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Rural household perception and adaptation strategies to climate change and variability: in the case of Libo-kemkem Woreda, Ethiopia

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Abstract

Studying Libo-kemkem Woreda households' perceptions and responses to climate change and variability was the primary focus of this study. A cross-sectional and primary data collection method was used in this study to address its main objective. Based on stratified and straightforward random selection methods, 216 rural households were selected for the study. Through the household survey, data was collected on perceptions of climate change, variability, and adaptation methods. To analyze the collected data, beta regression models, F-tests, and chi-squared tests were employed. The results showed that only 3.2% of respondents did not recognize the occurrence of climate change or variability, which means that 96.8% of respondents are aware of the phenomenon. According to the sample of respondents, temperatures grew by 91.9% and rainfall decreased by 88.8%. A total of 96.2% of the respondents noted that rainfall distribution was uneven in the study area. A survey revealed that almost 96.7% of respondents said climate change negatively impacts agriculture, animal output, water quality, and epidemic disease outbreaks. Additionally, the model showed that, rather than respondents' ages, factors like educational attainment, income earned on and off the farm, farm size, access to extension services, and weather information impacted climate change adaptation measures statistically significantly and favorably. Policymakers, woreda agricultural offices, and development staff need to take statistically significant factors into account when developing and implementing adaptation plans for climate change and variability.

Keywords: Adaptation strategies, Climate change, Climate variability, Perception

Introduction

Ethiopia is one of the most populated nations in Africa, which demonstrates a particular vulnerability to climate change and fluctuations (Hamza and Iyela 2012). As a result of a comparatively insufficient ability to withstand the shocks resulting from such events, Ethiopia and its people risk losing out on the benefits earned by its spectacular economic progress (Fikreyesus et al. 2014). In the article, it is noted that impoverished households lack adequate coping mechanisms and often sell off their meager possessions to feed their families. With effects on their livelihoods still discernible years after major weather catastrophes like the Great Famine of the 1980s, these asset-poor households also struggle with recovery (Shepherd et al. 2013).

The country has created a Climate Resilient Green Economy Strategy (CRGE) in response to a changing climate to sustain its development objectives (Fisher 2013). The government is creating an impressive portfolio of public policy responses to address climate variability and change and take advantage of the opportunities provided by climate change policies, such as access to climate finance, technology, and capacity-building measures, in order to achieve its goal of becoming a middle-income country before 2025 (Fikreyesus et al. 2014). Additionally, this study is in line with goals for Ethiopian public

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Megabia *et al. Environmental Systems Research*   (2022) 11:23

Page 2 of 10

policy. The adoption of adaptation strategies by farmers is impacted by a number of variables, not just perception. Adaptation to climate change takes place in a variety of social, economic, technological, and biophysical contexts across time, geography, and industry (Smit and Pilifosova 2016).

Additionally, in developing nations, notably in Ethiopia, where vulnerability is high, adaptation is crucial and required. The effects of climate change have an influence on the livelihoods and living conditions of the majority of people (Mikulewicz 2018). Farmers that are more knowledgeable about agronomic techniques and climate change are better equipped to apply adaptation strategies to deal with changing weather patterns and other socioeconomic factors (Nhemachena et al. 2014). Adaptation tactics are improving direct attempts to combat the effects of climate change. The effects of climate change on Ethiopian agriculture have been studied (Masud et al. 2017), and they identified potential adaptation measures for coping with the negative effects of climate change on crop and livestock production, but they did not mention the factors that guide the choice of adaptation measures.

The world's societies are currently facing their greatest environmental challenge due to climate change (Seles et al. 2018). Even if their contribution to the change was negligible, the poorest nations and people would suffer the most. Since these nations' economic operations are mostly dependent on climate-vulnerable natural resources (Dube et al. 2016). Similar to other parts of the world, climate and ecological changes brought on by global warming have had a number of detrimental effects on people's health, economies, and way of life (Eriksson 2008). Agriculture in Ethiopia is heavily dependent on rain and geographical location and topography, plus a low adaptive capacity, make the country highly vulnerable to the adverse impacts of climate change (Gebregziabher et al. 2011). Therefore, given its reliance on a livelihood system largely influenced by the environment, Ethiopia, and specifically Libo-kemkem woreda, cannot be an exception.

Climate change and variability, their causes and effects, and the necessary response mechanisms to cope with climate disasters are critical for any population in a given community (Bewket and Alemu 2011). As Amare (2018) explained, climate change adaptation is an important part of societal responses to climate change impacts. But, adaptation strategies vary within communities and even among individuals (Legesse et al. 2013; Temesgen et al. 2011) because local people have a range of adaptation strategies to cope with climate change and variability impacts. The knowledge of climate change perception and adaptation strategies could play a significant role in influencing policymakers (Marie et al. 2020).
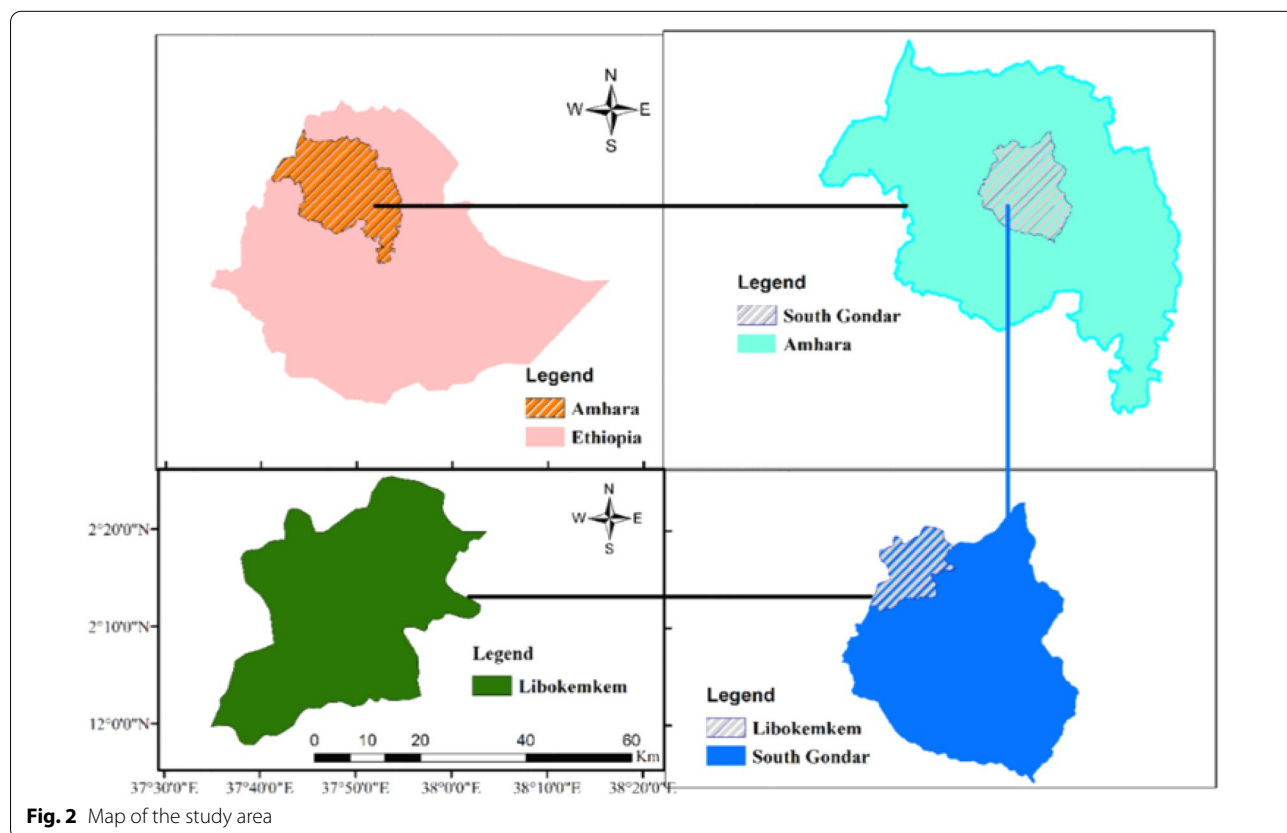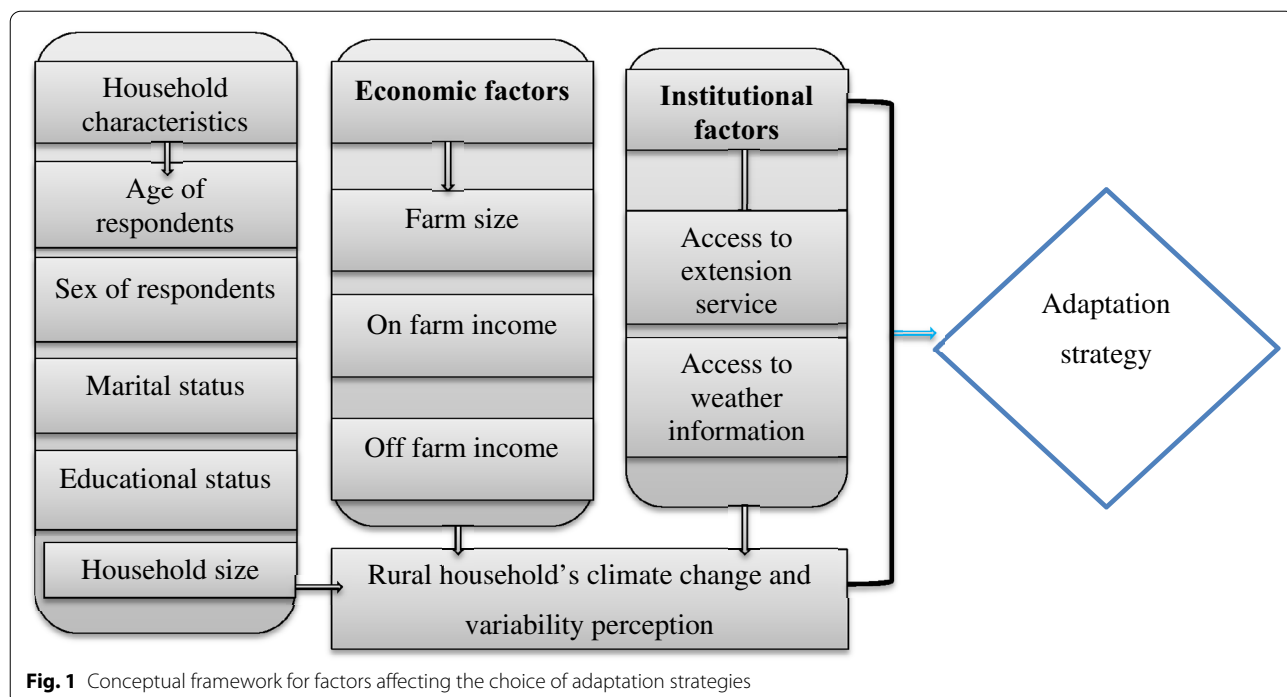
The majority of previous studies applied the multinomial logit model to analyze factors affecting the choice of climate change and variability adaptation strategies (Atinkut and Mebrat 2016; Ojo and Baiyegunhi 2020; Asfaw et al. 2019). The multinomial logistic model assumes that a farmer chooses exactly one adaptation strategy, though a farmer may choose more than one adaptation strategy at a time (Tesfaye and Seifu 2016). The findings of previous studies vary within and across societies due to the heterogeneity of factors faced by smallholder farmers (Kabiti et al. 2016). Additionally, perceptions of climate change and variability and adaptation strategies are location-specific (Temesgen 2009).

Climate change adaptation strategies should be created and implemented in order to lessen its negative effects in specific areas. Identifying the variables that influence a household's choice of adaptation methods and understanding how rural households perceive climate change and variability is crucial. Rural families in Libokemkem woreda have rarely been studied to determine their perceptions and adaptation strategies to climate change and unpredictability. The earlier study was also flawed methodologically. Therefore, this study was conducted to figure out a location-based analysis of rural households' perception and adaptation strategies to climate change and variability in Libokemkem woreda Amhara National Regional State, Ethiopia.

To create the conceptual framework for this study, a thorough literature assessment of prior research was conducted (Amare 2018; Ojo and Baiyegunhi 2020; Asfaw et al. 2019; Pello et al. 2021). The conceptual framework was created using household characteristics as an independent variable, along with economic factors (farm size, on-farm income, and off-farm income), institutional factors (access to extension services, and weather data), marital status, educational attainment, and household size. An adaptation strategy for climate change and variability served as the study's dependent variable (Fig. 1).

Methodology
The study was carried out in the Libo-kemkem woreda, which is situated between 11°40′ and 12°20′ N latitude and 37°30′ and 38°20′ E longitude in the northwest highlands of Ethiopia's Blue Nile Basin. Libo-kemkem is one of the woreda in Amhara Region part of South Gonder Zone 645 km apart from Addis Ababa 80 km from capital of Amhara Region/ANRS/Bahir Dar. The altitude varies from 1758 to 4104 masl. This woreda was purposively chosen due to the significant environmental degradation that has occurred there and the occurrence of climate change that will have an impact on agricultural production in three agro-ecological zones of kebeles of the Libo-kemkem woreda between the years 1997 and 2020

Fig. 1 Conceptual framework for factors affecting the choice of adaptation strategies

Fig. 2 Map of the study area

(Fig. 2). This study's research methodology was cross-sectional. In this essay, primary and secondary data were jointly used. FGD and structured questionnaires were used to gather primary data. The questionnaire contained different modules, such as household demographic and socioeconomic characteristics, climate change adaptation, perception and farm management, adoption of improved practices, and food and non-food expenditure.

A systematic random sampling technique was used to choose a sample of household heads. Using simple random selection, the sample respondents from each of the three agro-ecological zones were chosen. According to Kothari's calculation from (Kothari 2014), 216 households were proportionally chosen from these sampling kebeles valid and used for the analysis.

To determine the actual meteorological status, a 24 years (data between 1997 and 2020) rainfall and temperature data were analyzed for trends and anomalies using Mann–Kendall trend test. Based on their significance for interpreting the quantitative data that have been gathered from primary and secondary sources, both descriptive statistics and econometric models were utilized. The data was then examined using statistical software STATA employing descriptive statistical tools such as, mean, percentages, frequencies and standard deviations were used to summarize and categorize the information gathered. Crosstabs, F-test, and chi-square tests were employed to compare group means. A chi-square test was also performed in order to assess the relationship between categorical variables and agro-ecological zones. However, the F-test was also used to assess the mean difference between continuous variables among agro-ecological zones.

The final sample survey included fifteen climate change adaptation options that were found, tested, and evaluated. The degree to which the sample respondents have used the selected climate change adaptation strategies is indicated by the climate change adaptation strategy index (Lemma and Trivedi 2012). Based on sample respondents' replies to questions about predetermined adaptation methods, this study created a household adaptation strategy index. Finally, the formula that was used to create the climate change adaptation plan index was as follows:

$$CCASI = \frac{1}{TNAS_s} \sum_{i=1}^{n} \left[\begin{array}{c} \dfrac{CD\ score_i}{CD\ \max\ score} + \dfrac{WH\ score_i}{WH\ \max\ score} + \dfrac{IR\ score_i}{IR\ \max\ score} + \\ \dfrac{COWP\ score_i}{COWP\ \max\ score} .... + \dfrac{BM\ score_i}{BM\ \max\ score} \end{array} \right]$$

where, i = 1, 2, 3……. N. TNASs = Total Number of Adaptation Strategies. CD = Crop diversification. WH = Water harvesting. IR = Irrigation. COWP = Construction of water ponds. BM = Borrow money. CCASI = Climate Change Adaptation Strategy Index. Max = Maximum.

Econometric model
In order to examine factors impacting farmers' adaptation methods to climate variability and climate change in the research area, a multinomial logit (MNL) model was used in this study. Due to its greater capacity to anticipate discrete choices (Atinkut and Mebrat 2016; Tesfaye and Seifu 2016; Ojo and Baiyegunhi 2020; Asfaw et al. 2019; Marie et al. 2020), as well as the computational limitations of multinomial probit, multinomial estimation is acceptable (MNP). Consequently, this study applied the beta regression model to analyze the relationship between climate change adaptation strategy index and exogenous variables. The model is specified as follows using the logit link specification:

$$g(\mu_i) = \ln\left(\frac{\mu_i}{1-\mu_i}\right) = x_i'\beta \quad \Rightarrow \quad \ln\left(\frac{\mu_i}{1-\mu_i}\right)$$
$$= \beta_0 + \sum_{i=1}^{n} \beta_i X_i$$

where $X_{i\ denotes}$ the vector of covariates, β_0 is slope of the constant term and β_i refers to the vector of regression coefficients.

Variables included in the analysis
The households' selected adaptation techniques serve as the dependent variables in the empirical estimation. The selection of adaptation tactics is based on the measures taken by the sample households to counteract the adverse effects of climate variability and climate change (Table 1).

Results and discussion
Perceived climate change and variability from temperature and rainfall perspective
The researcher also questioned sample respondents' views on climate change and the fluctuation of temperature and rainfall. According to the survey's results, 91.9% of the sample's respondents had seen an increase in temperature during the previous 24 years. Only 1.9% of the respondents stated that the temperature had not changed, while the remaining respondents (6.2%) stated that the temperature had decreased. The results of the study are contrasted with a 24 year time series of meteorological data from the Western Amhara Meteorology

Table 1 Variables hypothesized to affect adaptation decisions by farmers in the Study area

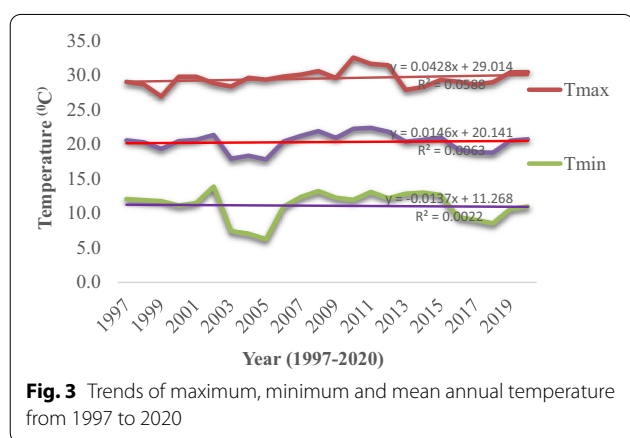| Variable label	Description and measurement	Variable type	Expected sign
Agro-ecology	1, if location (agro-ecology zone) is Woina Dega, 0 otherwise	Dummy	+
Sex	1, if the household head is male; 0, otherwise	Dummy	+
Educ	1, if the household head is literate 0, otherwise	Dummy	+
Age	Age of household head in years	Continuous	+
Fam_size	Number of people in the household, measured in number	Discrete	+
Offarm	Annual income in Birr from off/non-farm activities	Continuous	+
Onfarm	Annual income in Birr from on farm activities	Continuous	+
Farm size	Farm size of household head in hectares	Continuous	+
Extension service	Extension service experience of the household head	Continuous	+

Fig. 3 Trends of maximum, minimum and mean annual temperature from 1997 to 2020

Table 2 Sample respondents' perception of climate change from temperature and rainfall perspective

| Climate change and variability perception	Frequency	Percent
Temperature perspective		
Increased	192	91.9
Decreased	13	6.2
No change	4	1.9
Rainfall size		
Increased	19	9
Decreased	185	88.5
No e change	1	0.5
Rainfall distribution perspective		
Irregular	201	96.2
Regular	6	2.9
I do not know	2	1.0
Main season rain fall timing shift		
Yes	206	98.6
No	2	1.0
I do not know	1	0.5
Late start of rain fall		
Yes	206	98.6
No	1	0.5
I do not know	2	1.0
Early ending of rain fall		
Yes	203	97.1
No	5	2.4
I do not know	1	0.5

Station. The outcome of the meteorological data showed that the average yearly temperature has been rising over the last 24 years. This suggests that the average yearly temperature in the research region is increasing (Fig. 3). This outcome is consistent with survey data (91.9% of sample respondents indicated a rise in temperature as well as the results of earlier research (Minwuye 2017).

Similar questions asked the respondents to explain how they saw modifications in rainfall size, distribution, and timing. Accordingly, the study found that the majority of participants (88.5%) believed the amount of rainfall had decreased. This result is consistent with survey data results and findings from past studies (Amare et al. 2017). Additionally, as indicated in Table 2, the vast majority of respondents (96.2%) observed irregularities in the pattern of rain, with 98.6% of them observing a shift in the timing of the rainfall throughout the main season; 98.6% noticing a late start to the rainfall, and 97.1% noticing an early start. According to the survey, the majority of respondents believe that rainfall timing is altering during the main season and starts later. Between 1997 and 2020, an average of 1279 mm of rain per year was recorded. The amount of rainfall varied greatly within and between years (Fig. 4), with the mean annual values exhibiting a 16 mm significant rising trend ($y = 17.39x - 333624$, $R^2 = 0.0767$, $P = 0.001$). As a result, the results indicated that over the previous 24 years, the average annual rainfall had decreased. (Fig. 3).

Fig. 4 Trend of annual rainfall (mm) distribution from 1997 to 2020
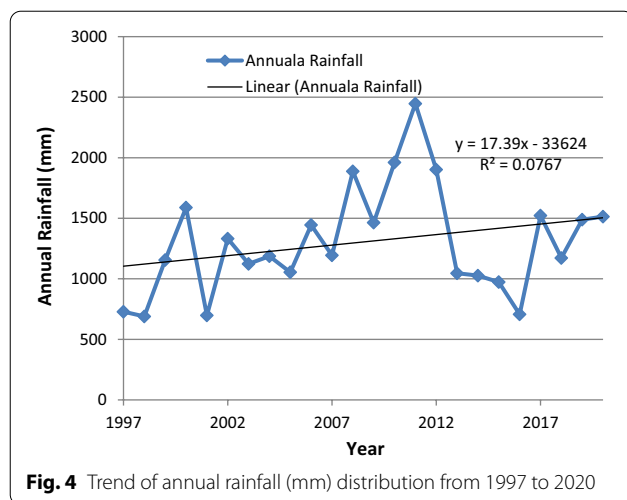
Climate change adaptation strategies

Adaptation strategies are used to lessen the threat posed by climate change. As a result, sample respondents have employed a range of adaptation strategies in response to climate change. As a result, the study assessed several climate change adaptation strategies using the samples. The following tactics have been identified as being adaptable: crop diversification; water harvesting; irrigation; pond building; replanting; altering the date of planting; planting fodder trees; switching to less expensive foods; manure compost; using artificial fertilizer; engaging in off-farm activities; using improved seeds; diversifying livestock; seasonal migration; and borrowing money.

To reduce the danger of climate change linked with the production of single crops, 83.3% of sample respondents used a crop diversification approach. To reduce the negative consequences of climate change, specifically, 24.5%, 19.4%, and 39.4% of sample respondents in low land, midland, and high land agro-ecology zones practiced crop diversification. Additionally, 22.7% of the sample's respondents employed a water collection technique to lessen the impact of climate change on their output. In particular, the low land, midland, and high land agro-ecological zones, respectively, were home to 11.1%, 7.9%, and 3.7% of sample respondents. In the Libo-kemkem woreda, replanting (84.3%), crop diversification (83.3%), utilizing manure and inorganic fertilizer (89.4%), and switching to cheaper food products are often the top four techniques employed by locals to combat climate change.

Contrarily, water collection (22.7%), diversification into non-farm activities (25.9%), planting fodder trees (33.3%), using improved livestock species (34.3%), and diversifying livestock (35.6%) are the five least-used approaches for combating climate change in the research area. Crop diversification, irrigation, pond construction, replanting,

planting fodder trees, switching to inexpensive foods, using improved seeds, engaging in off-farm activities, water harvesting, irrigation, and seasonal migration had significant associations with the three agro-ecologies at a $P < 0.01$ probability level, while livestock diversification is more advantageous. Employing artificial fertilizer and borrowing money have been seen as adaptable approaches despite the lack of a significant association between these tactics and residing in low land, mid land, or high land agro-ecologies (Table 3).

Adaptation strategies index

The level of adaptation strategies at the time of the survey is gauged using the household adaptation strategy index, as was previously discussed in chapter three. After finding 15 climate change adaptation methods, the Lemma and Trivedi (2012) formula were used to calculate the climate change adaptation strategies index. Finally, the three agro-ecological systems' climate change adaption strategy indexes were derived (Table 4). As a consequence, the result reveals that the average adaptation strategy index for families is 0.63, whereas it is 0.85, 0.38, and 0.61 for low land, midland, and high land agro-ecologies, respectively. It shows that lowland agro-ecology has the greatest adaptation strategy index (0.93) and midland agro-ecology has the lowest score (0.13). The F-test further suggested that low land, midland, and high land agro-ecologies have significantly different mean adaptation strategy indices. The results also showed that low land agro-ecology samples utilized climate change adaptation techniques more effectively than mid and high land agro-ecology samples.

Factors affecting rural households' choice of adaptation strategies

The beta regression model was used to examine the variables influencing the index score for climate change adaptation strategies. Thirteen explanatory variables were included in the model to evaluate the variables influencing the approach to coping with climate change. Each explanatory variable's coefficients, standard error, T-value, p-value, and marginal impact are shown in Table 5. According to the model's findings, the number of socioeconomic and institutional variables determines how smallholder farmers adapt to climate change.

Educational status

The computed coefficient of educational attainment suggests that the approach to coping with climate change will be positively impacted. The marginal effect result indicates that the household's strategy for coping with climate change will increase by 5.3% if the head of the

Table 3 The existing local adaptation strategies used by peoples in response to climate change

Adaptation strategies	Low land	Mid land	High land	Total (%)	X^2-value
Crop diversification	24.5	19.4	39.4	83.3	15.82[a]
Replanting	17.1	17.6	49.5	84.3	32.92[a]
Change in planting date	20.8	18.1	34.3	73.1	10.88[a]
Planting fodder trees	8.3	12	13	33.3	17.39[a]
Change to cheap food items	23.1	20.4	50.5	94	6.90[a]
Manure compost	20.8	19.9	48.6	89.4	10.19[a]
Artificial fertilizer	22.2	18.1	49.1	89.4	2.57
Using improved seeds	22.7	17.1	27.3	67.1	27.95[a]
Diversifying off-farm activities	10.2	9.3	6.5	25.9	24.83[a]
Water harvesting	11.1	7.9	3.7	22.7	34.86[a]
Irrigation	20.4	15.7	10.2	46.3	73[a]
Construction of ponds	12	16.2	20.8	49.1	21.17[a]
Diversifying livestock	12	8.8	14.8	35.6	6.62[a]
Uses of improved livestock species	13.9	8.8	11.6	34.3	18.10[a]
Seasonal migration	6.9	5.6	37.5	50	41.09[a]
Borrow money	14.4	14.4	37	65.7	4.44

[a] Significant at p < 0.01, 0.05 and 0.1, respectively

Table 4 Adaptation strategy index by agro-ecology

Variable	Agro-ecology			Total	F-value
	Low land	Mid land	High land		
Adaptation strategy index					
Minimum	0.73	0.13	0.47	0.13	54.50***
Maximum	0.93	0.47	0.73	0.93	
Mean	0.85	0.38	0.61	0.63	

household is literate. This indicates that household heads who were literate utilized different adaptation strategies for climate change than their illiterate counterparts. Literate household heads have a better understanding of how adaptation strategies can reduce the adverse short- and long-term effects of climate change. Furthermore, educated household heads implement best practices to increase productivity and production, which in turn

Table 5 Factors that affect rural households' choice of adaptation strategies

Variables	Coef	Std. Err	T-value	P-value	Marginal effects
Sex	0.031	0.052	0.600	0.550	0.006
Educational status	0.263	0.034	7.750	0.000	0.053
Age (18–35)	− 0.243	0.057	− 4.250	0.000	− 0.049
Age (36–60)	− 0.228	0.059	− 3.900	0.000	− 0.046
Household size	0.008	0.006	1.170	0.243	0.002
Married	0.012	0.045	0.270	0.786	0.002
Divorced	0.014	0.079	0.180	0.855	0.003
Widowed	0.112	0.077	1.450	0.147	0.023
Off farm income	0.056	0.008	6.710	0.000	0.011
On farm income	0.257	0.033	7.750	0.000	0.052
Farm size	0.558	0.118	4.730	0.000	0.113
Extension service	0.234	0.055	4.260	0.000	0.047
Weather information	0.231	0.051	4.550	0.000	0.047
Constant	− 3.115	0.290	− 10.730	0.000	

improves their understanding of the benefits of climate change adaptation methods. Additionally, literate household heads have more opportunities than illiterate ones to participate in various awareness-raising and experience-sharing activities on the benefits of using climate change adaptation strategies to increase agricultural output.

Research by Amare (2018) conducted in Ethiopia reveals that literate household heads are more likely than illiterate household heads to be aware of climate change and variability. According to Destaw and Fenta (2021), this indicates that literate smallholder farmers are more adept at using contemporary technology to manage climate change and fluctuation than their illiterate counterparts. Education aids smallholder farmers in better understanding and employing adaptation strategies for climate change and unpredictability, claim Addisu et al. (2016). Furthermore, as a household head's education level develops, so does their grasp of the adverse effects of climate change and how to adapt to them (Asfaw et al. 2019).

Age of respondents
At a significance threshold of $p < 0.1$, the model result showed that the respondents' ages between 18 and 60 had a detrimental and statistically significant impact on their use of adaptation techniques to climate change. This suggests that fewer solutions for coping with climate change are used as respondents' ages from 18 to 60 years increase. According to the marginal impact findings, a unit increase in respondents' ages from 18 to 60 years would result in a 4.9% and 4.6% decline in adaption strategy, respectively. According to Atinkut and Mebrat (2016), the age of the respondents exhibited a negative, statistically significant relationship with climate change adaptation techniques. This suggests that young household heads employ various climate change and variability adaptation techniques more frequently than older household heads because older household heads must manage various adaptation strategies while working in an active labor force.

On farm income
The association between climate change adaptation strategies and farm revenue was favorable and statistically significant at a significance level of $p < 0.01$. This suggests that farmers who earn more from their farms are more likely to employ coping mechanisms for climate change. In the study region, smallholder farmers' farms are their main source of income. Therefore, farmers frequently focus on actions that boost agricultural productivity in order to create more money for consumption and other production-related activities. On the other hand,

by allocating more money for the acquisition and use of technology, on-farm revenue boosts smallholder farmers' financial capacity to implement adaptation measures to climate change.

Furthermore, farmers with higher farm incomes are more likely to use climate change adaptation strategies than farmers with lower incomes. This implies that increased farm income increases farmers' awareness of and financial capacity to cope with climate change. The marginal impact of the model shows that for every unit increase in agricultural income, climate change adaptation approaches will increase by 5.2%. The likelihood that farmers will use a strategy to adapt to climate change increased by a ratio of one, according to Marie et al. (2020), for every unit rise in total annual farm revenue. The conclusion of this study is consistent with that of other investigations.

Off farm income
Off-farm income and climate change adaptation strategy had a positive and statistically significant association at the significance level of $p < 0.01$. A rise in off-farm income, per the direct link, increases a farmer's likelihood of implementing a climate change adaptation strategy. Farmers may be encouraged to engage in various forms of production by income sources other than farming, which is one explanation for this. Farmers have the opportunity to learn about the problems caused by climate change by taking part in various production operations. This knowledge facilitates their use of adaptation strategies in response to climate change. The results of the model show that for every unit increase in off-farm income, climate change adaptation techniques will grow by 1.1%.

Farm size
The size of the farm showed a positive and statistically significant relationship with the chosen adaptation strategy at a significance level of $p < 0.01$. The marginal impact results from the model predict that an increase in farm size will result in an 11.3% increase in climate change adaptation measures. This means that farms that are expanding will use more climate change adaptation strategies. In order to increase the standard of life for their families, farmers with larger farms will be able to raise more animals and grow more crops. According to this, owning a sizable farm encourages the owners to diversify their stock of livestock and crops. On the other hand, farmers on smaller farms focus on raising just one kind of animal or food.

Large farm owners are being compelled to implement a variety of productivity and production-enhancing technologies, which improves their understanding of climate

change adaptation strategies. The findings of Marie et al. (2020) are consistent with the idea that large-scale farmers are more likely to make adaptation decisions simply because they have the resources to do so. The findings of this study are consistent with those of earlier studies (Atinkut and Mebrat 2016; Pello et al. 2021).

Access to extension service

The model's results demonstrated that there was a favorable and statistically significant association between access to extension services and climate change adaption techniques at a significance threshold of $p < 0.01$. As a result, it is more likely that people will adopt strategies for coping with climate change if they have access to extension services. This shows that extension service users who possess the technical know-how to use better technology and are aware of the possible costs of doing nothing might adopt climate change adaptation strategies. In order to increase farm families' understanding of adaptation strategies, extension service staff also educates them on how climate change affects farm productivity and production, alternative methods to reduce its negative effects, and the advantages of adaptation practices. Extension services provide a link between farm households' perceptions of climate change, its effects on agricultural output and productivity, and corrective measures. The marginal effect finding indicates that using extension services will increase climate change adaptation strategy by 4.7%. According to Pello et al. (2021), access to extension services helps farmers become more aware of strategies for coping with climate change through field trips, experience sharing, and the practical application of best practices. This shows that extension service users are more likely than extension service non-users to adopt coping mechanisms for climate change.

Access to weather information

There was a positive and statistically significant relationship between access to weather information and farm households' increased awareness of climate change as a result of such access at a significance level of p 0.01. How to respond to climate change's unfavorable effects is now a question. As a result, users of meteorological data have a better understanding of how climate change affects the output of agriculture and animals. If farm households have access to meteorological information, they are more likely to use adaptation strategies in response to climate change. This implies that developing and putting climate change adaptation strategies into practice requires easy access to meteorological data. Farmers can use a variety of adaptation strategies by being informed about the present climatic conditions via weather information. Destaw and Fenta (2021) assert that access to meteorological information improves rural families' comprehension of the environment, its unpredictable nature, and the

significance of adaptation measures. The marginal effect finding indicates that access to meteorological information will increase climate change adaptation measures by 4.7%. This outcome is consistent with findings from past studies (Amare 2018).

Conclusion

The result of this study revealed that 96.8% of the respondents perceived climate change over the last 24 years. Thus, the majority of the respondents perceived climate change over the last 24 years. Besides this, the sample respondents identified possible causes of climate change. As the descriptive statistics indicated, 91.9% and 88.5% of the sample respondents perceived an increase in temperature and a decrease in rainfall, respectively. Moreover, about 96.2% of the respondents indicated an irregular distribution of rainfall for the last 24 years. Similarly, almost all of the respondents perceived the main season rainfall timing shift, the late start of rainfall, and the early ending of rainfall for the last 24 years. Consequently, the majority of sample respondents perceived the existing climate change and its indicators in the study area. Additionally, in order to reduce the danger of climate change, sample respondents used several adaptation measures. To reduce the risk of climate change linked with the cultivation of a single crop, 83.3% of sample respondents used the crop diversification method. Additionally, to reduce the negative effects of climate change, sample respondents used water harvesting, irrigation, the construction of water ponds, replanting, changing the date of planting, planting fodder trees, switching to inexpensive foods, manure compost, artificial fertilizer, diversifying off-farm activities, using improved seeds, diversifying livestock, using improved livestock species, seasonal migration, and borrowing money. The results of the chi-square test also showed that practically all of the techniques for adapting to climate change had a statistically significant relationship with agro-ecological zones. The subject of "What are the factors that determine the choice of climate change adaptation techniques in the research region?" was addressed using the beta regression model. The model's findings showed that access to extension services, farm size, off-farm income, on-farm income, educational status, and meteorological information all had statistically significant and favorable effects on climate change adaptation options. The age of the respondents, however, exhibited a negative and statistically significant link with climate change adaptation measures. This suggests that, in contrast to negatively linked factors, the aforementioned variables promote climate change adaptation techniques.

Megabia *et al. Environmental Systems Research*   (2022) 11:23

Page 10 of 10

Availability of data and materials
All data generated during analyzed this study are included in this article.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The Authors declare that they have no competing interests.

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