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FARMERS' PERCEPTION OF CLIMATE CHANGE ADAPTATION AND MITIGATION STRATEGIES FOR SOIL CONSERVATION IN ENUGU WEST SENATORIAL ZONE, NIGERIA

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Abstract

The study examined farmers' perception of climate change adaptation and mitigation strategies for soil conservation in Enugu West senatorial zone. A structured interview schedule was used to collect data from a cross section of 87 farmers. Male farmers dominated the study with an average age of 49 years. The mean monthly income of farmers was ₦38,699.78. Mixed cropping ($\bar{x}$=3.94); tree planting ($\bar{x}$=3.08) and farrowing ($\bar{x}$=3.03) were very effective existing soil conservation practices in the communities. Farmers' perceived changing the time of planting some crops ($\bar{x}$=3.12) and use of irrigation practices ($\bar{x}$=2.59) as effective climate change adaptation strategies for soil conservation while climate change mitigation strategies perceived by farmers as effective for soil conservation were: reduction of bush burning ($\bar{x}$=3.07) and planting of trees ($\bar{x}$=2.56). Inadequate extension personnel ($\bar{x}$=3.14) and lack of adequate training ($\bar{x}$=2.63) were major constraints to farmers' climate change adaptation and mitigation strategies for soil conservation. The factors that were found to influence climate change adaptation and mitigation strategies of the farmers were sex, marital status, level of education, household size and age. The study recommended among other things constant training of farmers on various strategies of adapting and mitigating to climate change variability.

Key words: Climate change, adaptation, mitigation, strategies, soil conservation

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Introduction

Soil conservation is every effort to reduce the depletion of soil nutrients available to plants and animals. According to Ezeaku (2012) it is a set of management strategies for prevention of soil being eroded from the earth's surface or becoming chemically altered by over use, salinization, acidification, or other chemical soil contamination. It comprises the combination of all methods of management and land use to guard against soil depletion or deterioration by natural or man-induced factors.

And so, soil conservation is a positive response to the devastating effects of land degradation which is one of the biggest threats to sustainable development of agriculture. In the opinion of Dumaski, Peiretti, Benitis, McCarry et. al., (2006), soil conservation efforts of farmers promote minimum disturbance of the soil by tillage, balance application of chemical inputs which are only required for improved soil quality for healthy crop and animal production with careful management. Similarly Smith and Smithers (2012) report that effective soil conservation practices reduce land and water pollution; reduce long-term dependency on external inputs which often times led to increased cost of production, enhance environmental management, improved water quality and water use efficiency, reduced emission of greenhouse gases through lessened use of fossil fuel and finally improved agricultural productivity with minimum cost. This calls for mitigation.

According to IPCC (2007), mitigation is an activity undertaken to either reduce releases of green house gases (GHGs) to, or increase removals of GHGs from the atmosphere. It also refers to any strategy or action taken to remove the GHGs released into the atmosphere or to reduce their amount (Ozor, 2011). A mitigation option is an overall approach to mitigating the level of GHGs in the atmosphere. A broad range of GHG mitigation options exist, including reduction, sequestration and capture/use (Oladele and Tekana, 2010).

On the other hand, adaptation is the process of improving society's ability to cope with change in climatic conditions across time scales from short term (e.g. seasonal to annual) to the long term (e.g. decades to centuries) (Nhemachena and Hassan, 2007). Also, the Inter-governmental Panel on Climate Change (IPCC) (2007) describes climate adaptation as an adjustment to or interventions which take place in order to manage the losses or take advantage of the opportunities presented by a changing climate. According to Agbongiarhuoyi et al. (2013), adaptation involves two types of modification in production systems.

The first is increased diversification that involves engaging in production activities that are drought tolerant and or resistant to temperature stress as well as activities that make efficient use of prevailing water and temperature conditions. Secondly, is the modification that focuses on crop management practices geared towards ensuring that critical crop growth stages do not coincide very harsh climate condition like mid-season droughts. The crop management practices that can be used include modifying the length of growing period and changing planting and harvesting dates.

Nevertheless farmers employ several soil conservation practices ranging from simple agronomic practices, soil management and use of mechanical methods of soil management. Though the use of these practices has considerably sustained production at least on subsistence level, but their impacts (long and short term) in relation to adapting, mitigating or exacerbating the problems of climate variability should be of concern (Dimelu, Ogbonna and

Enwelu (2013). However, with the recent and continued effects of climate change, farmers' efforts in soil conservation are being eroded. It is obvious that the most adverse effect of climate change is felt by farmers in developing countries especially those in Africa particularly Nigeria due to their low level of coping mechanisms (Odjugo, 2012). Therefore, climate change adaptation and mitigation strategies become inevitable.

Ali and Erenstein, (2017), reveal that adaptation and mitigation are complementary to each other. For example, if mitigation measures are undertaken effectively, the needs to which we adapt become less. Similarly, if adaptation measures (or the degree of preparedness) are strong, lesser might be the impacts associated with any given degree of climate change. Hence, applying climate change adaptation and mitigation strategies by farmers in soil conservation should be most expedient.

On the basis of the foregoing, the study examined farmers' perception of climate change adaptation and mitigation strategies for soil conservation in rural communities of Enugu West senatorial zone. Specifically the study described the socio-economic characteristics of the respondents; identified existing soil conservation practices in Enugu West senatorial zone; ascertained farmers' perceived effectiveness of climate change adaptation and mitigation strategies for soil conservation; farmers' level of use of climate change mitigation strategies for soil conservation; and constraints to farmers' perceived climate change adaptation and mitigation strategies for soil conservation.

Hypotheses of the study

H_o1: Socio economic characteristics of farmers have no significant relationship with climate change adaptation strategies.

H_o2: Socio economic characteristics of farmers have no significant relationship with climate change mitigation strategies.

Methodology

The study was carried out in Enugu State of Nigeria. Enugu State is one of the 36 states in Nigeria and is located between latitude 6.45837 N6°27'35.5837 and Longitude E7°32'39.90458 (Ezike, 2010). The State has a population of 2,452,996 (NPC, 2006). The vegetation of the state is mainly forest type but stretches out into derived savannah in the northern fringes. Enugu State experiences distinct wet and dry seasons with a total annual rainfall of about 1,700 mm (Enugu State Government Official Gazette, No. 25, 1997). The major occupation of people in the state is farming. Major crops cultivated include cassava, yam, cocoyam, vegetables and oil palm while poultry, goat, sheep and cattle were major livestock reared. The State has three senatorial zones namely: Enugu East, Enugu North and Enugu West and (17) seventeen local government areas (LGAs) which are divided into six agricultural zones namely; Enugu, Agbani, Udi, Awgu, Nsukka and Enugu Ezike.

The population of the study included all farmers involved in soil conservation practices in the study area. Multistage sampling procedure was used in selecting respondents for the study. In stage one, two local LGAs from Enugu West senatorial zone namely Awgu LGA and Udi LGA were purposively selected based on the LGAs that are actively involved in soil conservation practices. In stage two, two town communities were purposively selected from each selected LGA to give a total of four town communities. In Awgu LGA, Mmaku and

Awgu town were selected while in Udi LGA Umabi and Obinagu were selected. They were selected based on their active involvement in soil conservation activities.

GPS coordinates of communities where data were collected were thus:- For Awgu- Address; Unnamed Road, Awgu, Nigeria: Latitude 6.064, N6°3'50.38636; Longitude 7.476, E7°28'33.61692; For Mmaku Town- Address; EziNwankwo Bus Stop, Enugu-Mmaku, Nigeria: Latitude; 6.11687 N6°70.73452; Longitude; 7.45436 E7°27'15.70536.

For Obinagu- Address; Unnamed Road, Udi LGA Obinagu, Nigeria: Latitude; 6.28886 N6°17'19.90788; Longitude; 7.39758 E7°23'51.3042; For Umabi- Address; Obodocha Road, Umuabi, Udi LGA, Nigeria: Latitude; 6.28649 N6°17'11.37372; Longitude; 7.37867E7°22'43.73763

A list of forty (40) farmers was compiled in each town community in stage three and from the list 25 farmers were randomly selected to give a total of 100 respondents. However, only 87 respondents fully completed their interview schedule.

The study provided information on socio-economic characteristics of the respondents; existing soil conservation practices; farmers' perceived effectiveness of climate change adaptation and mitigation strategies for soil conservation; and constraints to farmers' perceived climate change adaptation and mitigation strategies for soil conservation. Descriptive statistics and multinomial regression were used in the analysis. Multinomial regression was used to test the two hypotheses stated. There variable specifications were the same.

Multinomial Regression

Multinomial logistic regression is a statistical method to analyze categorical data, El-Habil (2012).Multinomial regression can simultaneously compare more than a contrast; estimate the log odds of three or more covariates. The impact of predictor variables is then explained in odds ratios (El-Habil, 2012). Multinomial logistic regression applies maximum likelihood estimation in transforming the dependent variable into a logit variable, while changes are calculated in the log odds of the dependent and not in the dependent itself as in the ordinary least square. Multinomial logistic regression model uses pseudo R-square statistic to summarize the strength of the relationship that exist between the dependent and independent variables.

The requirements of multinomial logistic regression are less stringent, unlike the linear regression that assumes linearity of relationship between the independent and dependent variable, required the variables to be normally distributed, and that homoscedasticity must exist. The goodness of fit tests is check for, the significance of individual independent variables that should be retained in the further analysis of the model. The multinomial logistic regression adopted from EL-Habil (2012) is defined as:

$$Log\left[\frac{\pi_j\,(X_i)}{\pi_i\,(X_i)}\right] = \alpha_{oi} + \beta_{1j}X_{1i} + \beta_{2j}X_{2i} + \cdots \beta_{pj}X_{pi} \qquad (1)$$

Where $j = 1, 2, \ldots (k-1)$, $i = 1, 2, \ldots, n$

Where all the π*'s* adds to unity, then the reduced model is:

$$Log(\pi_j\,(X_i)) = \frac{exp^{\alpha_{oi}+\beta_{1j}X_{1i}+\beta_{2j}X_{2i}+\cdots\beta_{pj}X_{pi}}}{\sum_{j=1}^{k-1} exp^{\alpha_{oi}+\beta_{1j}X_{1i}+\beta_{2j}X_{2i}+\cdots\beta_{pj}X_{pi}}} \qquad (2)$$

Where π is the response categories or existing methods of soil erosion control, X_i are the vector(s) of explanatory variables (gender, marital status, level of education, household size, experience and income), β_j is the parameter to be estimated which uses maximum likelihood estimate method (Chatterjee and Hadi (2006).

Multinomial logistic regression uses a baseline category and the predicted probability of estimate is defined as:

$$\pi_j = \frac{e^{\alpha_j + \beta_j Y}}{\sum_h e^{\alpha_h + \beta_h Y}} \quad (3)$$

The first or last endogenous products are often used as the baseline sample, the probability of each socioeconomics and demographic characteristics is predicted from:

$$\widehat{\pi_1} = \frac{exp(y_i)}{1 + \sum exp(y_i)} \quad (4)$$

Where y_i is the predicted responses from the multinomial coefficient. The multinomial logistic regression model is simply defined as:

$$Log(\pi_i(X_i)) = \alpha_{oi} + \alpha_{1j}X_{1i} + \alpha_{2j}X_{2i} + \cdots \alpha_{pj}X_{pi}$$

Where: π is the response categories or level of mitigation strategies adopted by broiler farmers.
α_i = parameter to be estimated
X_i = vectors of socioeconomics characteristics.).

The Explanatory Variables include:
X_1 = sex (dummy variable; female=0, male=1)
X_2 = Age
X_3 = Marital status (dummy variable; single=1, married=2, divorce=3, widow=4)
X_4 = Level of education
X_5 = Household size of farmer
X_6 = Farming experience (years)
X_7=Cooperative membership
X_8= Income

Results and Discussions

Socioeconomic characteristics of the Respondents

Table 1 shows that majority (66.0%) of farmers were male while the remaining 34.0% were females (farmers). This is an indication that male respondents dominated the study.

Entries in Table 1 reveal that majority (56.0%) of the farmers were within the age bracket of 41 – 60 years while 39.0% were within the age of 21 – 40 years, 2.0% were greater than 60 years and 3.0% less than 21 years old. The average age was 49 years. This indicates that the farmers are still active and vibrant in age.

Data in Table 1 reveal that majority (72.0%) of farmers were married while the remaining farmers were; widowed (16.0%), single (8.0%) and divorced/separated (4.0%). This implies that married farmers dominated the study.

Table 1 shows that greater proportion (48.0%) of the farmers had secondary education while others had primary education (22.0%), tertiary education (17.0%) and no formal education (13.0%). This is an indication that farmers are fairly literate to understand some climate change mitigation and adaptation strategies.

Entries in Table 1 reveal that greater proportion (44.0%) of the farmers had a household size of 8 – 10 people while 32.0% had 5 – 7 people, 19.0% had 2 – 4 people and 5.0% had less than 2 people. The average household size was 7 people (farmers). The large household size of the household helps to supply cheap family labor.

Results in Table 1 show that majority (62.0%) of farmers had farming experience of over 9 years while about 24.0% had farming experience of 6 - 9 years, 9.0% had 2 - 5 years' experience and 5% had 2 years' experience. The average farmers farming experience was 8 years. The respondents have moderate experience in soil conservation and they are likely to grow in future.

Table 1 shows that majority (60.0%) of the farmers were not members of cooperatives while the remaining ones (40.0%) belonged to cooperative. Data in Table 1 reveal that majority (75.0%) of the farmers had less than 3 contacts with the extension agents per annum, 19.0% had 3 – 5 contacts and 6.0% had greater than 5 contacts. The average number of contacts per annum was 2 times. This has serious negative implication on progress of soil conservation and climate change mitigation and adaptation strategies.

Table 1 reveals that majority (58.0%) of the farmers' monthly income from all sources were less than ₦30,000 while 35.0% had ₦30,000 – ₦59,999 About 5.0% had ₦60,000 – ₦89,999 and 2.0% had greater than ₦89,999 monthly. The average monthly income of the farmers was ₦38,699.78. The monthly income of the farmers was above the N30,000 minimum wage recommended in Nigeria.

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Table 1: Socioeconomic characteristics of the farmers

Socio-economic variable	Percentage (%)	Mean ($\bar{x}$)
Sex:		
Female	34.0	
Male	66.0	
Age:		
< 21	3	
21-40	39	49
41-60	56	
> 60	2	
Marital status:		
Single	8.0	
Married	72.0	
Divorced/separated	4.0	
Widowed (er)	16.0	
Level of education		
No formal education	13.0	
Primary	22.0	
Secondary	48.0	
Tertiary	17.0	
Household size (Persons) :		
< 2	5.0	
2-4	19.0	7
5-7	32.0	
8-10	44.0	
Farming experience (years):		
< 2	5.0	
2-5	9.0	8
6-9	24.0	
>9	34.0	
	62.0	
Cooperative membership	40.0	
Extension contact per annum:		
< 3 times	75	
3-5 times	19	2
> 5 times	6	
Monthly income (₦)		
< 30,000	58.0	
30,000- 59,999	35.0	38,699.78
60,000-89,999	5.0	
90,000 and above	2.0	

Perceived effectiveness of existing soil conservation practices.

Data in Table 2 show that farmers perceived the following existing soil conservation practices as very effective: mixed cropping ($\bar{x}$=3.94); tree planting ($\bar{x}$=3.08); farrowing ($\bar{x}$=3.03)and mulching ($\bar{x}$=3.00).But cover cropping ($\bar{x}$=2.94) and crop rotation ($\bar{x}$=2.91) were perceived as effective. On the other hand, soil conservation practices perceived by farmers as not effective were: terracing ($\bar{x}$=1.89); reduced tillage ($\bar{x}$=2.00) and mixed farming ($\bar{x}$=2.43). Farmers may have perceived terracing as not affective probably because there may be no hill land in the rural communities studied or because of lack of information on the use of terracing. The cluster mean of 2.69 indicates that existing soil conservation practices in the zones are very effective. The results of the standard deviation being close to unity are indication that the situations may be real in the location. The finding is similar to Dimelu, Ogbonna and Enwelu (2013) except that terracing was not perceived as effective soil conservation practices existing in the communities.

Table 2: Perceived effectiveness of existing soil conservation practices.

Soil conservation practices	Mean ($\bar{x}$)	Std Dev.
Tree planting	3.08	0.79
Farrowing	3.03	0.88
Mulching	3.00	0.79
Mixed cropping	2.94	0.80
Cover crops	2.94	0.80
Crop rotation	2.91	0.84
Mixed farming	2.43	0.96
Reduced tillage	2.00	0.84
Terracing	1.89	0.75
Cluster mean	**2.69**	**0.83**

Cut off mean = 2.5

Perceived effectiveness of climate change adaptation strategies for soil conservation

Table 3 reveals that only very effective climate change adaptation strategy for soil conservation perceived by farmers was changing the time of planting some crops ($\bar{x}$=3.12). However, use of irrigation practices ($\bar{x}$=2.59) and use of improved crop varieties ($\bar{x}$=2.50) were perceived to be effective. Conversely, integration of livestock raising, fish production and crop production ($\bar{x}$=1.90); integrated pest management ($\bar{x}$=1.91); changing location of some crops ($\bar{x}$=2.24); and weather forecasting ($\bar{x}$=2.43) were perceived by farmers as not effective climate change adaptation strategies for soil conservation. The cluster means of 2.38 implies that most of the climate change adaptation strategies in the zones may not be effective for soil conservation. Also, the results of standard deviation are fair indication of the existing situation in the communities. This finding is an indication that the farmers may not have been fully educated by extension agents. Iwuchukwu, Udoye and Onwubuya (2013) report that farmer-extension contact is almost non-existent in most developing countries like Nigeria probably due to poor remuneration and logistical problems. However, Chukwunonso (2014), stress that effective adaptation strategies are needed to protect livelihoods.

Table 3: Farmers' perceived effectiveness of climate change adaptation strategies

Climate change adaptation strategies	Mean ($\bar{x}$)	Std. Dev.
Change the time of planting some crops	3.12	0.79
Use of irrigation practices	2.59	1.18
Use of improved crop varieties	2.50	1.14
Weather forecasting	2.43	1.08
Change of location of some crops	2.24	1.00
Integrated pest management	1.91	0.76
Integration of livestock raising/fish production/crop production	1.91	0.76
Cluster mean	**2.38**	**0.96**

Cuf off mean = 2.5

Perceived effectiveness of climate change mitigation strategies for soil conservation

Table 4 reveals that only reduction of bush burning ($\bar{x}$= 3.07) was perceived by farmers as very effective strategy of climate change mitigation for soil conservation. Nevertheless, planting of trees ($\bar{x}$=2.56) and proper management of animal products ($\bar{x}$ = 2.52) were perceived as effective strategy. On the other hand, avoiding use of fossil fuel ($\bar{x}$=2.19) and use of cooking gas ($\bar{x}$=2.43) were perceived by farmers as not effective climate change mitigation strategies for soil conservation. It is well known that farmers are economic being and may not afford to use cooking gas except it is subsidized by government. The cluster means of 2.55 implies that the mitigation strategies are effective for soil conservation. However, the results of standard deviation are an indication that the situation may not be real on the ground since most of the results of standard deviation are greater than unity.

Table 4: Farmers' perceived effectiveness of climate change mitigation strategies

Climate change mitigation strategies	Mean ($\bar{x}$)	Std. Dev.
Reduction of bush burning	3.07	0.89
Planting of trees	2.56	1.16
Proper management of animal products	2.52	1.04
Use of cooking gas	2.43	1.16
Avoiding the use of fossil fuel	2.19	1.16
Cluster mean	**2.55**	**1.05**

Cut off mean = 2.5

Extent of use of climate change mitigation strategies for soil conservation by farmers

The level of farmers' use of climate change mitigation strategies was further confirmed using brown taxonomy classification. The study revealed that majority (60.0%) of the farmers had medium level of use of climate change mitigation strategies; 36% had high level and 4.0%had low level of use. This result is encouraging since the farmers are stepping up to climate mitigation strategies.

Table 5: Extent of use of climate change mitigation strategies by farmers

	Classification	%	Mean ($\bar{x}$)	Std. Dev.
	Low (0-40%)	4.0		
	Medium (41-69%)	60.0	12.8	2.3
	High (above 69%)	36.0		
	Total	**100%**		

Constraints to climate change adaptation and mitigation strategies for soil conservation

Table 6 reveals that inadequate extension personnel ($\bar{x}$=3.14) constrained farmers' climate change mitigation and adaptation strategies to a great extent. However, lack of adequate training ($\bar{x}$= 2.63); inability to involve all stakeholders ($\bar{x}$= 2.56); inadequate funding ($\bar{x}$= 2.56); lack of political will ($\bar{x}$= 2.53); increased used of fuel/diesel ($\bar{x}$= 2.53); inadequate information and basic amenities ($\bar{x}$= 2.52)constrained farmers to an extent. On the other hand, only lack of technical know-how ($\bar{x}$=2.13) constrain farmers to little or no extent in the communities. The cluster mean was 2.55which indicates that the farmers may have accepted the variables presented to them as challenges. However, the results of standard deviation are an indication that the situation may not be real on the ground since most of the results of standard deviation are greater than unity. Anselm and Taofeeq (2010) report that most of the problems encountered by farmers in adaptation to climate change are associated with poverty, because poor and hungry farmers divert their limited farm income towards the basic necessities of life instead of ameliorating the challenges..

Table 6: Constraints to climate change adaptation and mitigation strategies

Constraints	Mean ($\bar{x}$)	Std. Dev.
Inadequate extension personnel	3.14	0.79
Lack of adequate training	2.63	1.10
Inadequate funding	2.56	1.13
Increased use of fuel/diesel	2.53	1.03
Lack of political will	2.53	1.04
Inability to involve all stakeholders	2.52	1.06
Inadequate information and basic amenities	2.52	1.06
Illiteracy among clientele	2.42	1.18
Lack of technical know-how	2.13	1.00
Cluster mean	**2.55**	**1.06**

Cut off mean = 2.5

Farmers' socio-economic characteristics and climate change adaptation strategies for soil conservation

The multinomial regression analysis model was used to examine the significant relationship between the socioeconomic characteristics of the farmers and climate change adaptation strategies for soil conservation. MNL was estimated by normalizing one category (base category). The parameter estimates gave the direction of the effect of the independent variables in the dependent variables. Thus, the marginal effects of the MNL, which measure the expected change with respect to a unit change in an independent variable, are reported. The diagnostic statistics showed the Pseudo R2 =0.469, likelihood ratio=25.75, LRChi2 154.82 and Prob b>Chi 0.0000. This implies that the model as a whole significantly and jointly predicted the significant relationship between the socioeconomic characteristics of the farmers and climate change adaptation strategies for soil conservation. For instance, there exists positive and significant relationship of age, marital status, level of education and household size and climate change adaptation strategies for soil conservation.

Table 7: Farmers' socio-economic characteristics and climate change adaptation strategies

Farmers' adaptation strategies	Coefficient	P>Z	Marginal effect
Intercept	1.944	0.51	0.21
Sex	-0.054	-0.09*	-0.06*
Age	0.003	0.002 **	0.001 **
Marital status	0.220	0.0005***	0.0002***
Level of education	0.030	0.005**	0.002**
Household size	0.012	0.007**	0.003**
Farming experience	0.013	0.004**	0.001**
Cooperative membership	0.025	0.091*	0.061*
Income	-0.024	-0.0002***	-0.0001***
Pseudo R^2=0.469			
Likelihood ratio=25.75***			
LRChi^{2}154.82			
Prob b>Chi 0.0000			

*, ** and *** are significant at 10%, 5% and 1% respectively

Farmers' socio-economic characteristics and climate change mitigation strategies for soil conservation

The multinomial regression analysis model was used to examine the significant relationship between the socioeconomic characteristics of the farmers and climate change mitigation strategies for soil conservation. MNL was estimated by normalizing one category (base category). The parameter estimates gave the direction of the effect of the independent variables in the dependent variables. Thus, the marginal effects of the MNL, which measure the expected change with respect to a unit change in an independent variable, are reported. The diagnostic statistics showed the Pseudo R2 =0.456, likelihood ratio=23.75, LRChi2 =174.82. This implies that the model as a whole significantly and jointly predicted the significant relationship between the socioeconomic characteristics of the farmers and climate change mitigation strategies for soil conservation. There exists positive and significant relationship of marital status, level of education and household size and climate change mitigation strategies for soil conservation.

Table 8: Farmers' socio-economic characteristics and climate change mitigation strategies

Farmers' mitigation strategies	Coefficient	P>Z	Marginal effect
Intercept	2.003	0.24	0.22
Sex	-0.066	-0.002**	-0.001**
Age	0.002	1.48	1.46
Marital status	0.378	0.0006***	0.0003***
Level of education	0.078	0.0002***	0.0001***
Household size	0.057	0.0006***	0.0004***
Farming experience	0.007	0.62	0.52
Cooperative membership	0.013	0.53	0.43
Income	-0.026	-1.50	-1.30
Pseudo R^2=0.456			
Likelihood ratio=23.75***			
LRChi^{2}174.82			
Prob b>Chi 0.0000			

*, ** and *** are significant at 10%, 5% and 1% respectively

Conclusion and recommendation

The study revealed that mixed cropping, tree planting, farrowing and mulching as very effective existing soil conservation practices in the communities. Farmers perceived changing the time of planting some crops as the only very effective climate change adaptation strategy for soil conservation. On the other hand, only reduction of bush burning was perceived as a very effective strategy of climate change mitigation for soil conservation. The study also found that majority of farmers had a medium level of use of climate change mitigation strategies. Inadequate extension personnel constrained farmers' climate change adaptation and mitigation strategies to a great extent. The study also revealed that marital status, level of education, cooperative membership and household size were socio-economic characteristics that had positive relationship with climate change adaptation and mitigation strategies.

The study recommended among other things the following: recruitment of more extension staff by the government to increase farmer-extension contact; regular training of farmers on various strategies to adapt and mitigate climate change for soil conservation; and encourage use of existing soil conservation practices by farmers.

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