%) of the household heads had perception that there were climate changes. About 78.87% had perception about the rise of temperature, while 77.89% that there was change in rainfall**.**

Of the household heads, 255(62.7%) and 295(72.5%) understood that the emerging human and animal diseases and dry up of rivers and streams were major indicators of temperature changes, while 291(71.5%) and 279(68.6%) stated that the late coming of rain fall and the decline of agricultural yields were the main results of rainfall patterns over time in the last two decades **(Table 3).**

Table 3: Indicators of temperature and rain fall pattern changes according to household heads in Gondar Zuria district, Northwest Ethiopia, 2015

Indicators	Frequency	%
Temperature change indicators		
Newly emerging human and animal diseases	255	62.7
Newly introduced plant and animal species	157	38.6
Changes in clothing styles	253	62.2
Dry up of rivers and streams	295	72.5
Habitat shift towards higher locations	167	41.0
Damage of crops by pests	219	53.8
Rainfall pattern indicators		
Loss of some animal and plant species	204	50.1
Increased drought frequency	267	65.6
Increased flood frequency	260	63.9
Crop growing period shortened	244	60.0
Rainfall comes early	272	66.8
Rainfall comes late	291	71.5
Decline of agricultural yields	279	68.6
Decreased available water	209	51.4

Perception of causes and solutions of climate changes: Of the total respondents, the majority agreed that human activity was responsible for climate change, followed by natural factors **(Figure 2).** Deforestation by human action was reported as a major cause of climate change by 369(90.7%) of the household heads **(Table 4).** Reforestation and family planning were reported as the main perceived solutions of climate changes according to 346 (85.0%) and313 (76.9%) of the respondents, respectively.

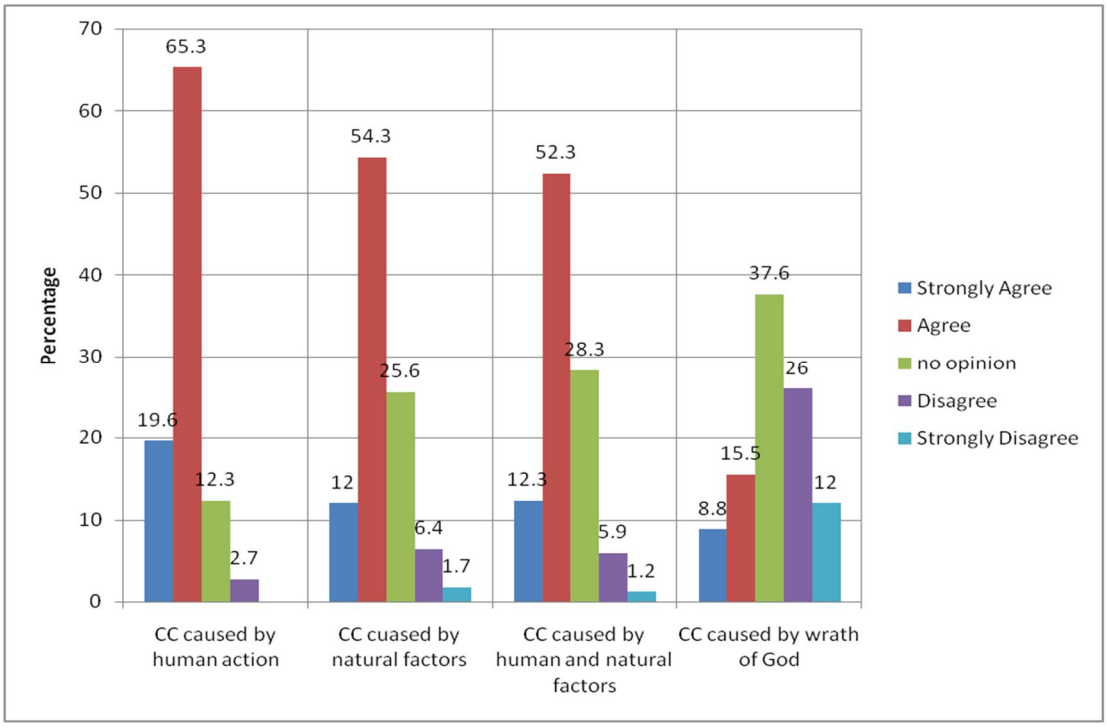

Figure 2: *Respondents' rating of the causes of climate changes in Gondar Zuria district, Northwest Ethiopia, 2015*

Table 4: Perceived human actions as causes and possible solutions of climate changes by households in Gondar Zuria district, Northwest Ethiopia, 2015.

Variables	Frequency	Percent
Perceived human actions as a cause of climate changes		
Over cultivation	240	59.0
Overgrazing	259	63.6
Deforestation	369	90.7
Forest Fires	318	78.1
Using Agrochemicals	149	36.6
Population pressure	271	66.6
Use of fossil fuels	159	39.1
Poor industrial practices	117	28.7
Solid and Liquid waste	112	27.5
Air pollution	111	27.3
Transportation (vehicle emissions)	72	17.7
Perceived possible solutions of climate change		
Reforestation	346	85.0
Enhance irrigation	233	57.2
Use of organic manure	240	59.0
Stops cultivation of sloppy area	259	63.6
Soil and water conservation	299	73.5
Family planning	313	76.9
Rainwater harvesting	172	42.3
Change in cropping pattern	172	42.3
Diversified income	131	32.2
Growing short maturing crops	193	47.4

Respondent perception of climate change effects: The majority of the respondents,85.5%, 82.0% and 81.5% perceived that climate changes had effects on sustainability, human health and direct impacts on them, respectively. **Figure 3).**

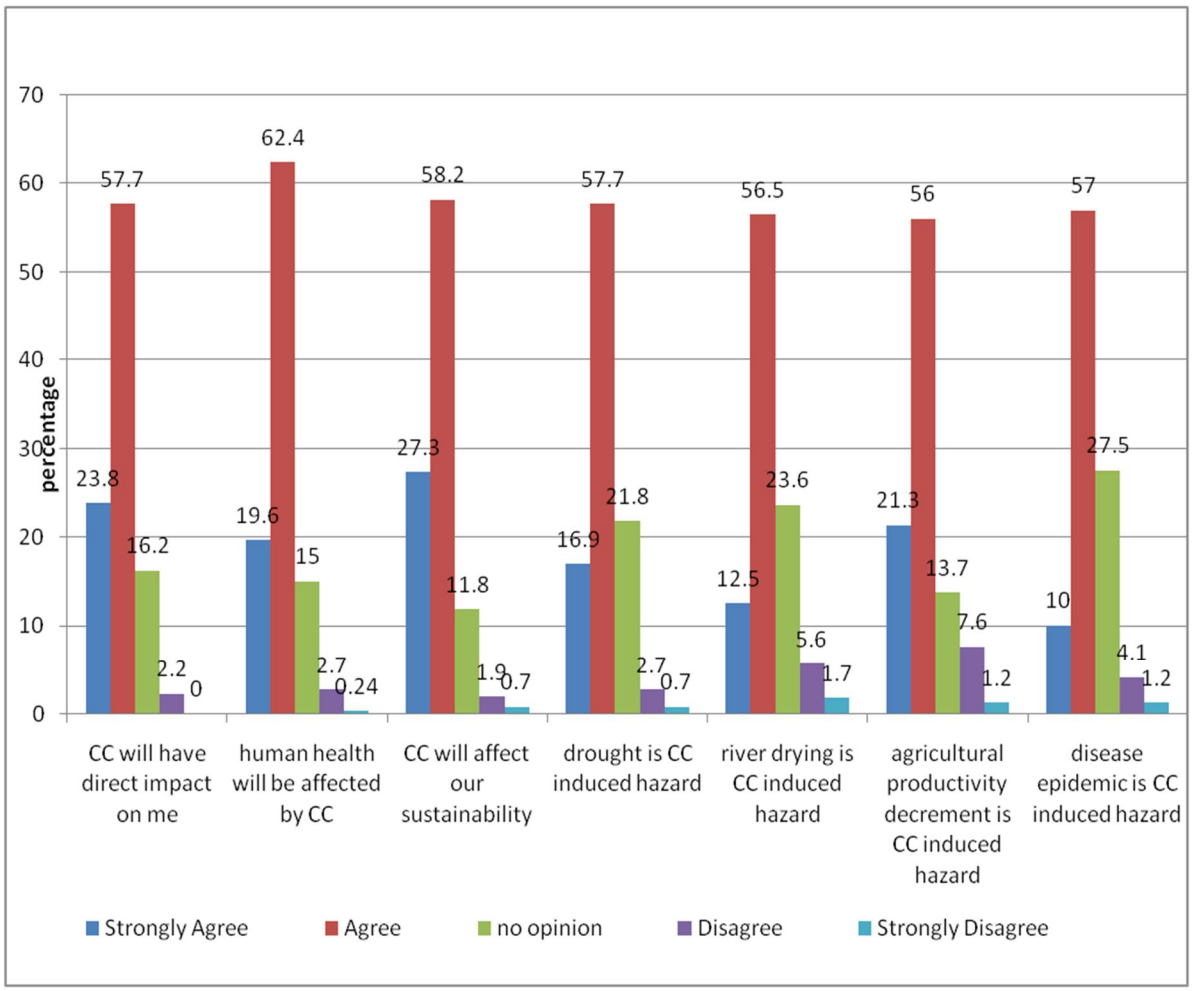

Figure 3: Respondent rating of perceived climate change effects on households of Gondar Zuria district, Northwest Ethiopia, 2015

Associated factors of perception of climate changes: Overall knowledge, household wealth index, access to information, farming experience and respondent occupation were significantly associated with the perception of climate changes at 5% level of significance (Table 5).

The odds of having perception on climate changes among household heads with good knowledge of climate changes were 1.8 [OR: 1.8, 95% CI: 1.04-3.20] times higher than those of respondents who had poor knowledge of climate changes. The odds of having perception of climate changes among study participants which farming experiences of 16-30, 31-45, 46-60 and above 60 years were 1.5[OR:1.51, 95% CI: 2.46-24.80], 2.6 [OR:2.61, 95%CI: 1.10-2.28], 4 [OR: 4.0, 95% CI: 1.91-8.60] and 7.8 [OR:7.8, 95% CI: 2.46-24.8] times higher, respectively, than those who had short (1-15years) farm experience.

The wealth of households had a positive impact on

climate change perception. The odds of having perception on climate changes among poor, rich and very rich were 2 [OR: 2.0, 95% CI: 1.03-3.7], 3.6 [OR: 3.61, 95% CI: 1.7-7.50], and 7 [OR: 7.4, 95% CI: 3.30-16] times higher than those of respondents who had very poor wealth, respectively.

The odds of having perception on climate changes among participants who had access to climate information, like radio receivers and TV sets were 6.8 [OR: 6.8, 95% CI: 4.10-11.90] times higher than those of their counterparts. With regard to occupation, the odds of having perception on climate changes among respondents with mixed occupations were 2.9 [OR: 2.9, 95% CI: 1.22-7.33] times more likely compared to farmers.

Table 5: Factors associated with the perception of climate changes in Gondar Zuria district, Northwest Ethiopia, 2015

Variables	Had perception towards climate change		Odds Ratio	
	Yes	No	COR(95%CI)	AOR(95%CI)
Overall knowledge				
Poor	53(13)	66(16.3)	1	1
Good	185(45.4))	103(25.3	2.2(1.4, 3.4)	1.8(1.0, 3.2)*
Wealth index				
Very poor	44(10.8)	66(16.3)	1	1
Poor	65(16)	57(14)	1.7(1.0, 2.8)	2.0(1.0, 3.7)*
Rich	63(15.5)	28(6.9)	3.4(1.8, 6.0)	3.6(1.7, 7.5)*
Very rich	66(16.3)	18(4.4)	5.50(2.8, 10.5)	7.5(3.3, 16.0)*
Respondents access to CC information				
No	51(12.5)	104(25.5)	1	1
Yes	187(45.9)	65(16)	5.9(3.8, 9.2)	6.8(4.1, 11.9)*
Farming experience (in years)				
1-15	29(7.1)	54(13.1)	1	1
16-30	19(4.6)	20(5)	1.8(0.8, 3.8)	1.51(2.5, 24.8)*
31-45	48(11.8)	27(6.6)	3.3(1.7, 6.3)	2.61(1.1, 2.3)*
46-60	96(23.6)	50(12.3)	3.6(2.0, 6.3)	4.0(1.9, 8.6)*
>60	46(11.3)	18(4.4)	4.8(2.3, 9.6)	7.8(2.5, 24.8)*
Respondents occupation				
Farmer	189(46.4)	143(35.1)	1	1
Mixed	49(12)	26(6.4)	1.4(0.8, 2.4)	2.9(1.2, 7.1)*

**= P-value ≤ 0.05, COR=Crude odds ratio, AOR=Adjusted odds ratio, CI=Confidence interval*

DISCUSSION

In this study, more than half of the respondents perceived the trends, causes and effects of climate changes. Knowledge, wealth status, accesses to climate changes information, farming experience, and occupation were identified factors for perception of climate changes.

The level of perception in this study was less than that in Nigeria (89.4%)(23). The reason for this difference could be lack of information access and level of awareness. Of the respondents, about three-fourths had perception that temperature had been increasing**.** This result was consistent with the findings of studies done in Nigeria (73 %) (23)and 86.7% in Ethiopia (Nile basin)(21). Analysis using 49 years of temperature and rainfall data in north central Ethiopia revealed that there had been increasing trends of maximum temperature (24).

Besides, in this study a substantial percentage (77.89%) of the respondents had perception of the change in the rainfall patterns. Studies in India, Nigeria and Kenya supported this result that peoples perceived changes in the quantity of rainfall and/or distribution over the last 30 years (12, 13, 22). In Ethiopia, the average minimum and maximum rainfall had a general tendency of decreasing by a very high level of variability over the past 50 years (9, 24).

Considering the issues of climate change, 65.3% of the respondents agreed that the climate had been changing over the years due to human activities. The result was comparable with that of study in South Africa were 70% of the respondents agreed that humans were causing climate changes(25). Around 90 and 66% of the respondents revealed that deforestation and population pressure were the main human causes of climate change in the study area, respectively. But they gave little credit (28.7%) to poor industrial practices, 36% to agro chemicals and 17% to vehicle emission due to transportation. A study conducted in Kenya and Nigeria also showed that the main causes of climate change included deforestation, overgrazing of farm lands, liquid waste and air pollution from automobile exhaust (4, 22). This is due to the fact that the environment has been changing over the years because of human activities, such as farming, deforestation either by cutting down of trees for fuel, roofing, farmland extension, furniture, overgrazing, bush burning, urbanization and industrialization.

About eight in ten respondents perceived that health was affected by climate change induced hazards. The finding was supported by different studies conducted in Ethiopia (Oromia), Nigeria and Bangladesh (1, 21, 26). Climate change has enormous impacts on population health (27), and will worsen unless efforts are made to curb the emission of greenhouse gases into the atmosphere (28). Health and wellbeing are affected in several ways because of increasing the distribution and transmission of several vector borne infectious diseases and diseases caused by severe floods and droughts as well as losses in food production, biodiversity and ecosystem functions (27).

In this study, more knowledgeable people as well as respondents with access to climate change information could easily perceive and recognize climate change. A consistent result was noted in studies conducted in the upper catchment of the Blue Nile and the Nile Basin (Ethiopia)(17, 21) and Zimbabwe (29). This finding was also supported by a systematic review conducted on Sub-saharan Africa (19).This might be due to the fact that the mass media play an important role in climate change information.

This study showed that experienced respondents tended to perceive changes in climate more than

those with less farm experience. This result was consistent with that of another studies (17, 19, 30).Respondents with mixed occupations had more perception on climate change than just farmers. This could be explained by the fact that people have better opportunities to communicate and share ideas on climate change during engagements in mixed activities than HH practicing farming only. The wealth of households had a positive impact on climate change perception. This result was consistent with the findings of studies showing that wealth had a significant effect on farmers' perception of climate changes(17, 21). That is because wealthier farmers tend to have better access to information and technology (31).

As a limitation, recall bias could not be ruled out in this study as respondents were asked to recall perceptions on climate change trends.

CONCLUSION

More than half of the household heads in the study area had perception that climate was changing over time. Variables, including respondent climate change knowledge, farming experience, wealth index, access to climate information and occupation had significant associations with the perception of climate changes. Therefore, public enlightenment should be raised vigorously on the causes and effects of climate changes using the mass media, such as the radio and TV which play an important role in the dissemination of climate change information.

Abbreviations: AOR: Adjusted Odds Ratio; KAP: Knowledge Attitude and Practice; CC: Climate Change; CI: Confidence interval; HH: Household head; NAPA: National Adaptation Program of Action; OR: Odds ratio; UNEP: United Nations Environment Program; WHO: World Health Organization

Declaration

Consent for publication: Not applicable.

Availability of data and materials: The data could be obtained upon reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Author's contributions: All authors participated equally on the conception, design, data collection, analysis and interpretation. The manuscript preparation was done by GD, KFM and KA. All authors read and approved the final manuscript.

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