



Determinants of choice of adaptation to climate change by maize-based farmers in Ekiti state, Nigeria

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General Note



Article is recommended to print as color version in recycled paper. *Save Trees, Save Climate.*

ABSTRACT

This study examined the determinants of choice of adaptation strategies to climate change employed by maize-based farmers in Ekiti State, Nigeria. Multistage sampling technique was used to select 172 maize-based farmers for the study. The data were obtained on respondents' socio-economic characteristics, inputs, outputs and climate change adaptation strategies of maize-based farmers using a pre-tested questionnaire. Descriptive statistics, and Tobit regression techniques were used for data analysis. Results revealed that 79.1% of the farmers were male, 89.0% were married and 73.2% had formal education with mean age, farm and household sizes of 47 years, 2.90 hectares and 5 persons respectively. Furthermore, 63.9% had secondary occupation, 25.6% had access to credit, 84.9% had access to extension visits and 67.4% were aware of climate change. Common adaptation strategies used

by the farmers were multiple crop type ($\bar{x} = 2.40$), crop rotation ($\bar{x} = 2.26$), crop diversification ($\bar{x} = 2.16$), planting of cover crops ($\bar{x} = 2.06$) and multiple planting dates ($\bar{x} = 2.03$). Principal constraints faced by the respondents in adapting to climate change were high costs of improved seeds (90.1%), invasion of farm by Fulani herdsmen (85.5%), lack of timely information on weather conditions (85.4%), inadequate access to institutional facilities (81.9%) and high costs of irrigation facilities (76.2%). Chi-square showed a significant ($p < 0.01$) association between adaptation strategies used and maize output ($\chi^2 = 208.0$, $df = 11$). Tobit model revealed that sex ($\beta = -0.0945761$), household size ($\beta = -0.0204273$) and income ($\beta = 7.39e-08$) were major determinants of adaptation strategies ($p < 0.10$, $p < 0.10$ and $p < 0.05$ respectively). The study concluded that climate change adaptation strategies affected maize output. The study recommended that the maize-based farmers in the study area should continue to make use of multiple crop type, crop diversification, multiple planting dates, mixed farming, land fragmentation, use of agricultural insurance, crop rotation, planting of cover crops, fertilizer application as climate change adaptation strategies to improve maize output.

Keywords: Maize based farmers, Adaptation, Climate Change, Nigeria

1. INTRODUCTION

Agriculture places heavy burden on the environment in the process of providing humanity with food and fibre, and climate is one of the determinants of agricultural productivity. Nearly all agricultural products are being affected by climate change. Studies indicate that Africa's agriculture is negatively affected by climate change (Pearce *et al.*, 1996; McCarthy *et al.*, 2001). Given the fundamental role of agriculture in human welfare, concern has been expressed by Federal agencies and concerned stakeholders regarding the potential effects of climate change on agricultural productivity. Interest in this area has motivated a substantial body of research on climate change and agriculture over the past decades (Fischer *et al.*, 2002; Wolfe *et al.*, 2005; Lobell *et al.*, 2008).

According to Amado *et al.* (2010), changing weather and climatic conditions is likely to affect the supply of raw materials, interrupt transport and logistics, damage infrastructure and physical assets, reduce revenues, and create other direct and indirect impacts. This can even reduce the nation's Gross Domestic Product (GDP).

However, having realized that agricultural products are being affected by climate changes, it is therefore essential to examine how far Nigerian maize-based farmers are coping with the issues of climate change in many states in the country.

Most people in Nigeria depend on cereals especially maize as a contributing source of food and nutrition (CBN, 2005). Maize, however is a major important cereal crop being cultivated in the rainforest and the Derived Savanna Zones of Nigeria (Iken and Amusa, 2004). Despite its high yielding potential, maize production is faced with challenges which can be traced to change in weather elements (Ayanlade and Odekunle, 2006). Long term changes in patterns of temperature and precipitation is expected to shift production seasons, pest and diseases patterns, and modify sets of feasible crops, affecting production, prices, income and ultimately, livelihood. It is also predicted that crop yield in Africa may fall by 10% - 20% by 2050 due to climate change, most especially because African agriculture is predominantly rain-fed and hence fundamentally owing to change in weather variables (Jones and Thornton, 2003).

Oluwasusi and Tijani (2013) explained that the major adaptation strategies used in Ekiti State (on yam production though), are planting of cover crops, mulching, use of weather forecasts, and so on. It is expedient to identify some other strategies that are practised and the challenges associated in adopting any of the strategies. For example, the new and major challenge by many scholars has been invasion of cattle herdsmen. This study sought to find out all these, and possible policies to mitigate them would be recommended.

The Objectives are stated as follows:

- i. describe the socio-economic characteristics of the maize-based farmers in the study area;
- ii. identify various adaptation strategies used by the maize-based farmers in the study area;
- iii. determine the factors affecting adoption of adaptation strategies employed by maize-based farmers in the study area; and
- iv. describe the constraints faced by maize-based farmers in adapting to climate change in the study area.

Hypothesis

H₀: There is no significant relationship between adaptation strategies employed by maize-based farmers and their production.

H_A: There is significant relationship between adaptation strategies employed by maize-based farmers and their production.

2. LITERATURE REVIEW

Concept of Adaptation

Though, there is a problem of climate change, can we then say farmers (both food and cash crop farmers) are fully disadvantaged? No, they still adapt by making use of some strategies; these adaptation strategies are however needed to be discussed to have a better understanding of climate change as far as this study is concerned. Adaptation to climate change is an adjustment made to human, ecological, physical or socio-economic systems, in response to perceived vulnerability or expected and actual climatic stimuli, their effects or impacts (Adger *et al.*, 2007; IPCC, 2001; Smit *et al.*, 2000). Nhemachena and Hassan (2007) explained adaptation to climate change as changes in agricultural management practices in response to changes in climate conditions.

Adaptation to Climate Change in Agriculture

Adaptation and mitigation can both be used to reduce the negative impacts of climate change. Mitigation refers to reducing climate change by reducing the GHG emissions. Adaptations are adjustments or interventions, which take place in order to manage the losses or take advantage of the opportunities presented by a changing climate (IPCC 2001). Adaptation is the process of improving society's ability to cope with changes in climatic conditions across time scales, from short term (e.g. seasonal to annual) to the long term (e.g. decades to centuries). Adaptation to climate change refers to the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects to moderate harm or exploit beneficial opportunities (IPCC 2001).

Even though mitigation targets uprooting the major causes of climate change and offers long-run solutions, adaptation is much more important for the group of developing countries. Emphasis should focus on adaptation because human activities have already affected climate, climate change continues given past trends, and the effect of emission reductions will take several decades before showing results, and adaptation can be undertaken at the local or national level as it depends less on the actions of others (Fussler 2007). There are various ways to classify or distinguish between adaptation options. First, depending on the timing, goal and motive of its implementation, adaptation can be either reactive or anticipatory. (Richard, Reactive adaptation occurs after the initial impacts of climate change have become manifest, whilst anticipatory (or proactive) adaptation takes place before impacts are apparent. A second distinction can be based on the system in which the adaptation takes place: the natural system (in which adaptation is by definition re-active) or the human system (in which both reactive and anticipatory adaptation are observed).

Within the human system a third distinction can be based on whether the adaptation decision is motivated by private or public interests. Private decision-makers include both individual households and commercial companies, whilst public interests are served by governments at all levels. Capacity to adapt to climate change is very closely linked to socioeconomic factors, such as poverty, diversification of income sources, level of education, and access to infrastructure and technology. Promoting broad-based agricultural development to lift rural communities out of poverty is probably the effective adaptation strategy available (Johnston *et al.*, 2009). Smit and Skinner (2002) grouped agricultural adaptation options to four (4) main categories, but observed that they are not mutually exclusive, namely: technological developments, government programmes and insurance, Farm production practices and Farm financial management.

Adaptation strategies

1. Farm production practices:

- a. *Farm Production:-*
 - i. Diversify crop types and varieties, including crop substitution, to address the environmental variations and economic risks associated with climate change.
 - ii. Diversify livestock types and varieties to address the environmental variations and economic risks associated with climate change.
 - iii. Change the intensification of production to address the environmental with respect to climate-related income loss.
 - iv. Modify subsidy, support and incentive programmes to influence farm-level production practices and financial management.
 - v. Change ad hoc compensation and assistance programmes to share publicly the risk of farm-level income loss associated with disasters and extreme events.
 - vi. Variations and economic risks associated with climate change.
- b. *Land Use:-*
 - i. Change the location of crop and livestock production to address the environmental variations and economic risks associated with climate change.
 - ii. Use alternative fallow and tillage practices to address climate change-related moisture and nutrient deficiencies.

c. *Land Topography:-*

- i. Change land topography to address the moisture deficiencies associated with climate change and reduces the risk of farm land degradation.

d. *Irrigation:-*

- i. Implement irrigation practices to address the moisture deficiencies associated with climate change and reduce the risk of income loss due to recurring drought.

e. *Timing of Operations:-*

- i. Change timing of farm operations to address the changing duration of growing seasons and associated changes in temperature and moisture.

2. Government Programmes and Insurance:

a. *Agricultural Subsidy and Support Programmes:-*

- i. Modify crop insurance programmes to influence farm-level risk management strategies with respect to climate-related loss of crop yields.
- ii. Change investment in established income stabilization programmes to influence farm-level risk management strategies

b. *Private Insurance:-*

- i. Develop private insurance to reduce climate-related risks to farm-level production, infrastructure and income.

c. *Resource Management Programmes:-*

- i. Develop and implement policies and programmes to influence farm-level land and water resource use and management practices in light of changing climate conditions.

3. Technological Development:

a. *Crop Development:-*

- i. Develop new crop varieties, including hybrids, to increase the tolerance and suitability of plants to temperature, moisture and other relevant climatic conditions.

b. *Weather and Climate Information Systems:-*

- i. Develop early warning systems that provide daily weather predictions and seasonal forecasts.

c. *Resource Management Innovations:-*

- i. Develop water management innovations, including irrigation, to address the risk of moisture deficiencies and increasing frequency of droughts.
- ii. Develop farm-level resource management innovations to address the risk associated with changing temperature, moisture and other relevant climatic conditions.

4. Farm Financial Management:

a. *Crop Insurance:-*

- i. Purchase crop insurance to reduce the risks of climate-related income loss.

b. *Crop Shares and Futures*

- i. Invest in crop shares and futures to reduce the risks of climate-related income loss.

c. *Income Stabilization Programmes:-*

- i. Participate in income stabilization programmes to reduce the risk of income loss due to changing climate conditions and change.

d. *Household Income:-*

i. Diversify source of household income in order to address the risk of climate-related income loss.

3. METHODOLOGY

The Study Area

The study area is Ekiti state. Ekiti State is in the South Western Rain Forest Zone of Nigeria. It is located between Longitude $4^{\circ}51'$ East of the Greenwich Meridian and latitude $7^{\circ}15'1''$ north of the Equator. Ekiti State has tropical climate in two seasons; these are the raining season (April – October) and dry season (November – March). Temperature ranges between 21°C and 28°C with high humidity of over 75%. Tropical rain forest exists in the south, while guinea savanna occupies the northern part of the country. The State is endowed with water resources including major rivers like Ero, Osun, Ose, Ogbese, Oni etc. The State is also dotted with rugged hills, among which are Ikere Ekiti Hills in the southern part, Efon,-Alaaye Hills in the western boundary and Ado Hills in the central part. The State is bounded to the North by Kwara and Kogi States while it is bounded by Osun state to the West, Edo to the East, and Ondo to the South. Ekiti state is a landlocked State, having no coastal boundary.

Data Collection

Primary data was used for this study and this was collected by the use of questionnaire. This questionnaire contained questions that have to do with the socio-economic characteristics of the respondents, issues as regards their inputs, outputs and climate change adaptation strategies they adopt.

Sampling Procedure for the primary data

The sampling procedure for the primary data was multistage sampling technique.

Stage 1 involved random selection of two agricultural zones from the three agricultural zones in Ekiti State. The three agricultural zones are Aramoko, Ikole and Ikere. Aramoko and Ikole zones were randomly selected among the three zones. Stage 2 involved random selection of two blocks from the agricultural zones. The blocks selected were Aramoko, Efon Alaaye, Ikole Ekiti and Oye Ekiti. Stage 3 involved a selection of 3 villages from each block. The villages selected were Aramoko, Itawure, Okemesi, Erio, Iwaji, Odo Amo, Ikole, Isaba-Asin, Odo-Oro, Oye-Osin, Ilupeju, Itapa Ekiti and stage 4 involved convenient sampling of 15 maize-based farmers from each selected village. The total number of respondents was 180, out of which 172 gave useful information that suits the purpose of this study.

Model Specification

The Tobit Model

This model was used to analyze the factors that determine the adoption of any climate change adaptation strategies by the respondents in the study area.

The stochastic underlying Tobit model as given by Greene (1990); Riatania *et al*(2014) is as stated below:

$$Yi^* = \beta_0 + \sum_{m=1}^h \beta_m X_{Im} + \varepsilon_1$$

Rewriting the above equation,

We could have:

$$y_t = X_t \beta + \mu$$

The y_t is a latent variable that is observed for values greater than 0 and censored otherwise.

The observed y is defined by the following measurement equation

If $X_t \beta + \mu_t > 0$

If $X_t \beta + \mu_t \leq 0$

$t = 1, 2, 3, 4, \dots, N$

N = Number of observations

X_t = Explanatory Variables

y_t = Dependent variable. The dependent variable is the adoption ratio of the adaptation strategies of the farmers in the study area.

Adoption Ratio: Ratio of the number of adopted adaptation strategies to the total number of the adaptation strategies for each respondent.

β = Vector of Unknown cause

U_t = iid error

The factors that were considered as the explanatory variables (X_{is}) are:

X_1 = Age (years)

X_2 = Sex (dummy; 1 if male, 0 if otherwise)

X_3 = Marital Status

X_4 = Numbers of years spent in formal education

X_5 = Household size (numbers of persons)

X_6 = Secondary Occupation (dummy: 1 if there is secondary occupation, 0 if otherwise)

X_7 = Awareness of climate change (dummy: 1 if aware, 0 if otherwise)

X_8 = Access to extension agent (dummy: 1 if there is extension contact, 0 if otherwise)

X_9 = Access to credit (dummy: 1 if there is access to credit, 0 if otherwise)

X_{10} = Farm size (hectares)

X_{11} = Farmers' income (naira)

4. RESULTS AND DISCUSSION

Socio Economic Characteristics of the Respondents

This includes distribution of respondents according to age, gender, marital status, household size, educational status, secondary occupation of the respondents in the study area.

Age of respondents

Table 3 shows that 32.6% of the respondents were between 21-40 years, 59.3% were between 41-60 years and 8.1% were above 60 years with mean age of 47 years and standard deviation of 11.4. It can be deduced that majority (59.3%) are in their productive age, with potential for income generation and positive returns. This is in line with Sangotogbe *et al.* (2012). A suggested reason why there are not many young people below 40 years in the study area is that most of them prefer less climate risk businesses unlike farming which is highly vulnerable owing to climate change.

Sex of respondents

This study reveals that 79.1% of the respondents were males while 20.9% were females. This shows that men are more involved in maize production in the study area than females as mostly found out by many agricultural researchers. This is in line with the findings of Sangotogbe *et al.* (2012), Oluwasusi and Tijani (2013), who also reported that males are more involved in farming activities than females. The likely reason for this may be due to natural ruggedness of males which may make them withstand the rigorous activities associated with farming activities.

Religion of Respondents

The study shows that 66.9% of the respondents were Christians, 29.7% were Muslims and 3.5% were found to be traditional believers.

Marital Status of Respondents

Also, it was found out that 8.7% of the respondents were single while 89.0% were married and 2.3% were widowed. This corroborates the work of Oluwasusi and Tijani (2013) who conducted a study on farmers' adaptation strategies to the effect of climate variation in Ekiti State, Nigeria and reported that majority of farmers were married. Majority of the respondents being married can assist their farming activities because both wives and children may serve as family labour on their farms.

Household Size of Respondents

The study showed that 44.8% had household size ranged between 1 and 4, 50.6% had between 5 and 8 and 4.7% had household size between 9 and 16. The mean household size is 5 persons. This suggests that there would be labour availability from family, hereby reducing cost of labour on the farm.

Secondary Occupation of respondents

The study revealed that 36% of the respondents had no secondary occupation while 63.9% of the respondents had secondary occupation. Some of the secondary occupations stated by the respondents are tailoring, trading, printing, bricklaying, furniture making and so on. This suggests that most of the farmers still have other source of income for them to fall back on, should in case there is a huge loss due to climate change. This can be technically called off-farm employment leading to income diversification.

Distribution of respondents according to Farm size

It was revealed that 16.3% of the respondents had farm size of 0.2-1 hectares and the majority (72.2%) had farm size between 1.1-5 hectares, 6.9% had farm size between 6 and 11 hectares while 4.7% had farm size between 12 and 20 hectares. The result shows that majority of the respondents have farm sizes between 1.1 and 5 hectares.

Credit Accessibility of respondents and extension agents

Majority (74.4%) of the respondents did not have access to credit; this may limit the ability of the farmers to expand their scale of production. This lack of access to credit facilities may be due to high interest rates being charged by financial institutions, and other bureaucratic issues which characterize loan acquisition and disbursement in this country.

Majority (84.9%) of the respondents said they have access to extension agents and 15.1% responded that they had no access to extension agents. This is against Sangotogbe *et al.*, (2012) who reported that most food crop farmers in South Western area of the nation had no extension contact.

Awareness of Climate change

About 67.4% of the respondents said they were aware that the climate varies from time to time at a particular location while 32.6% responded that they were not aware of climate change.

Income of Respondents

About 30% of the respondents earned between ₦101,000-₦200,000 while 0.6% earned ₦601,000-₦700,000. 4.1% earned 701,000-800,000 and 19.7% earned above ₦800,000 per annum with a mean of ₦583,670.

Table 1 Distribution of respondents according to Socio Economic characteristics (n=172)

Characteristics	Frequency	Percentage (%)	Mean (standard deviation)
Age			
21-40	56	32.6	46.6 (11.4)
41-60	102	59.3	
Above 60	14	8.1	
Marital Status			
Single	15	8.7	
Married	153	89.0	
Widowed	4	2.3	
Sex			
Males	136	79.1	
Females	36	20.9	
Religion			
Christianity	115	66.9	

Islam	51	29.7
Traditional Belief	6	3.5

Household size

1-4	77	44.8	
5-8	87	50.6	5 (2.25)
9-16	8	4.7	

Educational status

Never attended school	46	26.7	
Attended primary school	40	23.2	2.4 (1.12)
Attended Secondary School	51	29.7	
Attended higher institution	35	20.3	

Secondary occupation

No secondary occupation	62	36.0
Secondary occupation	110	63.9

Farm Size

0.2-1	28	16.3	
1.1-5	124	72.2	2.90 (3.38)
6-10	12	6.9	
12-20	8	4.7	

Access to credit

Yes	44	25.6
No	128	74.4

Access to extension agents

Access	146	84.9
No Access	26	15.1

Annual Income

≤100,000	18	10.5	
101,000-200,000	51	29.7	
201,000-300,000	18	10.5	
301,000-400,000	15	8.7	
401,000-500,000	18	10.5	583,670 (552,190)
501,000-600,000	10	5.8	
601,000-700,000	1	0.6	
701,000-800,000	7	4.1	
≥800,000	34	19.7	

Awareness of climate change

Aware	116	67.4
Not aware	56	32.6

Source: Field Study, 2017

Maize-Based Farmers' Adaptation Strategy to Climate Change in the study area

The adaptation strategies employed by the respondents are as shown in the table 2.

For multiple cropping, 51.7% of the respondents claimed that they used it always while 36.6% said that they used it occasionally while 11.6% responded that they never made use it as a strategy to mitigate climate change. The study also found out that multiple planting dates were also engaged in this way: 40.7% used it always, 22.1% used it occasionally and 37.2% never used it. The study further showed that 38.4% made use of crop diversification always, 39.0% used it occasionally and 22.7% did not use it at all. Also, 27.3%, 45.3% and 27.3% said they made use of land fragmentation always, occasionally, and never, respectively.

About 13% of the maize farmers employed the use of irrigation always, while 37.4% used irrigation occasionally and 49.4% never made use of irrigation as a means of adapting to climate change. It was also observed that 25.0% also used off-farm employment always while 43.6% used it occasionally and 31.4% never used it as a means of adapting to climate change. The study also found out that, 27.9% of the respondents used mulching always, while 29.1% used it occasionally and 43.0% did not use it as a means of adaptation to climate change.

Planting of cover crops was always used by 29.7%, occasionally used by 47.1% and 23.3% never used it. About 24% of the respondents applied fertilizer always, to adapt to climate change, while 43.6% applied it occasionally and 32.6% never applied fertilizer for adapting to climate change. Also 5.2% of the respondents planted trees always, 45.9% planted trees occasionally and 48.8% did not use planting of trees as a means of adapting. In case of crop rotation, 39.0% practiced it always, 48.3% practiced it occasionally and 12.8% never practiced it as adaptation strategy. Agricultural insurance is another method, in which 2.9% of the respondents are found to use it always, 7.6% were found to use it occasionally and 89.5% never used agricultural insurance. This may be owing to non-availability of these insurance policies or even if they are available, farmers may not have access to them.

The last strategy engaged in this study is mixed farming and 30.2% of the farmers claimed to use it as a strategy to climate change, while 37.2% used it occasionally and 32.6% never used it. These results are in line with Rudolf and Hermann (2009) and Apata *et al* (2009) who reported that main strategies for reducing climate risk is to diversify production and livelihood systems such as soil and water management measures, and plant protection measures that varied to maintain adequate crop yields.

Table 2 Distribution (%) of respondents according to their adaptation strategies (n=172)

Adaptation Strategies	Always	Occasionally	Never
Multiple Crop type	51.7	36.6	11.6
Crop Diversification	38.4	39.0	22.7
Multiple planting dates	40.7	22.1	37.2
Mixed farming	30.2	37.2	32.6
Land Fragmentation	27.3	45.3	27.3
Use of agricultural insurance	2.9	7.6	89.5
Planting of trees	5.2	45.9	48.8
Irrigation	13.4	37.2	49.4
Crop Rotation	39.0	48.3	12.8
Mulching	27.9	29.1	43.0
Planting of cover crops	29.7	47.1	23.3
Fertilizer Application	23.8	43.6	32.6

Source: Field Study, 2017

Factors Determining Adoption of Adaptation Strategies Employed by the Farmers in the study area

As shown in Table 3, sex and household size have negative impact on adoption ($p < 0.10$). This implies that the likelihood of farmers to choose any of the strategies is in favour of female farmers in the study area i.e. female farmers in the study area use climate change adaptation strategies than male farmers. Household size which is also negatively significant suggests that as farmers' size of household increases, there is decrease in the likelihood to adopt adaptation strategies. This corroborates the report of Obayelu *et. al* (2014) that household size had negative significant relationship with adoption of adaptation strategies like diversification into non-farm crops in the study area. This could have been caused by exodus of children in households out of the farming communities possibly to urban or civilized areas for greener pastures. Income was found to be positively significant ($p < 0.05$). This suggests that as the income of these farming houses increases, there is increase in likelihood of farmers to adopt climate change adaptation strategies. This is expected, and it is good to note that one motive for adapting to climate change is either to have something to fall back on in case of loss due to climate change, avert effects of climate change or reduce the effects of climate change to the barest minimum. So, this result shows that the more farmers earn, the more they involve in climate change adaptation strategies that increase their sources of income.

Table 3 Parameter estimates of the Tobit regression, explaining the factors affecting the choice of adaptation strategies employed by the respondents

Variables	Coefficients (β)	t-values	p> t
Age	0.0024552	0.90	0.290
Marital Status	-0.0732205	-1.02	0.309
Sex	-0.0945761*	-1.83	0.069
Years in School	-0.0016415	-0.41	0.680
Household size	-0.0348536*	-1.89	0.060
Awareness	-0.0348536	-0.67	0.502
Farm size	-0.0099471	-1.42	0.158
Income	7.39e-08**	1.95	0.053
Access to Credit	-0.0261356	-0.51	0.613
Secondary Occupation	-0.0004308	0.06	0.950
Access to extension	0.0004308	0.34	0.732
Constant	0.7620427***	6.05	0.000

* denotes 10% level of significance

** denotes 5% level of significance

*** denotes 1% level of significance

Number of Observations = 172

Pseudo R² = 0.0363

Source: Field Study, 2017

Constraints faced by the Respondents in adapting to climate change

The result shows that 8.1% of the respondents said illiteracy is a very severe constraint, 21.5% considered it to be severe, 37.8% said it is a not severe constraint and 32.6% said it is not a constraint at all. This may imply that most of the farmers in the study area are literate and this has been helping in their quest to know more about climate change and also means to adapt to it. The result also shows that 7.6%, 34.9%, 43.0% and 14.5% regarded poor access to climate adaptation strategies as very severe, severe, not severe and not a constraint respectively. We can say from this that minority opined that poor access to climate adaptation strategy is very severe.

Also, 20.3% of the respondents said inadequate access to supporting institutional facilities like (cooperative, adult education programme) is a very severe challenge, 51.7% considered it as severe, 9.9% said it is not severe and 18.0% declared that it is not a constraint. The tedious nature of some of these strategies was also considered as a constraint; 9.3% opined it is very severe, 24.4% said it is severe, 52.3% said it is not severe and 14.0% said it is not a constraint at all.

Furthermore, some of the respondents also said that high cost of improved seed is very severe (18.0%), while 22.7% said it is severe, 49.4% said it is not severe and 9.9% said it is not a constraint.

In the study, 14.5% said poor extension service delivery as a constraint is very severe, 10.5% said it is severe, 46.5% opined that it is not severe, yet a constraint and 28.5% response is that it is never a constraint.

Some respondents, 3.5% also said traditional belief is very severe, 8.7% said it is severe, 34.3% declared that it is severe and 53.5% said it is not constraint at all. These kinds of belief like new yam festival, cooperate commencement of farming season disturb in adapting to climate change because it alters planting season.

The study also shows that 35.5% expressed their opinion that high cost of irrigation facilities is very severe, 37.8% said it is severe, 2.9% opined it is not severe and 23.8% explained that that it is not a constraint. Lack of timely information on weather conditions was considered to be very severe by 11.0% of the respondents, 37.2% considered it to be severe, 37.2% said it not severe, 14.5% considered it not to be constraint. This implies that there is inadequacy of information on the on climate as required for effective adaptation measures in the study area.

Very small percentage of the respondents (9.9%), in their own opinion said lack of improved seeds is a very severe constraint, 40.1% is severe, 28.5% said it is severe and 21.5% declared that is not a constraint at all. Efforts should be made to provide (through a well intensified extension programme) improved varieties of crops, which are not only disease and drought resistant, but are weed resistant. This will help farmers adapt to the effects of climate change caused by pests, diseases, prolonged drought and multiplication of stubborn weeds, all of which characterize climate change.

Invasion of herdsmen and their cattle was also considered, 29.7% considered it to be very severe, 50.0% said it is severe, 5.8% responded that it is severe while 14.5% said it is never a constraint. This implies that no matter how effective any strategy to adapt to climate change might prove to be, as long as there are no modalities to curb the excesses of the pastoralists in the study area, there cannot be any success. This is in line with Sangotogbe *et.al* (2012) who conducted a study in Oke Ogun area of South Western Nigeria and found out that the main constraint faced by farmers in adapting to climate adaptation strategies is invasion by Fulani herdsmen. Also it corroborates with Ufuoku and Isife (2009) who reported that farmers will have their outputs decreasing until there is a measure on ground to stop pastoralists from allowing their animals to graze on farmlands.

Table 4 Distribution of respondents in percentage (%) based on constraints faced in choosing any method in adapting to climate change. (n=172)

Constraint	Very Severe	Severe	Not Severe	Not a Constraint
Illiteracy	8.1	21.5	37.8	32.6
Poor access to climate adaption strategies	7.6	34.9	43.0	14.5
Inadequate access to Institutional facilities	20.3	51.7	9.9	18.0
Tedious nature of the strategies	9.3	24.4	52.3	14.0
High cost of Improved seeds	18.0	22.7	49.4	9.9
Poor extension service delivery	14.5	10.5	46.5	28.5
Traditional Belief	3.5	8.7	34.3	53.5
High costs of irrigation facilities	35.5	37.8	2.9	23.8
Lack of timely information on weather conditions	11.0	37.2	37.2	14.5
Lack of improved seeds	9.9	40.1	28.5	21.5
Invasion of farm by Fulani herdsmen	29.7	50.0	5.8	14.5

Source: Field Study, 2017

Test of Hypothesis

Chi-square analysis result on table five gave a chi-square value of 208.0. The individual variables tested relationship between climate change adaptation strategies and production of the maize-based farmers in the study area. Each of the adaptation strategies were considered in testing the hypothesis and the result showed that multiple crop type, land fragmentation, multiple planting dates, crop diversification, planting cover crops, fertilizer application, crop rotation, agricultural insurance, mixed farming were the strategies that had significant effect on the outputs of the respondents (with χ^2 = 98.256, 33.581, 14.535, 53.581, 28.488, 22.349,

95.256, 104.395, 23.814 respectively) while irrigation, planting of trees and mulching were not significantly affecting the output of the respondents (with $\chi^2 = 0.023, 0.897, 0.222$ respectively) in the study area.

Table 5 Chi-square result showing relationship between climate change adaptation strategies and production of the maize based farmers in the study area

Adaptation Strategies	Df	χ^2	Significant	Levels Decisions
Multiple Crop Type	1	98.256	0.000	Significant
Land Fragmentation	1	33.581	0.000	Significant
Multiple Planting Dates	1	14.535	0.000	Significant
Irrigation	1	0.023	0.879	Not Significant
Crop Diversification	1	53.581	0.000	Significant
Planting Cover Crops	1	28.488	0.000	Significant
Fertilizer Application	1	22.349	0.000	Significant
Planting of trees	1	0.023	0.897	Not Significant
Crop Rotation	1	95.256	0.000	Significant
Agricultural Insurance	1	104.395	0.000	Significant
Mixed Farming	1	23.814	0.000	Significant
Mulching	1	1.488	0.222	Not Significant

Source: Field Study, 2017 Df = Degree of freedom; χ^2 = Chi Square

5. CONCLUSIONS AND RECOMMENDATIONS

The adaptation strategies employed by farmers are multiple crop types, crop diversification, multiple planting dates, mixed farming, land fragmentation, use of agricultural insurance, planting of trees, irrigation, crop rotation, mulching, planting of cover crops, and fertilizer application. However, there were constraints faced by the respondents in making use of any of the strategies. The Chi square result which was used for the test of hypothesis to know whether the adaptation strategies had effect on the production of the maize farmers in the study area showed that climate change adaptation strategies significantly affected the outputs of the respondents in the study area. Also, the chi square result from the adoption index generated from the various adaptation strategies was found to be significant ($p < 0.01$) with a Chi-square value of 208.0. The study however recommended that income enhancement programmes should be promoted more in the study area, so as to make farmers generate more income and by this, they can continue to adopt climate change adaptation strategies and farmers in the study area should be taught how to properly make use of irrigation, planting of trees and mulching as adaptation strategies to climate change.

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