



## SOCIO-ECONOMIC FACTORS INFLUENCING MAIZE FARMERS' AWARENESS ON CLIMATE CHANGE IN NORTHEAST NIGERIA

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### ABSTRACT

The study examined the socio-economic factors influencing maize farmers' awareness on climate change in Northeast, Nigeria. A multi-stage sampling procedure was employed in the selection of 337 respondents for this study. Descriptive and logit regression were used in analyzing the data. The results indicated that over one-third (37.09%) of the farmer's fell within the age bracket of 41-50 years. Majority (87.80%) of the farmers were male and most (98.00%) of them were married. Further, the study showed that 44.5% of the farmers had between 7-10 household members and 14.8% of them had 11-13 household size with mean of 8 members. The result of awareness on climate change revealed that farmers were aware on the shortfall of rainfall (4.027) was ranked 1<sup>st</sup> while awareness on decrease in agricultural production (3.991) was rank 2<sup>nd</sup>. The estimated parameters of the binary Logit model show that level of education was found to positively influence awareness level of farmers at 5% significance level with coefficient of ( $\beta=0.5902$ ). The marginal effect for education variable showed that one additional year in educational status of the household head increases the probability of 45% level of awareness of farmers on climate change issues. The study recommend that government should provide good policy to improved extension service delivery and regular workshops, conferences, and international affiliations should be organize to provide updates on climate change issues as well as regular contacts with NiMet information in the study area.

**Keywords:** Awareness, Climate. Change, Farmers and Factors.

### INTRODUCTION

Maize (*Zea mays* L.) is the Nigerian second leading staple food crops apart from rice with increasing domestic demand and plays key role in food security and generation of income for most farmers. Maize is one of the most important Nigeria's food crops that contribute to household security in Nigeria (Muhammad *et al.*, 2020). Lawal *et al.* (2018) reported that the importance of maize in Nigeria cannot be over emphasize due to its contribution to Gross Domestic Product (GDP). Maize has recently surpassed cassava as Nigerian's most important food crops in terms of calories and nutritional content (carbohydrate, protein, vitamins and minerals) consumed and serves as a main source of income to producers in the maize growing area. Ali (2018) also opined that maize contribute to the growth of Nigerian's economy in various ways namely: in the provision of food security for the increasing population, and supply of adequate raw materials to a growing industrial sector, major source of employment and generation of foreign exchange earnings.

Muhammad *et al.* (2020) stressed that utilization of maize in different ways as staple food crop in Nigeria from one region to another, and from one ethnic group to the other include; *pap*, *tuwo*, *gwate*, *biski*, *fura* and *kunu*. In addition, maize is used as industrial raw material for animal feed formulation, and as medicines (Abdulrahman and Kolawole, 2006). Besides, fresh maize is roasted and boiled along streets in urban and rural areas and hawked by women and children who serve as source of income for many of the poor households. Musa (2019) indicated that subsistence maize farmers in Nigeria are characterized with rain-feed farming,



limited use of improved seeds, inadequate fertilizer, and mechanization for production which resulted to low productivity and poor income. Webb and Highly (2019) observed that agricultural sector has the poorest occupational group in Nigeria with food crop farmers being the worst group. This makes the sector a major target for both food security challenge and poverty reduction interventions in the country. Maize is widely cultivated across all zones of the country but its production is severely affected by climate change (Shua'ibu *et al.*, 2016). Climate change is regarded as a long-term change in the statistical distribution of weather patterns, as temperature and precipitation lasting for an extended period. Ali (2018) view that climate change is seen as change in weather over time, due to natural fluctuations or due to human activities. Climate change is the major contemporary environmental threat facing mankind today as many factors and characteristics of the earth weather are changing mainly due to natural (rainfall, drought and sand dusk etc) and man-made (carbon monoxide, greenhouse gases) causes as well as poor awareness on climate change (Apata *et al.*, 2009).

Awareness and perception of maize farmers make certain changes on their livelihood patterns that occur through climate change. Thus, experience in Nigeria suggests that, farmers' awareness is often among the determinants of adaption. When new strategies' or innovation offer genuine benefit to farmers, fast adoption rate is expected from the farmers. That situation no doubt arises when there is a divergence between conservation techniques they are aware and perceived it is profitable with the new innovation (West *et al.*, 2017). Odjugo (2010) defines awareness as the ability of a farmer to see, hear and understand something through the senses. Ali (2018) stated that awareness is the way in which something is regarded, understood and interpreted by farmers. Therefore, climate change awareness is posing the greatest threat to food security particularly in North- east, Nigeria and farmers have to employ some adaptatives measures to climate change (Musa, 2019). Klein (2018) describes adaptive measures to climate change as the ability of a system or an individual to adjust to climate change so as to minimize the potential damages and cope with the consequences.

In the same vein, Ali (2018) reported that the biggest effects of climate change in the North-East, Nigeria to includes reduced farm yield, reduced incomes, drying of streams and rivers, reduction in storage quality of crop, loss of pasture land and vegetation due to erosion, flooding, prolong dry season and erratic rainfall. Odjugo (2010) pointed that concern over the years at local and international level have been widely expressed given that maize plays fundamental role to Nigerian national food security and Africa by agronomist, research institutions, governmental agencies on the need to tackle the impacts of climate change on maize yield (WHO, 2015). However, sufficient condition for proper awareness, perception and adaptation measures on climate change in North-east Nigeria is necessary to alleviate the challenges of sustainable agricultural development. Ali (2018) suggested that there is need for adequate information on farmers livelihood strategies and learn the positions of rural farmer's, their needs, and perception on climate change, in order to offer adaptation practices that meet their needs in North-east Nigeria, as it's observed that most of the studies carry out consider only one or two states in the region and this study intend to cover the North-east completely and compare their similarities/differences on awareness of climate change. Therefore, this research aims to fill this gap and analyze the farmers' awareness on climate change, explore the ways they are affected and how well they are aware on adaptation to effects of climate change. This informs the need to carry out a study to determine the socio- economic factors influencing awareness level of maize farmers on climate change in the study area. It is in view of the above that this paper attempted to proffer solution to the following research questions are formulated:

1. What are the socio-economic characteristics of the maize farmers in the study area?



2. Do maize farmers' have awareness on climate change?
3. How socio-economic factors are influencing awareness level of maize farmers on climate change?

## METHODOLOGY

### The Study Area

The study was conducted in Northeastern, Nigeria which consists of six States viz; Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe States. The study area is located between Latitudes  $9^{\circ} 4' N$  and Longitude  $8^{\circ} 40' E$  above the sea level. The study area has a population of 26,169,568 people based on 3.2% annul population growth according to National Population Commission (NPC) (2006 census projected to 2023) and cover total land area of 282,904 km<sup>2</sup> (Musa, 2019). North-East is bordered by the states of Jigawa to the North-west, Kaduna to the west and Plateau to the southwest. Its eastern border forms the national border with Cameroon and Chad Republic while to the northern border with Niger Republic (Ali, 2018). The study area has two distinct climates, the dry season (November-March) and the rainy season (April-October) and the zone is primarily divided between the semi-desert Sahelian Savannah and the tropical West Sudanian Savannah ecoregions. However, rainfall generally range between 1,300 millimeters (36.7 inch) per annum in the southern part and only 933 millimeters (28 inch) per annum in the extreme northern part of the study area with mean annual temperature, ranging between 28°C-42°C. North East consists of people of different background, tribes and beliefs. More so, the major ethnic groups across the region include; Hausa, Fulani, Kanuri, Badawa, Bolewa, Tangale, Jarawa, Hausa, Warjawa, Zulawa, Mumuye, Tiv, Wurkun, Kaka, Ngizim, Kare-kare, Baburawa, Kamba and Shuwa Arabic among others. The main economic activities in the area include; crop farming and livestock rearing, hunting, fishing, food processing, transportation and craft businesses. Most farm families reside in rural areas and farmers still use traditional cultivation methods in the area (Musa, 2019).

### Sampling Procedure

Multi-stage sampling procedure was used for the study. In the first stage, North-east was conveniently selected due to the large number of registers maize farmers. In the second stage, Adamawa, Bauchi and Gombe States were purposively selected due to avoid areas major communities affected with insurgency in the North-eastern Nigeria. In the third stage, the stratified agricultural zoning of the selected states was adopted and involved selection of three Agricultural zones from each state, giving a total of nine (9) agricultural zones. In the fourth stage, from each of the agricultural zones, two (2) Local Government Areas (LGAs) were randomly selected, thus giving a total of eighteen (18) LGAs. In the fifth stage, from each of the selected LGAs, three (3) villages were also randomly selected, thus giving a total of fifty-four (54) Communities. Using a Cochran formulae, a total of 337 famers were randomly selected as sample size drawn from the sampling frame 7,630 obtained from the States ADPs coupled with reconnaissance survey. The formulae is presented in eqn. (1) and (2) bellowed.

### Cochran formula:

$$n_a = \frac{n_r}{1 + \frac{n_r - 1}{N}} \quad \dots (1)$$

$$n_r = \frac{(1.645)^2 p q}{e^2} \quad \dots (2)$$

Where:

$n_a$  = adjusted sample size for finite population

$n_r$  = sample size for infinite Population

$N$  = population size

$p$  = proportion of population having a particular characteristic



$$q = 1 - p$$

e = error gap (0.10%)

Thus,  $p = 0.40$  and  $q = 1 - 0.40 = 0.60$ .

### Method of Data Analysis

Logistics Regression: These estimates the probability of an event occurring such as voted or didn't vote, based on a given dataset of independent variables or predict a dependent categorical target variable.

#### Logistics Regression Model

Implicit model:

$$Y = f(X_1, X_2, X_3, X_4 \dots \dots \dots X_n) \quad \dots (3)$$

Explicit model:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 \dots \dots \dots + \beta_K X_K + e \quad \dots (4)$$

Thus, with a binary dependent variable  $Y_i$ , is called a linear probability model and express as;

$$\sum \left( \frac{Y}{X_1}, X_2, X_3, X_4 \dots \dots \dots X_K \right) = P(Y = 1/X_1, X_2, X_3, X_4 \dots \dots \dots X_K) \quad \dots (5)$$

Where:

$$P(Y = 1/X_1, X_2, X_3, X_4 \dots \dots \dots X_K) = \hat{y} = \beta_0 + \beta_1 + \beta_2 \dots \dots \dots + \beta_K \quad \dots (6)$$

$\beta_i$  = Interpreted change in probability that  $Y_i = 1$  and  $K - 1$  for a given value of  $X_1 \dots X_K$

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + e \quad \dots (7)$$

Where:

$Y_i$  = Awareness on climate change (yes = 1) (No = 0)

$b_1, b_2, b_3, b_4 \dots \dots \dots b_n$  = Coefficients of the independent variables

$X_1 \dots X_{11}$  = Number of explanatory socio-economic variables

$X_1$  = Age of respondents measured in (years)

$X_2$  = Sex of the respondent (male = 1, female = 0)

$X_3$  = Marital status of the respondent (married = 1, otherwise = 0)

$X_4$  = Level of Education (year(s))

$X_5$  = Membership of organization (yes = 1, otherwise = 0)

$X_6$  = Household size (number of persons)

$X_7$  = Farming experience (years)

$X_8$  = Extension visit (number of contact)

$X_9$  = Access to credit facilities (yes = 1, otherwise = 0)

$e$  = Error term

### Socio-economic Characteristics of the Maize Farmers

The results in Table 1 indicated that over one-third (37.09%) of the farmer's age distributions fall within the age bracket of 41-50 years with mean age of 46.9 years. This implies that farmers in the study area were still in their active age and therefore constitute readily available labour force in maize production. Further, the findings indicated that age is positively related to the conservation of measures and potential awareness to climate change effects. It is expected that the age of the respondents should had both positive and negative effects on awareness. The finding comes in conformity to the cultural belief that 'almost every rural person is a farmer from birth'. This assertion is supported by Musa (2019) result which stated that majority (87%) of the respondents were within the older age bracket of 40 and above while only (13%) were within the younger age bracket 35-45 years in North-east, Nigeria.

Also, the results indicated that majority (87.80%) of the farmers were male while female farmers accounted for only 12.20% in the study area. This is perhaps may be due to the



cultural and religious restriction that tends to place females to mere household keepers rather than participating in strength-demanding farming activities. This result agreed with Kemmey (2015) finding which indicated that majority (72.0%) of the farmers were male while only (28%) of the farmers were female in Nandi County, Kenya. However, the findings reveal that most (98.00%) of the farmers were married and only (2.0%) of the farmers were single. Marriage is an institution that cuts across communities, tribes and religion. Also, married farmers are likely to be committed to increasing the yield on their farms as it is critical to the sustenance of their family. This implies that since the farmers were married. They could have more time to learn new skill as well as save enough money for their family and maize production. The result goes in line with Klein (2018) finding which indicated that 89.9%, 6.1% and 2% of the farmers were married, widowed and divorced in Imo State, Nigeria.



**Table1: Socio-economic Characteristics of the Maize Farmers**

Variables	Frequency	Percentage	Mean
<b>Age</b>			
20 - 39	12	03.56	46.9
40 - 49	103	30.56	
50 - 59	125	37.09	
60 - 69	61	18.10	
70 and above	36	10.69	
<b>Sex</b>			
Male	296	87.80	
Female	41	12.20	
<b>Marital status</b>			
Married	333	98.00	
Single	4	01.20	
<b>Household size</b>			
1 - 3	36	10.7	8
4 - 6	85	25.2	
7 - 10	150	44.5	
11 - 13	50	14.8	
14 – 16	9	2.7	
17 and above	7	2.1	
<b>Membership of Organization</b>			
Member	132	39.20	
Not member	205	60.80	
<b>Level of Education</b>			
Islamic	27	08.00	
Primary	79	23.40	
Secondary	125	37.10	
Tertiary	106	31.50	
<b>Extension Visit</b>			
One time	87	25.80	
Two times	218	64.70	
Three times	32	09.50	
<b>Years of Farming Experience</b>			
1 - 10	290	86.05	7.4
11 - 20	33	09.79	
21 - 30	12	03.56	
31 and above	2	00.60	
<b>Farm size</b>			
1 - 1.99	18	05.30	1.6
2 - 2.99	149	44.20	
3 - 3.99	112	33.20	
4 - 4.99	51	15.10	
5 and above	7	02.10	
<b>Total</b>	<b>337</b>	<b>100</b>	

**Sources: Field Survey, 2022.**

### **Farmers' Awareness on Climate Change**

Farmers' knowledge on climate change varies among them best on factors such as; level of education, years in farming experience and contact with extension workers, etc. Farmers' awareness on climate change was measured on using five-point likert scale of strongly agree,





agree, undecided, disagree and strongly disagree. The mean score threshold level considered as favorable was  $\geq 3$ .

The results in Table 2 revealed that farmers were aware on the shortfall of rainfall as favorable with mean of 4.027 and rank first. This indicate that shortfall of rainfall is one of the most favorable variable farmers use to notice the sign of climate change in the study area. Relatedly, farmers demonstrated contextual knowledge of climate variability, as they reported increased rainfall, prolonged dry seasons and changes in rainfall patterns as the most favorable factor on level of awareness. The finding agrees with Webb and Highly (2019) result which stated that most of the farmers were aware that the climate is changing in their locality, serious change of climate in terms of erratic rainfall and frequent drought is noticed in Nairobi, Kenya.

Furthermore, the study view awareness on decrease agricultural production as favorable with mean of 3.991 and rank second. This imply that farmers were aware of lose in agricultural yield that is due to climate change and those that were resulted from negative government policy in the study area. The finding goes in contrary with Shua'ibu *et al.* (2016) result which showed that awareness to maize production policies had significant and negative relationship with decrease agricultural production. Besides, the findings argued that farmer's belief knowledge on climate change was favorable and rank third on awareness level with mean of 3.979. The results demonstrated that an increased awareness by smallholder farmers about the meaning of climate change and variability is sufficient due to numerous scientific research and effective extension services delivery. The results go in contrary with West *et al.* (2017) finding which indicated that most farmers are not aware of climate change effects on their crop farming activities, know little or nothing about climate change, know little about the phenomenon while farmers were not aware about climate change at all among others in central plateau of Burkina Faso.

**Table 2: Farmers Awareness on Climate Change (n = 337)**

Variables	Mean	Rank
Awareness on heavy/shortfall of rainfall	4.027	1 <sup>st</sup>
Awareness on decrease agricultural production	3.991	2 <sup>nd</sup>
Knowledge on climate change	3.979	3 <sup>rd</sup>
Awareness on loss of incomes	3.786	4 <sup>th</sup>
Awareness on excess erosion	3.712	5 <sup>th</sup>
Awareness on increase drought	3.709	6 <sup>th</sup>
Awareness on weather change condition	3.970	7 <sup>th</sup>
Awareness on reduce maize yield	3.641	8 <sup>th</sup>
Awareness on excessive sunshine	3.617	9 <sup>th</sup>
Awareness on pest/disease infestation	3.591	10 <sup>th</sup>
Awareness on heat waves	3.569	11 <sup>th</sup>
Awareness on impact of climate change	3.460	12 <sup>th</sup>
Awareness that climate manifest in diverse ways	3.418	13 <sup>th</sup>
Awareness need urgent concern	3.386	14 <sup>th</sup>
Awareness that climate change happens	3.344	15 <sup>th</sup>
Awareness on depletion of ozone layer	3.306	16 <sup>th</sup>
Awareness on high Wind	3.249	17 <sup>th</sup>

**Sources:** Field Survey, 2022

### **Socio-Economic Factors Influencing Farmers Awareness on Climate Change**

The estimated parameters of the binary logit model and marginal effects were shown in Table 3. The data first confirmed the rationality of the overall relationship between explanatory



variables and farmer awareness probability and the likelihood ratio = -106.11301 tests were significant at ( $p < 0.001$ ) suggesting that the model had strong explanatory power. Also Pseudo  $R^2 = 0.2206$  indicated that the values of variables in the models have higher explanatory power. The Prob  $> \chi^2 = 0.000***$  significant at ( $p < 0.001$ ). Besides, model results factors driving the farmers' awareness on climate change revealed on the eleven explanatory variables inserted, there were six that are positively influencing the farmers' awareness on climate change and these includes: household size; education level; and, membership of organization. Others were extension visit; farm size; and, access to climate information. In contrast: age; sex; years of farming experience; maize income; and, access to credit facilities were negatively and not significant.

The age of the household head is not significant and has negative coefficient of ( $\beta = -.000194$ ;  $p = -.00015$ ) with marginal effect suggesting that an increase age of the farmer would had decrease level of awareness of farmers by .015%. The possible reason for this is that as the farmers grows older; they tend to maintain the old practice/skill they know to adapt climate variability and avoid the new adaptive method on climate change and that may be due to it difficulties or cost implication. This result is in accordance with West *et al.* (2017) finding which revealed that older farmers tend to be less aware to new climate change adaptation strategies which may be due to their long experience in farming at central plateau of Burkina Faso. It therefore means that there must be a synergy between farm practices and package of operations and the ability of the farmer to adjust to changes for positive results in the study area. The effect of gender on awareness level has negative coefficient of ( $\beta = -0.02556$ ;  $p = -.00196$ ) and is not significant. This imply that if there is a switch of the farmers' gender then their marginal effects is likely to decrease by 0.19% on awareness of farmers thus, inverse effects on level of awareness of farmers on climate change. This is in concordance with Kemmey (2015) result which highlighted that climate change increases gender inequality (making women less aware about the negative effects of climate change), reduces women's ability to be financially independent and has an overall negative impact on the social and political rights of women, especially in economies that are heavily based on agriculture in Nandi County, Kenya.

However, the climate change was also found to be significant and positively influencing the involvement of farmers' membership of organizations ( $\beta = 1.0493$ ;  $p = 0.0811$ ). Accordingly, the marginal effects of farmers who actively involved in membership of organizations were increase by 8.1% in level of awareness on climate change. Besides, the local community organizations are also environments for members to help each other in improving livelihoods through promoting social activities. By regularly participating in the activities of community organizations, farmers may be able to access useful information, knowledge, skills, and resources, which potentially promote their awareness and adaptation in reality. Indeed, by engaging in these groups, farmers have opportunities to observe adaptation choices from the other members before applying. This could enhance farmers' belief about the adaptation practices and increase the adoption probability. This result differs with Kemmey (2015) finding which showed that membership in Nandi County, Kenya local organizations has a negligible influence on level of awareness of farmers on climate change.

Also, educational was found to positively influence awareness level of farmers at 5% significance level with coefficient of ( $\beta = 0.5902$ ;  $p = 0.456$ ). The marginal effect for education variable showed that one additional year in educational status of the household head increases the probability of 45% level of awareness of farmers on climate change issues. Thus, for every extra schooling level achieved by the house head, the level of awareness of farmers will increase by one-unit increase. This concurs well with previous findings that a higher





educational qualification increases the probability of awareness and thus, adaptation to climate change. The finding goes in line with Apata *et al.* (2009) result which found that farmers with high qualifications are more likely to adapt to climate change by switching to new cultivars and following up weather forecasts in South-western Nigeria. Also, the finding is supported by Lawal *et al.* (2018) result which suggested that high educated farmers are more knowledgeable due to their ability to access information pertaining climate change and adaptation options in North-east, Nigeria. It can be argued that being educated will raise farmer perception and attitude to climate-related risks. The results also agree with Mohammed *et al.* (2020) finding which affirmed that higher educational level of farmers tends to increase his/her level of awareness to climate change. This is probably due to the facts that education tends to open up more opportunity through new technology and skills which increases the income generation activities of the household in Northern Guinea Savannah of Kaduna State, Nigeria.

**Table 3: Socio-economic Factors Influencing Awareness on Climate Change**

Variables	Coeff.	Std. Err.	z	P> z	dy/dx (Marginal Effects)
Age	-.0019494	.0242986	-0.08	0.936 <sup>ns</sup>	-.0001507
Sex	-.0255653	.5288392	-0.05	0.961 <sup>ns</sup>	-.0019604
Household size	.127503	.0496386	2.57	0.010**	.0098562
Level of education	.5902847	.2000023	2.95	0.003**	.0456298
Membership of organization	1.049396	.402551	2.61	0.009**	.0811198
Extension visits per month	.9052759	.354261	2.56	0.011**	.0699791
Years of farming experience	.0506807	.0400371	1.27	0.206 <sup>ns</sup>	.0039177
Farm size	-.7738788	.2304554	-3.36	0.001***	-.0598219
Maize income	-1.08e-06	9.68e-07	-1.11	0.265 <sup>ns</sup>	-8.34e-08
Access to credit facilities	-.0254086	.4398801	-0.06	0.954 <sup>ns</sup>	-.0019641
Access climate information	.8643707	.432696	2.00	0.046*	.0768135
Constant	-2.124598	1.637101	-1.30	0.194 <sup>ns</sup>	
Wald chi2(11)	= 54.49				
Prob > chi2	= 0.0000***				
Pseudo R2	= 0.2206				
Log pseudo likelihood	= -106.11301				

Source: Field Survey (2021). \*\*\*Significant @ 1%, \*\* Significant @ 5%, <sup>ns</sup> Not Significant

## CONCLUSION AND RECOMMENDATIONS

The results of the study showed applicable method and practices for policy makers and other relevant institution for implementation of awareness on climate change. The findings discover some major factors to consider on awareness of climate change of farmers such as; awareness on heavy/shortfall of rainfall, awareness on decrease agricultural production and knowledge on climate change etc. The study found that farmers were aware of climate change with their assorted levels of occurrences but majority had high adaptive capacity to climate change due to climate change hazards experienced in the past few years. The farmers under study would need to enhance their awareness on climate change considering some socio- economics factors influencing them in the study area.

The study recommends the following;

- The need to overhaul the present extension delivery systems so as to ensure that the right technologies are transferred to the farmers with modern implements.



- ii. The development of climate change policy that will enhance the awareness of farmers in rural communities that is specifically geared toward more vulnerable areas of the States with emphasis on poverty reduction.
- iii. There should be regular workshops and conferences, and international affiliations should be organized to provide updates on climate change issues.

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