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DRIVERS OF MAIZE FARMERS' CHOICE OF CLIMATE COPING STRATEGIES IN KATSINA STATE, NIGERIA: DOUBLE HUDDLE MODEL APPROACH

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ABSTRACT

The study determined drivers of maize farmers' choice of climate coping strategies in Katsina state, Nigeria. Multistage sampling procedure was used to select 528 respondents from which primary data were collected. The data were analyzed using descriptive statistics and double huddle model. The Maize farmers' average age was 46.27 years, and 48.30% of them were within the age range of 42-52 years. Their average household size, farm size, maize production experience and extension contacts per season were 16 people 2.37ha, 14.74 years and 4.03 contacts, respectively. The farmers agreed that climate change has adversely affected their own maize production. Recasts the result for the double hurdle model show that education, experience, tree planting off-farm activities and cooperative membership were some of the factors that significantly influenced the farmers' choice of climate change coping strategies. Some factors were identified to significantly influence both the farmers' understanding of climate change effects and choice of climate change coping strategies. It is concluded that the maize farmers had understanding of climate change effects and there were lots of factors that influenced the farmers' choice of coping strategies. It is recommended that extension contacts and cooperative membership should be improved among the maize farmers in the state.

Keywords: Maize, Drivers, Climate Change, Coping Strategies

INTRODUCTION

Maize is one the most important staple crops in Katsina State and many part of the world. It is used as food and feed as well as source of income to its farmers and marketers. It is playing important role in the provision of food and feeds in Africa and other regions of the world. It was pointed out that maize is an important staple food in many areas of the world, especially Africa and Central America, as it contributes 20% of the calories in human diets in many low-income countries, especially in SSA, Latin America and Asia (Consultative Group on International Agricultural Research (CGIAR), 2016). Nonetheless, it is one of the crops that are easily adversely affected by climate change. However, taking appropriate actions against the adverse effects of the change by the farmers is vital in improving maize production amid the change. Climate change refers to the change in weather patterns over a long period of time due to anthropogenic activities and Earth's natural processes (United State National Academy of Sciences (USNAS) & Royal Society (RS) (2020). This change is accompanied by adverse conditions such as drought, flood, wind, high temperature, change in rainfall pattern, pests' infestation, diseases outbreak and soil deterioration (Federal Ministry of Environment (FME), 2021). It is reported that warming in Sub-Saharan Africa (SSA) is projected to be greater than the global average, and thus, rainfall will decline in some areas (FAO, 2011). Therefore, it is pointed out that cereal production in SSA is expected to decline which will in turn lead to an increase the level of food insecurity in the region (United State Environmental Protection Agency (USEPA), 2016).

Climate change is a phenomenon that is inevitably that is happening in every part of the world. It affects people, plants and animals in different ways and degrees. It affects millions of people that are already suffering from the dreadful effects of extreme weather conditions such as pronged drought in SSA to shattering tropical storms in South-East Asia, the Caribbean and Pacific (Amnesty International (IA), 2023).

There are various climate change coping strategies that can be used by maize farmers to suppress the effect of the change on their maize production. Akinnagbe and Irohibe (2014), reported that there are various agricultural adaptation strategies used among crop farmers in Africa include planting of drought resistant crop varieties, crop diversification, irrigation, contour ridges, mulching, tree planting, among others. Abdulwahab and Abdulbaki (2021) reported that other adaptation strategies used by farmers in SSA include early planting, use of improved varieties, crop rotation, irrigation and drainage and livelihood diversification. Hence, it is vital to identify factors that influenced the choice of climate change coping strategies among maize farmers in the different parts of the region. Legesse, Ayele and Bewket (2012) and Oduniyi (2016) reported that extension contacts had positive relationship and significant influence on maize farmers' understanding of climate change. Mfere (2021) reported that cooperative membership has direct and significant influence (at 10% level of probability) of Congo-Brazzaville maize farmers' adoption of climate change coping strategies.

Nigeria is among the ten top listed countries that are susceptible to climate change, which exacerbate rise in temperature, flooding, landslides, gully erosion and drought; migrations of pests due to weather changes have been growing with disturbing consequences on crop production (Akpata, 2022). Thus, the drivers of maize farmers' choice of climate change coping strategies in Katsina State need to be identified so that appropriate policy measures could be taken to ameliorate maize production in the state. Identification of such factors will pave more ways on how to deal with threats of climate change in the state, which could in turn help in improving food availability in the state amid the change.

METHODOLOGY

Description of the Study Area

Katsina State is one of the states of Nigeria where maize is produced in large quantity. It is dominated by Hausa and Fulani people which are mostly small scale farmers. It has a land area of 23,938km^2 and lies within Latitudes $11^0 7'49''$ and $13^0 22'57''$N and Longitudes $6^0 52'3''$ and $9^0 2'$E, and by the year 2022, the population of the State (based on the growth rate of 3.7%) was projected to be 10,368,500 people (City Population, 2022). The average temperature and rainfall of the State were 26^0C and 600 mm, respectively (climate-data.org., n. d.). The most critical problems facing farmers in the state in terms of climate conditions are temperature and rainfall fluctuations. However, the state produced various crops (examples, maize millet, sorghum, rice, wheat, groundnuts, cowpea, sugarcane, yam, cassava, potatoes, onion, tomato, cabbage, carrot, pepper, lettuce, mango, guava, banana, cotton and jute) and livestock (example cattle, sheep, goats, camel, horse, chickens, duck, geese, guinea fowl, fish and honey bees). The State has thirty four LGAs and consists of three agro-ecological zones- Sahel, Sudan and Northern Guinea Savanna, which coincidentally fall under Katsina Agricultural and Rural Development Authority (KTARDA) Zone I, III and II, respectively (Adewale, Terry & Ademola, 2005). It shares boarder with Jigawa and Kano States to the East, Kaduna State to the South, Zamfara State to the West and to the North, it shares international border with Niger Republic.

Sampling Procedure and Sample Size

Multistage sampling procedure was used to select the sample size for the study. In a population where certain characteristics can be identified such characteristics need to be represented in the sampling process in order to have a good feel about the entire population (Asika, 1991). Thus, in the first stage, the state was divided into three zones based on its agricultural zones- KTARDA I, II and III, in which Sudano-Sahelian, Northern Guinea and Sudan Savanna agro-ecological zones coincidentally fall, respectively. In the second stage, Jibia and Kaita LGAs (in KTARDA I) from the five LGAs- that produced maize (Usman, 2017, personal communication) were randomly selected in the zone. In Zone II and III, since nine and ten LGAs in the zones produced maize, four (Bakori, Dadume, Funtua and Sabuwa) and five LGAs (Dan-Musa, Dutsin-Ma, Kankia, Matazu and Musawa) were randomly selected. In the third stage, six communities from each of the selected LGAs were randomly selected. In the fourth stage number of farmers that produced maize in each community was obtained with the help of KTARDA staff. In the fifth stage, eight maize farmers (on the average) from each of the selected communities were proportionately and randomly selected. The random selections (balloting method) were carried out using the lists of maize farmers obtained with help of KTARDA staff. Thus, from the above sampling procedure that 11 (2 + 4 +5) LGAs, 66 (6 x 11) communities and 528 (8 x 66) were selected for the study.

Data Collection

Primary data were used for the study. The primary data was collected using structured questionnaire by trained enumerators. Information captured in the questionnaire were socio-economic characteristics of maize farmers, maize farmers' understanding of climate change effects on their own maize production activities and number of climate change coping strategies adopted by the maize farmers.

Data Analysis

Descriptive statistics and Double Huddle model (combination of Logistic and Tobit regression model) were used to analyze the data.

Double hurdle model was based on the assumption that a farmer makes choice of climate change coping strategies when he/she has the knowledge of the effects of the change on his/her production. The first hurdle is concerned with the knowledge of climate change effects while the second is concerned with the choice of coping strategies to cope with the effects. The model is one of the variants of Tobit model which includes binary choice and continuous choice simultaneously (Yusuf *et al.,* 2017). It was originated by Cragg in 1971 as the generalization of the Tobit model (Akinbode & Bamire, 2015).

The first hurdle was achieved by using Logistic regression model while the second hurdle was achieved using Tobit regression model which is a statistical tool proposed by Tobit in 1958 to explain relationship between a non-negative dependent variable (Y) and independent variables (Xs) (Yusuf *et al.,* 2017).

In the first hurdle Likert scale was used to determine index of the knowledge of the effects of climate change on maize farmers' production (dependent variable) for each respondent by asking farmer about whether he/she agrees or disagrees that whether the changes in temperature, rainfall, sunshine, wind, drought, flood, soil erosion, pests and diseases and yield affect his/her maize production over the years. The elements were arranged in a tabular form so that the farmer could express his/her knowledge about climate change effects on maize production. The Likert scale used elements were; strongly agree, agree, neutral, disagree and strongly disagree, which have value of 2, 1, 0, -1 and -2, respectively. The negative sign indicates that the respondent concerned has no knowledge of the effects of climate change as pointed out by his response. Thus, farmers' knowledge of the climate change effects on his/her maize production index was computed by summing up his responses. The knowledge index was computed as follows:

$$FKI = PR - NR \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots . (i)$$

FKI = Farmer knowledge index.
PR = Positive response.
NR = Negative response.
In a situation where the sum of the index is positive, the farmer was considered to have positive knowledge about climate change effects and have an index of 1, otherwise 0. This knowledge index was used as the dependent variable (y) in the Logistic regression model for the determination of the factors that influenced maize farmers' knowledge of climate change in Katsina State. The model is specified as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_{17} X_{17} + U_i \dots\dots\dots\dots (ii)$$

$$Y = \begin{cases} Y = 1, \text{if aware of climate change} \\ Y = 0, \text{otherwise} \end{cases}$$

Where:
Y = Dependent variable (farmers' knowledge of climate change), and;
β_0 = Constant.
$\beta_1 - \beta_{17}$ = Coefficients of the respective independent variables.
$X_1 - X_{17}$ = Household characteristics [as defined below].
X_1 = Household size (number of persons under household care).
X_2 = Educational status (number of years spent in school).
X_3 = Maize production experience (years in maize production).
X_4 = Access to extension agent (number of contacts per year).
X_5 = Major occupation (1, if farming; 0, otherwise).
X_6 = Off-farm activities (1, if yes; 0, otherwise).
X_7 = Membership of association (years of being a member).
X_8 = Land tenure system (1, if owned; 0 if otherwise).
X_9 = Farm size allocated to maize production (hectares cultivated).
X_{10} = Livestock production (1, if yes; 0, otherwise).
X_{11} = Maize irrigation (number of hectares irrigated).
X_{12} = Ridging and terracing (1, if yes; 0, otherwise).
X_{13} = Planting as soon as it rains (1, if yes; 0, otherwise).
X_{14} = Planting early maturing variety (1, if yes; 0, otherwise).
X_{15} = Crop diversification (1, if yes; 0, otherwise).
X_{16} = Planting of trees in the farms (1, if yes; 0, otherwise).
X_{17} = Action against tree felling (1, if yes; 0, otherwise).
$U_{i,}$ = Error terms (assumed to be normally distributed with zero mean and constant variance).

Tobit model (used in the second hurdle) is also known as censored regression model because some of the observations on the dependent variable *Y* are censored (concealed/covered up) that is for which *Y* is < 0 (Sun & Taylor, 2014). The model was expressed as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_{17} X_{17} + U_i \dots\dots . (iii)$$

$$Y = \begin{cases} 1 \text{ bserve, if a farmer choose a climate change coping strategy} \\ 0, \text{otherwise} \end{cases}$$

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Respondents

There are various factors that influence choice of coping strategies. In the case of farming communities, these factors are mostly the socio-economic and institutional characteristics of farmers, as well as their induction characteristics. These characteristics were captured due to their significance in agricultural production. The results in Table 1 show descriptive statistics of some of the socio-economic characteristics of Katsina State maize farmers. It can be seen from the results that the mean age, household size, experience, extension contacts, farm size and amount of credit received were 46.27 years, 16.25 persons, 14.74 years, 4.04 contacts, 2.37 hectares and 29,736.00 naira, respectively.

Table 1: Descriptive statistics of some socio-economic characteristics of the respondents

Variables	Minimum	Maximum	Mean	Standard Deviation
Age	20.00	80.00	46.27	9.17
Household size	1.00	55.00	16.25	9.09
Education	3.00	16.00	8.35	4.89
Maize production experience	1.00	45.00	14.74	9.01
Extension contacts	0.00	36.00	4.04	4.94
Major crop produced	0.00	1.00	0.72	0.45
Off-farm activities	0.00	1.00	0.73	0.45
Cooperative membership	0.00	1.00	0.41	0.49
Ownership of land	0.00	1.00	0.91	0.29
Farm size	0.50	15.00	2.37	1.94
Livestock ownership	0.00	1.00	0.88	0.33
Irrigation	0.00	1.00	0.34	0.47
Ridging and terracing	0.00	1.00	0.83	0.38
Early planting	0.00	1.00	0.93	0.25
Use of early maturing varieties	0.00	1.00	0.92	0.27
Crop diversification	0.00	1.00	0.74	0.44
Tree planting	0.00	1.00	0.52	0.50
Action against tree felling	0.00	1.00	0.48	0.50
Amount of credit received	0	500000.00	29736.00	69411.13

Source: Field survey, 2018.

Maize farmers' agreement of climatic change effects on their own production

Climate change poses a lot of adverse effects on the lives of people especially farmers whose means of living are largely determined by climate. The view of maize farmers in Katsina State were assessed as to whether they were directly affected by the impact of climate change as regards to their own maize production activities. The results presented in Figure 1 show that 57.20% of the respondents agreed that climate change has affected their production negatively while 3.98% disagreed. Those who agreed that the change has affected their production might be due to the fact that they realized that the change has been causing damage to their farming activities due to adverse conditions it causes while those who disagreed admitted that they adopted some coping strategies such as use of improved varieties that helped them to cope with the change. This supports the findings of El-Ladan (2018) who assessed peasant farmers' adaptation strategies to climate change in Jibia LGA of Katsina State and reported that 40.00% and 30.00% of his respondents agreed that climate change led to infestation of pests and outbreak of diseases on their farms, respectively. These findings are in line with those of Adetayo (2013) Falaki *et al.* (2013) and Oruonye (2014) reported that 92.90%, 83.70% and 87.80% of their respondents respectively, agreed that climate change has been adversely affecting their own production activities. Similarly, Okunlola *et al.* (2018) revealed that among the crop farmers they sampled in South Western Nigeria, 50%, 66.7%, 51.7% and 56.7% admitted that they were adversely affected by rainfall fluctuations, extreme temperature, increase in pests and diseases and high wind intensity, respectively. Thus, it is suffice to say that the maize farmers in Katsina State had knowledge that climate change had been adversely affecting their own maize production activities.

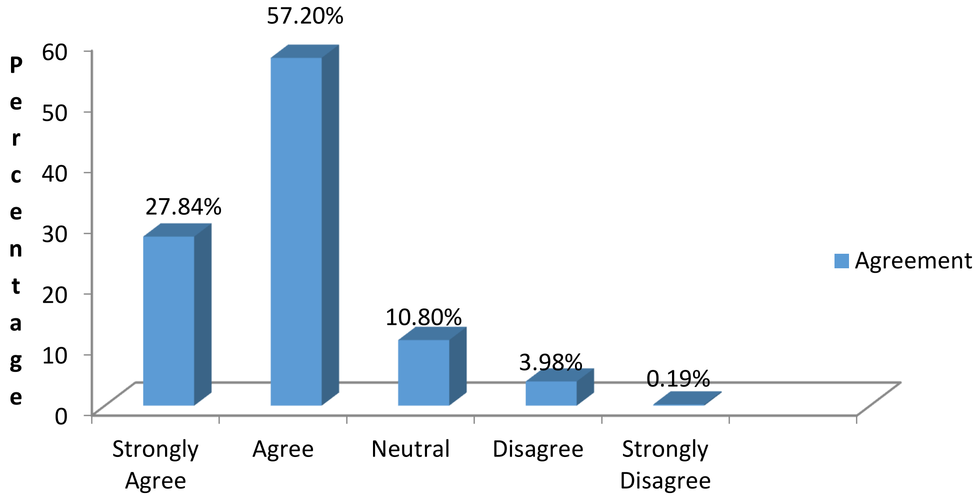

Figure 1: Respondents' agreement of climate change affects their own maize production
Source: Field survey, 2018.

Drivers of Maize Farmers' Choice of Climate Change Coping Strategies

It is obvious that the decision to choose a climate change coping strategy by farmers is largely determined by the understanding of climate change adverse effects. Thus, Double Huddle Model was employed to identify drivers (factors influencing/determinants) of maize farmers' choice of climate change coping strategies among maize farmers in Katsina State. The First Huddle involves the identification of factors influencing the farmers' understanding of the effects of climate change on their own maize production activities, which could in turn influence the farmers to adopt strategies so as to cope with the effects of the change. The second huddle involves finding the factors that influence maize farmers' choice of climate change coping strategies.

The results of the double hurdle analysis are presented in Table 2. The Table show the results of the first hurdle on the left hand side while the results of the second hurdle on the left hand side. The results show that education and major occupation were statistically significant at the first huddle only, while off-farm activities, livestock ownership, early planting, planting early maturing variety and crop diversification were statistically significant only at the second huddle. Experience, extension contacts, cooperative membership, irrigation, ridging and terracing and fight against felling trees were statistically significant in both first and second huddle.

The results in Table 2 show that in the first hurdle education had positive relationship and significant (at 5% level of probability) influence on the respondents' understanding of the effects of climate change on maize production. This implies that if the level of maize farmers' education increases their understanding of climate change effects on their maize production increases. Similarly, Mfere (2021) reported that that level of education positively and significantly influenced (at 5% level of probability) the Congo-Brazzaville maize farmers' understanding of climate change effects.

Table 2: Factors influencing maize farmers' choice of climate change coping strategies

Variables	First Huddles (Effect Understanding)			Second Huddle (Coping strategies Choice)		
	Coefficient	**Std Err**	**P-values**	**Coefficient**	**Std Err**	**P-values**
Constant	19.98	57.56	0.997	0.63*	0.36	0.083
Household size	-0.03	0.02	0.150	-0.00	0.01	0.854
Education	0.10**	0.05	0.049	-0.00	0.01	0.730
Experience	0.05*	0.03	0.073	-0.73***	0.730	0.000
Extension contact	0.15**	0.07	0.027	0.03**	0.01	0.012
Major occupation	0.51***	0.42	0.000	0.00	0.11	0.967
Off-farm activities	0.63	0.49	0.200	1.47***	0.12	0.000
Cooperative membership	1.03**	0.47	0.027	0.31***	0.10	0.003
Land ownership	-1.16	0.84	0.169	0.06	0.17	0.724
Farm size	-0.04	0.10	0.675	0.02	0.76	0.446
Livestock ownership	-1.11	1.13	0.328	0.05**	1.99	0.047
Irrigation	1.47**	0.60	0.014	0.38***	15.31	0.000
Ridging and terracing	-1.85**	0.83	0.027	0.07***	3.12	0.002
Early planting	-7.88	5756.21	0.998	0.16***	6.00	0.000
Planting early maturing variety	0.65	0.63	0.305	0.13***	5.70	0.000
Crop diversification	-0.03	10.53	0.955	0.23***	9.27	0.000
Planting trees	-0.08	10.47	0.868	0.32***	12.46	0.000
Fight against felling trees	1.48	0.61	0.015**	0.25***	9.47	0.000
Observations	528			490		

***(p<0.01), **(p<0.05) and *(p<0.1) = significant at 1%, 5% and 10%, respectively. Std Err = Standard Error.
Source: Field survey, 2018.

The results in Table 2 also indicate that in the first huddle experience had positive relationship with the respondents' understanding of climate change effects on maize production, as well as having significant influence (at 10% level of probability; p = 0.073) on the understanding. This means that if the experience of respondents increases his understanding of the climate change effects also increases. It can be seen that in the second huddle, experience had significant influence (at 1% level of probability; p = 0.000), but had negative relationship with the respondents' choice of climate change coping strategies. This means that if the experience of a maize farmer increases his choice of climate change coping strategies decreases. The interpretation of this is that, as the experience of the maize farmer increases, his understanding of climate change coping strategy that could serve many purposes could increase and thus, there need for him to select few to serve his purposes. For instance, selecting of drought resistant; early maturing and high yielding variety instead of selecting three varieties each with a particular characteristic.

The results in Table 2 indicate that extension contact had positive relationship and significant (at 5% level of probability) influence on both the respondents' understanding of climate change effects and choice of climate change coping strategies. This implies that if the contact increases, both the variables would also increase. This is emphasizes the importance of contacts between farmers and extension agents in adoption of agricultural innovations. These findings agree with those of Legesse, Ayele and Bewket (2012) and Oduniyi (2016) who reported that extension contacts had positive relationship and significant influence on their respondents' understanding of climate change. Similarly, Aidoo *et al.* (2021) reported that extension visit positively and significantly influenced maize farmers' adoption of climate change coping strategies in two agro-ecological zones of Ghana.

The results in Table 2 also show that major occupation was positively related to the respondents understanding of climate change effects on maize production and significantly influenced the understanding at 1% level of probability ($p = 0.000$). This means that as the farmer embrace farming (maize production) as his/her major occupation, his/her understanding about climate change effects on maize production will improve significantly, which could in turn help him/her in taking appropriate actions about how to cope with the climate change effects.

Off-farm activities as depicted by the results in Table 2 had direct relationship and significant influence (at 1% level of probability that is $p < 0.000$) on the respondents' choice of climate change coping strategies. This means that if off-farm activities increase the maize farmers' choice of climate change coping strategies increases. This implies that the variables are important in suppressing the effects of climate change on maize production in Katsina State. This is because the farmer could get more incomes through the activities that could help him to afford more climate change coping strategies.

Cooperative membership had positive relationship and significant influence on both the understanding of climate change effects on maize production (at 5% level of probability) and choice of coping strategies against climate (at 1% level of probability). This implies that as these variables increase, the level of the maize farmers' understanding of the climate change effects and choice of the climate change coping strategies would also increase. This is due to the fact that participation in cooperative activities helps farmers to come across innovations, skills and opportunities that could lead to the improvement in their farming activities. This findings is in line with that of Mfere (2021) who reported that cooperative membership has direct and significant influence (at 10% level of probability) of Congo-Brazzaville maize farmers' adoption of climate change coping strategies.

It can also be observed from the results in Table 2 that livestock ownership had direct relationship and significant influence (at 5% level of probability that is $p < 0.047$) on the respondents' choice of climate change coping strategies. This means that if the maize farmers' livestock production increases, the maize famers' choice of climate change coping strategies would also increases. The interpretation of this is that, livestock production is a source of earning more incomes that could be used to afford more climate change coping strategies; their dung also helps in the improvement of soil structure as well as replenishing nutrients to the soil amid climate change.

Irrigation as can be seen in Table 2 had positive relationship and significant influence on both Katsina State maize farmers' understanding of climate change effects on maize production and choice of coping strategies against the change. This means that if irrigation increases both the variables increase. Irrigation helps maize farmers to produce more per unit area amid climate change. A part from the fact that it is as source of more farm incomes to the maize farmers that could be used in affording climate change coping strategies, it also helps in the improvement of microclimate.

The results in Table 2 also indicate that ridging and terracing had significant influence on both the maize farmers' understanding of climate change effects and the farmers' choice of climate change coping strategies. However, whereas it has negative relationship with the respondents' understanding of climate change effects, it has positive relationship with their choice of climate change coping strategies. This means that if the level of ridging and terracing increases, the understanding of climate change effects on maize production by the farmers will also decreases. This might be due to the fact less of ridging and terracing is needed because the land topography is plain in most of the area where maize is cultivated. However, the more the farmers continue to make ridges and terraces on their farms, the less would be the effects of climate change on their farming activities and the less they will notice its adverse effects on their maize production because, ridging and terracing help to reduce the effects of climate change on maize production, if it is practiced appropriately where it is needed. For instance, ridging and terracing help in checking soil erosion, moisture conservation and suppress weeds.

On the other hand, if ridging and terracing increases, the choice of climate change coping strategies increases. The interpretation of is that as the maize farmers practiced ridging and terracing (especially those that are not producing maize on plain topography), they would noticed the importance of adopting coping strategies against climate change as such they would be triggered to look for more climate change coping strategies that could help them to suppress the effects of climate change on their production activities.

The results in Table 2 also revealed that early planting had direct relationship and significant influence (at 1% level of probability that is $p < 0.001$) on the respondents' choice of climate change coping strategies. This means that as this variable increases the maize farmers' choice of climate change coping strategies increases. Early planting helps the maize farmers to produce their maize crop within the scope of rainfall. Thus, those farmers who plant their maize late are likely to be more adversely affected by climate change than those who plant early, especially if there is early cessation of rainfall. Realizing the consequences of planting their maize seeds late would influence the farmers to choose early plating as important climate change coping strategies.

The results in Table 2 also revealed that planting of early maturing varieties had direct relationship and significant influence (at 1% level of probability that is $p < 0.001$) on the respondents' choice of climate change coping strategies. This means that as these variables increase the maize farmers' choice of climate change coping strategies increases. This implies that the variables are important in suppressing the effects of climate change on maize production in Katsina State. This means that if planting of early maturing varieties by the farmers increases, the productivity of the farmers would increase, thereby reducing the effects of climate change and vulnerability, which in turn would aid the economic well-being of the farmers as well.

As can also be noticed from the results in Table 2 crop diversification, had direct relationship and significant influence (at 1% level of probability that is $p < 0.001$) on the respondents' choice of climate change coping strategies. This means that as this variable increases the maize farmers' choice of climate change coping strategies increases. This implies that the variable is important in suppressing the effects of climate change on maize production in Katsina State. This is due to the fact that crop diversification serve as security against crop failure, because some crop are more durable to climate change effects than maize and thus, those maize farmers who diversify more are likely to be less affected by climate change than those who diversify their crops less. Diversification helps in reducing the effects of climate change and vulnerability of the farmers, which in turn would aid the economic well-being of the farmers as well.

The results in Table 2 also revealed that tree planting had direct relationship and significant influence (at 1% level of probability that is $p < 0.001$) on the respondents' choice of climate change coping strategies. This means that as this variable increases the maize farmers' choice of climate change coping strategies increases. This implies that the variable is important in suppressing the effects of climate change on maize production in Katsina State. This is due to the fact that tree planting is an important Climate Smart Agricultural Practice (CSAP) that helps in carbon sequestration.

The results in Table 2 also show that actions against felling trees had positive relationship and significant influence on both the respondents' understanding of climate change and choice of climate change coping strategies. This means that as this variables increase, the level of the maize farmers' understanding of climate change effects on the maize production and choice of climate change coping strategies would also increase. This is due to the fact that the more the farmers are concerned about checking indiscriminate tree felling the more the environment will be protected against climate change and the less will be the adverse effects of the change on maize production.

CONCLUSION

Katsina State maize farmers had the understanding of climate change adverse effects on their own maize production activities. This triggered them to choose various coping strategies against the effects of the change. There were a lot of drivers (factors) that significantly influenced the maize farmers' choice climate change coping strategies. Some of these factors had significant influence on both the farmers' understanding of the adverse effects of climate change on their maize production activities and their choice of climate change coping strategies. Others only had significant influence on either the maize farmers' understanding of climate change effects maize production or their choice of climate change coping strategies. Identifying the drivers of maize farmers' choice of coping strategies against climate change is vital in formulating appropriate policies that could help in improving maize production in the state. This will in turn help in uplifting the living standard of the farmers.

RECOMMENDATIONS

The following recommendations were made:

i. The state government and its Local government authorities should put more effort to ensure that there is improvement in contacts between extension agents and the farmers.
ii. Governments should formulate and properly implement more policies against indiscriminate felling of trees. The policies should incorporate farmers so as to offer their contributions in taking actions against tree falling. The policies already on the ground should be strengthen and adhered strictly.
iii. Maize farmers should abide by the governments' policies that are meant to check indiscriminate tree felling and cooperate fully with government officials that are assigned to guide, supervise and ensure strict adherence of the policies. This would help in improving their activities as well as uplifting their well-being.

iv. The maize farmers should organize themselves into more strong cooperative societies and participate actively in the activities of the societies. This could help them to obtain and adopt valuable innovations that could help them to deal with the threat of climate change which could in turn help in improving the living standard.

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