

Determinants of Climate Change Adaptation Among Cassava Farmers in Akwa Ibom State, Nigeria.

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Abstract

The importance of agricultural sector of any economy cannot be over emphasized as food security is a major issue in developing the economy of any Nation. Food security helps to promote self-sufficiency, healthy and efficient labor force. The production of cassava is declining drastically due to the effect of climate change. The main objective of this research work was to ascertain the determinants of climate change adaptation of cassava farmers in Akwa Ibom State, Nigeria. Data was collected with the aid of a well-structured questionnaire administered to 120 farmers through a multistage sampling technique were used in selecting the cassava farmers. Descriptive statistics and multi regression analysis were used to analyze the objectives of the study. The result for the socio-economic characteristics revealed that 56.4% of the respondents were male and 43.6% were female, the reason being that the researcher administered most of the questionnaire to male respondents. The mean of the major age ranges (31-50, 51=60) was 43.5, 69.1% were married and majority of the respondents had formal education, 68% of the respondents had 11-20 years of experience in cassava farming. The results of farmers' annual income showed that majority (47.3%) of the farmers were low income farmers. Only 11.8% of the farmers had earned above N 200,000 annually from the sales of their cassava produce. Majority of the respondents about 88.18% ($X=3.22$) claimed to have idea of climate change, The result of the logistic regression model showed the significant factors which influenced climate change adaptation included; age ($p<0.05$), education ($p<0.05$), years of experience ($p<0.05$), access to credit ($p<0.01$), among others. Climate change affects cassava production due to the fact that it is climate dependent. Climate change pattern such as; increased intensity and frequency of extreme temperature impact negatively on food production, environment and the population that depend on it for food security. It was recommended that arable crop farmers should be trained on climate change adaptation and be given access to credit for the adoption of technologies to cope with climate change.

Key Word: Determinants, Climate Change, Adaptation, multistage

Introduction: Agriculture plays important role in shaping the economy of many countries. In Nigeria, it is the highest employer of labor and serves as a major means of livelihood covering 70% of its population (World Bank, 2001). Agriculture provides over 90% of the food consumed locally and contributes 40% of the Gross Domestic Product (GDP) of Nigeria Nyong, &Nweze, 2012); (Ozor, 2009). However, it is a major source of household income and provides raw materials for agro-based industries (Oluigbo, 2012) ∴ Agriculture enhances food security and impacts on the overall economic growth of the country. It also provides feed for domestic animals and most of its by-products are of economic importance. Although the agricultural sector is being transformed by commercialization at the small, medium and large scale enterprise levels, the country is still faced with a number of problems in which addition to these; climate and weather patterns have been changing. (Ziervogel G., A. Nyong, B. Osman, C. Conde, S. Cortes, and T. Dowing, 2006) observed in their studies that Climate change, which is attributable to the natural climate cycle and human activities, has adversely affected agricultural productivity in Africa. Cassava (*Manihot Esculentuz* Crantz) is an important root crop in Nigeria. Nigeria is the largest producer of cassava in the world. Currently, production of cassava is put at about 34 metric tons. Cassava serves as food for man as well as in feeding livestock animals. Man

consumes over two thirds of the total production of cassava roots in various forms and the remainder is used as animal feed. The starchy, thickened storage roots are valuable source of inexpensive calories (Awoyinka,2009); (Nyong, &Nweze, 2012). Cassava roots are consumed raw, boiled or processed into cassava flour which is used in many industries. Leaves are used as vegetable and can be harvested periodically throughout the growing season Nyong, &Nweze, 2012); (Nwaiwu et al, 2010). As a result of its use as an industrial crop, cassava has been categorized as a cash crop. Cassava is an important crop with huge potential and has gained the attention through the launching of "Presidential Initiative on Cassava Production in Nigeria" which was inaugurated with the aim of achieving on annual basis five billion dollars from export of cassava.

However, according to (Nwafor 2007; Jagtap 2007), climate change is global, likewise its impacts; but the most adverse effects will be felt mainly by developing countries especially those in Africa, due to their low level of adaptation strategies and capabilities, Nigeria seems to be one of these developing countries that is involved. Agriculture places heavy burden on the environment in the process of providing humanity with food and fiber, while climate is the primary one of the determinant of agricultural productivity. A clear understanding of climate change is of critical importance in cassava crop production because agricultural production in developing countries are climate dependent, this is because

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the impacts of climate change on agriculture could be devastating in many areas and subsequently tends to be an additional challenge couple with the poverty related problems faced the farmers. Many regions already feel these impacts, which will get progressively more severe as mean temperatures rise and the climate becomes more variable. Nyong, & Nweze, 2012) in their studies indicated that Africa's agriculture is negatively affected by climate change.

According to Intergovernmental Panel on Climate Change (IPCC) (2001; 2007) climate change is the average weather conditions of a given place over time. The classical period is 30 years as defined by the World Meteorological Organization (WMO). Climate encompasses the statistics of temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric partial count and other meteorological elemental measurement in a given region. On the other hand, climate change is a significant and lasting change in the statistical distribution of weather patterns over period ranging from decades to millions of years (Wikipedia, 2010). Climate change and Agriculture are inter-related processes, both of which take place on a global scale. Nyong, & Nweze, 2012); Sowunmi & Akintola (2010) in their studies observed that the decline in crop yield and food production could be attributed to reduction or changes in rainfall, increased temperature, increased relative humidity, among others which are agents of climate. This change requires that farmers should perceive the changes in the prevailing climatic conditions and then identify useful mitigation practices or strategies. On this note, climate change adaptation practice has to do with those practices that will lead adjustments in the natural or human activities in response to the actual or expected climatic changes and their effects which could cause harm or exploit the beneficial opportunities by the rural farmers (Nyong & Bassey 2019); (Efe, 2011). Hence, this study is set to investigate the determinants of climate change adaptation among cassava farmers in Obot Akara Local Government Area, Akwa Ibom State, Nigeria. According to (Nyong & Bassey 2019); Sha, Fischer and van Velthuizen (2009) the adverse consequences of climate change will take an irreplaceable toll on food production and food security especially in developing countries which have a low capacity to cope and adapt to these challenges. Temidayo Gabriel Apata (2009) also asserted that climate change in the form of higher temperature, reduced rainfall and increased rainfall variability reduces crop yield and threatens food security in low income and agriculture-based economies like Nigeria. Evidence from Schlenker and Roberts (2009) confirmed the effects of climate change on farm net revenue in different parts of the globe through rainfall and temperature variability. Observable determinants of adaptation also provide some evidence that institutional and social economic factors play an important part in allowing farmers to adapt. It may also be attributed that access to credit is associated with the decision to adapt. However, it appears that the type of credit affects the propensity to adapt. Whereas informal credit is negatively related to the probability of adapting, formal credit is positively correlated with the probability of adaptation (Ashley Gorstet.al 2018). This underlines the need for a greater reach of formal credit.

In spite of the various uses cassava is known for, as an agent of self-sufficiency in food production, the gain derived

from its production by rural farmers is still not sufficient to keep the resource poor farmers above poverty line. The socio economic characteristics and resources of individual households have been identified as basic factors influencing the food security status of households (Nyong & Bassey 2019); (Sowunmi, F. A. and Akintola, J. O., 2010). When the returns from agricultural production is not be equated to the investment, agricultural production will be left in the hands of the elderly or the non-educated ones who cannot make decision. The researcher at this point was aimed at digging deep to find the determinants of climate change adaptation among cassava crop farmers in the study area. The Broad Objective of the study was to analyze the determinants of climate change adaptation among cassava farmers in Obot Akara local government area, Akwa Ibom State, Nigeria. The Specific Objectives of the study were to:; identify the socio-economic characteristics of cassava crop farmers in the study area. And examine the determinants of climate change on cassava production in the study area;

Area of Study: The study was carried out in Obot Akara local government area of Akwa Ibom State, Nigeria. Akwa Ibom is a state in Nigeria. It is located in the coastal southern part of the country; it has a total land area of 714km². It lies between Latitude 7° 11' and 5° 33 North; and Longitude 7° 35' E and 8° 25's East. The study area is in the rainforest zone and has two distinct seasons via: the rainy and the dry season. The annual precipitation ranges from 2000-3000mm per annum. Most of the inhabitants of the study area are small scale farmers dwelling especially in the peri-urban and rural communities and the most commonly cultivated crops grown in the area include: Yam, cocoyam, Cassava, maize, Raffia palm, Citrus and Vegetables etc.

Sampling Technique and Sampling Size: The data were collected by means of structured questionnaire administered to 120 respondents using a combination of purposive and sample random sampling techniques. Two agricultural zone were purposively selected, based on the fact that they form among others, the major producers of cassava in the area. Four cells were purposively chosen from each of clans, because of high number of cassava farmers among them. Then 15 respondents were randomly selected from each the three cells, making a total of 120 respondents, (2×4×15=120). To examine the effect of climate change on cassava crop production; Multinomial Logit regression model was used to analyse the collected data. The advantage of the multinomial logit is that it permits the analysis of decisions across more than two categories, allowing the determination of choice probabilities for different categories of climate change adaptation. This approach is more appropriate than the probit or logit models that have been conventionally used. The decision of whether or not to use any adaptation option could fall under the general framework of utility and profit maximization. Consider a rational farmer who seeks to maximize the present value of expected benefits of production over a specified time

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horizon, and must choose among a set of J adaptation options. The farmer i decide to use j adaptation option if the

perceived benefit from option j is greater than the utility from other options (say, k) depicted as:

$$U_{ij} (\beta^* j X_i + \varepsilon_j) > U_{ik} (\beta^* k X_k + \varepsilon_k) \dots \dots \dots (1)$$

Where j is not equal to k , U_{ij} and U_{ik} are the perceived utility by farmer i of adaptation options j and k , respectively; and ε_j and ε_k are the error terms.

Under the revealed preference assumption that the farmer practices an adaptation option that generates net benefits and does not practice an adaptation option otherwise, we can relate the observable discrete choice of practice to the unobservable (latent) continuous net benefit variable as:

$$Y_{ij} = 1 \text{ if } U_{ij} > 0, \text{ and } Y_{ij} = 0 \text{ if } U_{ij} < 0.$$

In this formulation, Y is a dichotomous dependent variable taking the value of 1 when the farmer chooses an adaptation option in question and 0 otherwise. The probability that farmer i will choose adaptation option j among the set of adaptation options could be defined as follows:

$$\begin{aligned} P(Y=1/X) &= P(U_{ij} > U_{ik})/X \dots \dots \dots (2) \\ &= P[(\beta^* j X_i + \varepsilon_i - \beta^* k X_i - \varepsilon_k) > 0 / X] \\ &= P[(\beta^* j - \beta^* k) X_i + \varepsilon_j - \varepsilon_k > 0 / X] \\ &= P(\beta^* X_i + \varepsilon^* > 0 / X) = F(\beta^* X_i) \end{aligned}$$

ε^* is a random disturbance term,

β^* is a vector of unknown parameters that can be interpreted as the net influence of the vector of explanatory variables influencing adaptation,

X_i are the explanatory variables, and they included the following

X_1 = Farming experience in years

X_2 = Educational level

X_3 = Age in years

X_4 = Household farm size

X_5 = cooperative membership

X_6 = nonfarm activities

X_7 = access to extension service

X_8 = gender

X_9 = Marital status

X_{10} = annual income

X_{11} = Land size

X_{12} = Access to credit, and

$F(\beta^* X_i)$ is the cumulative distribution of ε^* evaluated at $\beta^* X_i$.

The Multinomial logit model is thus specified according to Green, 2003 as:

$$\text{ex}'\beta \dots \dots \dots (3)$$

$$P_{ij} = \text{prob}(Y = j)$$

$$1 + \sum \text{ex}'\beta$$

$$J=1$$

$$j=1, \dots, n$$

Where β is a vector of parameters that satisfy $\ln(P_{ij}/P_{ik}) = X'(\beta_j - \beta_k)$ (Greene, 2003).

Unbiased and consistent parameters estimates of the MNL model in Equation 13 require the assumption of independence of irrelevant alternatives (IIA) to hold. Specifically, the IIA assumption requires that the likelihood of a household's using a certain adaptation measure needs to be independent of other alternative adaptive measures used by the same household.

Thus, the IIA assumption involves the independence and homoscedastic disturbance terms of the adaptation model in Equation 3. The validity of the IIA assumption is based on the fact that if a choice set is irrelevant, eliminating a choice or choice sets from the model altogether will not change parameter estimates systematically. Differentiating Equation 3 with respect to each explanatory variable provides marginal effects of the explanatory variables given as $j-1$

$$\partial p_j / \partial x_k = P_j [\beta_{kj} - \sum P_j \beta_{jk}] \dots \dots \dots (4)$$

$$J=1$$

Result and Discussion: The socio-economic characteristics of cassava farmers in the study area: The socio-economic characteristics of cassava farmers in Obot Akara Local Government Area of Akwa Ibom State is presented in table 1a and 1b with 56.4% of the respondents being male and 43.6% being female implying that men were found to be more active participants than female farmers. Also majority 69.1% of the respondents is married while

10.0% of the respondents are single, 6.4% is divorce, 14.5% are widowed. This may indicate that the majority of cassava farmers in Obot Akara Local Government Area can generate enough income to sustain the family. The educational status of crop farmers will enable them to acquire knowledge and skill and this will help to increase their productivity and reduce food insecurity. This result is in collaboration with the findings of Nyong & Bassey 2019) who observed high

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literacy level of farmers in the study area. About 68% of the respondents had 11-20 years of experience in farming, implying that these farmers are well knowledgeable on farming activities. According to Nyong & Bassey 2019); Brady, Dumanski, Johnston, Chiotti, Singh (2008), greater years of farming experience increase the possibility of adoption of innovations and new technologies. 53.6% of the respondents cultivate arable crops for family use and commercial use; this implies that food security is ensured. 49.1% inherited the land they used in cultivation and 25.5% purchased the land while 17.2% acquired the combination of the above land sources, implying that they have land for cultivation. Over sixty percent (64.5%) of the respondents did not belong to cooperative societies while about 35.5% were members of co-operative societies. The result also revealed that 90.0% of the farmers used local tools and implement while 9.1% used both tractor and local tools implying that large agricultural activities is not predominant in the study area. More so, since agriculture is a seasonal activity respondents engage into different non agricultural activities which was revealed to be the following, civil service 24.5%, pensioners 13.6%, artisans 13.6%, petty trade 37.1%. The results of farmers' annual income showed that majority (47.3%) of the farmers were low income farmers. Only 11.8% of the farmers had earned above N 200,000 annually from the sales of their farm produce. This showed that farming in the study area was practiced at a subsistence level, Nyong & Bassey 2019).

Determinants of adaptation strategies by Cassava Farmers in Obot Akara LGA: Educational level (X1) of the household head is significantly and positively related with adaptation to climate change. Higher level of education is believed to be associated with access to information on improved technologies and higher productivity (Nyong & Bassey 2019)

(Norris and Batic, 1987). Igoden *et al* (1990); Lin (1991) argue that evidence from various sources indicate that there is a positive relationship between the educational level of the household head and the adoption of improved technologies and according to Maddison (2006), adaptation to climate change. The implication is that with higher levels of education, household heads and informed families are more likely to adapt better to climate change. Deressa *et al* (2009) opined that a unit increase in number of years of schooling would result in a 1% increase in the probability of soil conservation and a 0.6% increase in change in planting dates to adapt to climate change. The age (X2) of household heads which can also be used to capture farming experience did not have a significant relationship with adaptation to climate change. This is contrary to *a priori* expectation. This is at variance with Deressa *et al* (2009) who discovered in their study that age of household head affected adaptation to climate change. Other studies in Ethiopia have also shown a positive relationship between number of years of experience in agriculture and the adoption of improved agricultural technologies Nyong & Bassey 2019)

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. However, a study by Nyong, & Nweze, 2012) indicates a negative relationship between age and adoption of improved soil conservation practices. Farm size (X3) of the farming households has no relationship with adaptation to climate change, if it had, this would have meant that increasing farm size significantly increase the probability of adaptation. Even when there was no relationship, it can be inferred that the larger the farm size, the better the chance of adapting the climate change. Household size (X4) is positively related to adaptation to climate change. Increasing household size increased the probability of adaptation to climate change. This is at variance with the findings of Deressa *et al* (2009) who discovered that increasing household size did not significantly increase the probability of adaptation. This study supports Nyong & Bassey 2019) who argue that households with a larger pool of labour are more likely to adopt agricultural technology and use it more intensively because they have fewer labour shortages at peak times. It is expected that large households are more likely to adapt to climate change (Deressa *et al*, 2009). It can therefore be hypothesized that the larger the household size, the better the change of adapting to climate change. Farm income (X5) did not have a positive relationship with adaptation to climate change. This is contrary to *a priori* expectation. It is regularly inferred that the adoption of agricultural technologies requires sufficient finance

Nyong & Bassey 2019) in his investigation of the impact of income on adoption discovered a positive correlation. Extension visit (X6) has a positive correlation with adaptation to climate change. This is in consonance with *a priori* expectation. Deressa *et al* (2009) argue that extension on crop and livestock production and information on climate represent access to the information required to make the decision to adapt to climate change. As expected, the reformed, access to crop extension has a positive and significant effect on climate change adaptation. Extension is also the source of information on climate change to farmers. The information on climate change is expected to have a significant positive impact on the likelihood of adopting various climate change adaptation measures. Visit to other farmers (X7) has a positive correlation with adaptation to climate change, congruent with *a priori* expectation. Visit to other farmers is here referred to as farmer-to-farmer extension. Farmers' access to 'farmer to-farmer' extension increases the likelihood of adaptation to climate change. This is congruent with Deressa *et al* (2009) who suggest that having access to 'farmer-to farmer' extension increases the likelihood of using different crop varieties by 11.3% and planting trees by 12%. Meeting attendance (X8) has impact on adaptation to climate change. This again is at variance with *a priori* expectation. Farmers' association meetings are known to be clearing houses of knowledge and information among farmers. Through these meetings the farmers exchange ideas,

knowledge and information Nyong & Bassey 2019) This implies that an increase in meeting attendance would mean an increased likelihood to adapt to climate change will use more climate change adaptation

Conclusion: It is absolutely very important to know the factors that affect climate change adaptation. This can help in the formulation of policies and investments strategies cushioning the effects of long term climate change. Since most rural farmers depend on rain-fed agriculture as their source of livelihoods and have a low capacity to adapt to changes in climate change, policies to help farmer adopt are of great importance. An understanding of the adaptation measures employed by the household will enhance policy towards tackling the effects of climate change. Adaptation strategies employed by households included; Change planting and harvesting time, Prevent bush burning, Plant legumes, Practice crop rotation, Treatment of soil, Use improved /drought resistant variety, Control erosion.

Recommendation: Based on the findings of this study, it was recommended that cassava farmers should be provided with access to credit and inputs to be able to address the challenges of climate change. Adequate education and training should be encouraged among the cassava farmers. Furthermore, government should make meteorological information on climate change available and accessible to cassava farmers to guide them in their adaptation strategies on the farm. Government of Akwa Ibom State and other agricultural related bodies in the state should work to ensure that cassava farmers have increased access to functional extension services, as this will provide less educated farmers with up-to-date information needed for better productivity and improved techniques. In policy making there is need to include the elderly as they are well vested with weather patterns hence having an influence on adaptation and may increase the acceptability of a strategy by households.

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Table 1 .Socio-Economic Characteristics of Cassava Farmers

Gender	Frequency	Percentage (%)
Male	62	56.4
Female	48	43.6
Total	110	100
Age Range	Frequency	Percentage (%)
18-30	11	10.0
31-50	65	59.1
51-60	22	20.0
61-above	12	10.9
Total	110	100
Marital Status	Frequency	Percentage (%)
Single	11	10.0
Married	76	69.1
Divorced	7	6.4
Widowed	16	14.5
Total	110	100
Educational Level	Frequency	Percentage (%)
Non-Formal	7	6.4
Primary	22	20.0

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Secondary	56	50.9
Tertiary	25	22.7
Total	110	100

ARABLE CROP FARMERS	FREQUENCY	PERCENTAGE (%)
YES	98	89.1
NO	12	10.9
TOTAL	110	100
YEARS OF EXPERIENCE	Frequency	Percentage (%)
1-5	6	5.5
6-10	12	10.9
11-15	41	37.3
16-20	34	30.9
21-ABOVE	17	15.4
TOTAL	110	100
PURPOSE OF CULTIVATION	Frequency	Percentage (%)
HOUSEHOLD	29	26.4
COMMERCIAL	22	20.0
BOTH	60	53.6
TOTAL	110	100
COOPERATIVE MEMBER	Frequency	Percentage (%)
YES	39	35.5
NO	71	64.5
TOTAL	110	100
LAND ACQUISITION	Frequency	Percentage (%)
INHERITANCE	54	49.1
PURCHASE	28	25.5
LEASED	8	7.2
CONTRACT	1	0.9
BOTH	19	17.2
TOTAL	110	100
FARM SIZE	Frequency	Percentage (%)
LESS THAN 1 HA	54	49.0

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MORE THAN 1 HA	56	50.9
TOTAL	110	100
NON FAMING ACTIVITIES	Frequency	Percentage (%)
CIVIL SERVICE	27	24.5
PENSIONER	15	13.6
ARTISAN	15	13.6
PETTY TRADER	41	37.1
DRIVER/RIDER	1	0.9
BULK SELLER	2	1.8
OTHERS	9	8.2
TOTAL	110	100
INCOME PER ANNUM	Frequency	Percentage (%)
< N 100,000	31	28.2
N100,000- N150,000	52	47.3
N151,000 -N200,000	14	12.7
>N 200,000	13	11.8
TOTAL	110	100
TYPE OF LABOUR	Frequency	Percentage (%)
FAMILY	58	52.7
HIRED	41	37.3
BOTH	11	10.0
TOTAL	110	100
SEED ACQUISITION	Frequency	Percentage (%)
MARKET	27	24.5
ADP	3	2.7
NEIGHBORING FARM	6	5.6
PREVIOUS HARVEST	14	12.7
COMBINED	60	54.5
TOTAL	110	100
FARM DISTANCE	Frequency	Percentage (%)
< 1 MILE	77	70.0
> 1 MILE	33	30.0
TOTAL	110	100

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TYPE OF TOOLS USED	Frequency	Percentage (%)
LOCAL TOOLS	100	90.9
TRACTOR	0	0
BOTH	10	9.1
TOTAL	110	100

Source: Field Survey Data, 2025

Table 2: Regression estimate of the relationship between socio-economic characteristics of farmers and adaptation

	Coefficients	Standard Error	t-stat	p-value
Intercepts	-1.1556736	0.318865672	-3.6243*	0.00043873
X1 – Level of education	0.06500839	0.017806559	3.65081*	0.000400262
X2 – Age	0.00267997	0.004023272	0.66612	0.506717717
X3 – Farm size	0.2125744	0.035981552	5.90787	3.86629-08
X4 – Household size (HH)	0.1478175	0.015760749	3.23023*	0.001627667
X5 – Farm income	9.2804E-08	1.00421E-07	0.92415	0.357414993
X6 – Farm tools	0.69362037	0.100951248	6.87084*	3.89456E-10
X7 – Extension visit	0.07508128	0.02080736	3.6084001*	0.544165109
X8 – Marital status	0.13500739	0.025113171	5.37596*	4.26029E-07
R2	0.95595562			
Adjusted R2	0.95278125			
F – Ratio	301.1481931			

t-statistic computed; *** statistically significant at 1%; **statistically significant at 5%

Source: Computed from Field Survey Data, 2025.

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