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SOCIO-ECONOMIC ANALYSIS OF FACTORS THAT INFLUENCE THE ADAPTIVE CAPACITY OF MAIZE FARMERS TO CLIMATE CHANGE IN SOUTHWEST NIGERIA

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Abstract

The study assessed the climactic variables effect on maize farmers in South-western Nigeria. Especially, the maize farmers' socio-economic characteristics in both the guinea savannah and rainforest Agricultural Ecological Zones (AEZs) were assessed. The adaptive capacity and socio-economic variables that impact on the adaptive capacity of the maize farmers were determined in both zones. A multi-stage sampling was used for the study. Ekiti and Oyo state were purposively selected for the study because they are the highest producers of maize in the region, 360 maize farmers were interviewed for the study. The methods of data analysis includes descriptive statistics, 5-point Likert-type scale, Livelihood Diversification Index (LDI) and Logit Regression Model (LRM). The descriptive statistics result revealed that farmers in the rainforest zone were older than their counterparts in the guinea savannah with the mean age of 50.9 years and 49.2 years respectively. The study revealed that maize farmers' in the guinea savannah ecological zone perceived climate change as high intensity of sun with the grand mean values (X) of 3.88. Also, logistic regression estimation found age square, level of education, farming experience, income, access to credit, farm size and land ownership as significant policy variables of livelihood diversification (Adaptive capacity) among maize farmers in the study area. Therefore, from the findings of the study, it was suggested that government at all levels and Non-Governmental Organizations (NGOs) should enhance the adaptive capacity of the maize farmers' in the study area by providing credit facilites to them at single-digit interest rate.

Key words**:** *maize farmers, adaptive capacity, Logit Regression Model, agricultural ecological zones*

INTRODUCTION

The unprecedented increase in human activities as a result of industrialization has being acknowledged as one of the major causes of global warming. This has led to unpredictability of weather and is affecting the agricultural yield significantly. Also, it has being established that there is nexus between weather variables and agricultural yield according to the Intergovernmental Panel on Climate Change (IPCC), (2010) [12].

Agriculture in the form of crop production, livestock breeding, fishery and forestry contributes reasonably to the economy of Nigeria at local, state and national level. The sector employs the majority of the Nigerian population **(**Ayoade, 2012**)** [4]. Most rural dwellers are involved in agricultural activities. This can be in form of input marketing, production, value addition, transportation and output marketing.

Therefore, high percentage of the labour force (70%) in Nigeria is engage in agricultural related activities. According to Olukoya, (2007) [23], the sector contribution to Gross Domestic Products (GDP) in 2006 was about 25%. The economy of Nigeria is dominated by agriculture and natural resources extraction which drives the national economic development.

The findings of Deressa and Ringer, (2009) [7] revealed that agricultural sector in most Sub Sahara Africa (SSA) productivity is low and is as a result of small scale production that is predominant in the sector. Several factors such as lack of access to credit, improved inputs, lack of infrastructures and deforestation among others accounted for the low productivity in the continent agricultural sector. These factors impact negatively on the

adaptive capacity of the farmers and increase their vulnerability index. Hence the high exposure of farmers to production, marketing and climate change risk.

In Nigeria, maize is of critical importance to food and income generation. Maize is a major and important cereal being cultivated in all the agricultural zones in Nigeria because of better varieties. It serves as the main staple food for millions of Nigerians (Oyewo, 2016) [28]. Maize is consumed in various forms in Nigeria, especially in the southwest, southeast and south-south of the country. Maize could be boiled and eat or processed to pap and porridge.

Maize is industrially important chiefly for the production of starch and alcohol. The starch can be used for cooking and salad dressing (Onuk *et al., 2015)* [26]. Maize is a major ingredient in infant and livestock feed industries. It is also fermented to produce dextrins, sugars, and syrup (Sowumi and Akintola, 2014) [30]. The maize subsector provides employment for many farmers. Many farmers are into maize production because of its economy value and due to its usage in the industries (National Bureau of Statistics (NBS), 2016) [17]. The importance of maize cannot be overestimated (Ojo, 2016) [20]. Its importance cut across different spheres of human life.

Nigerian government at all levels are making efforts to ensure increase in agricultural productivity, however, the effects of climate change is pronounced in this sector. Since temperature, light, and rainfall which are weather variables are the main determinant of crop yields. Again, climate change which is the variations in relative humidity, sunshine, and particularly temperature and rainfall, can have severe adverse effects on agricultural practices and the outputs of both cash and food crops as well as on animal production potential (Omotosho, 2009) [25]. Consequently, it is important to assess the maize farmers' perception and the socio-economic factors that influence their adaptive capacity to climate change in Nigeria. This is to enhance the formulation of efficient and effective policies that will reduce the negative impact of climate change risks on maize farmers' productivity in Nigeria.

MATERIALS AND METHODS

Study Area

The study was conducted in Ekiti and Oyo States in the Southwestern Nigeria. There are 49 Local Government Areas (LGAs) in the two states. Ekiti has 16 LGAs and Oyo has 33 LGAs (Adejuwon and Odekunle, 2006) [1]. All the States are within the tropical rainforest, they have bi-modal rainfall distribution but with less intensity. There is a distinct dry and rainy seasons in the region. All the States have an average annual rainfall and temperature of 1490mm and 26.3ºC respectively (Omotosho, 2009) [25]. The states have a high density of human population of 5,869,902 (NPC, 2007) [18] and most of the people are farmers. The states are a major source of timber in the region. In the humid rain forest of the states are found economic cash crops such as oil palm, (*Elaeis guineensis*), cocoa (*Theobroma cacao*), Rubber (*Hevea brasiliensis*) banana/plantain (*Musa* spp.) and cola nut (*Cola nitida*). Also found are some principal staple food crops and fruits. (Oyekale, 2014) [27]

Fig. 1. Map of South-western Region of Nigeria
Source: NPC, 2007.

The states are peopled predominantly by Yorubas who speak various dialects of the Yoruba language and the life patterns of the people represent an embodiment of culture, ranging from the local foodstuff to the mode of dressing, dancing, wood crafts, such as, carved house posts and decorated doors (Omonijo *et al*., 2014) [24]. Figure 1 shows the map of south-western Nigeria.

Sample and Sampling Techniques

The sampling technique used for the study was multi-stage. Two states namely Ekiti and Oyo were purposively selected for the study because they are the highest producers of maize in the region (NBS, 2016) [17]. In each state, four Local Government Areas (LGAs) that are major producers of maize were purposively selected for the study. In each LGA, three (3) communities that are major producers of maize were purposively selected through the assistance of the Fadama II and Agricultural Development Programme (ADP) extension agents in each State. Furthermore, in each community, 10 maize farmers' were randomly selected. Therefore, 360 maize farmers were interviewed for the study. Structured questionnaire was used to collect data from each LGA. Taking cognizance of the Agro-Ecological Zones (AEZs) in the states and determining the perception of the farmers with regards to what they perceive as climate change. Also, identifying the significant variables that influence the farmers' adaptive capacity in the study area.

Nature and Sources of Data

Data used in this study were collected from one source, namely primary. Data were obtained through administering structured questionnaire on the maize farmers who were visited. The dataset collected include: maize farmers' socio-economic characteristics, membership of associations, access to credit and extension services, perceptions of climate change, other source of income apart from maize farming.

Data Analysis and Model Specification

Descriptive statistics, Livelihood Diversification Index (LDI) and logit regression model were used to analysis the data collected. Descriptive statistics such as frequency distribution, mean, mode, simple proportions, 5-point Likert-type scale, bar chart and graph were used to examine the socio-economic characteristics of maize farmers in the study area. To determine the maize farmers' perception of climate change in the study area, 5-point Likert-type scale was used. Respondents were asked to respond to statements relating to intensity of sun over time, degree of temperature over time, rainfall frequency, frequency of floods and droughts, using Strongly Agreed (SA), Agreed (A), Undecided (U), Disagreed (D), Strongly Disagreed (SD). The responses were scored as 5,4,3,2 and1for SA, A, U, D and SD respectively.

The mean from each statement was obtained and used to classify the responses on each statement into SA (>4.50), A (3.50-4.49), U (2.50-3.49), D (1.50-2.49) and SD (<1.50). The grand means for all the statements were calculated to be able to place all the responses on a continuum that enabled a conclusion to be drawn on what the perception of the respondents were with regard to climate change in each AEZ. Livelihood Diversification Index (LDI) using Herfindahl index of diversification was used (Kimenju and Tschirley, 2009) [15] to determine the adaptive capacity of the respondents, which is calculated as

$$D_k = 1 - \sum_{i=1}^{N} \left(S_{i,k}\right)^2 \text{ -------- (1)}$$

where,

D_k is the diversification index, i is the specific livelihood activity, N is the total number of activities being considered, k is the particular household and $S_{i,k}$ is the share of i^{th} activity to the total household income for k^{th} household.

Logit Regression Model (LRM) was used to determine the factors that influence the livelihood diversification of maize farmers in both the guinea savannah and rainforest AEZs.

The model is stated thus:

$$L_i = P_i / \text{Ln } 1\text{-}P_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 \text{----} \beta_{14} X_{14} + U_i \text{ ----- (2)}$$

where P_i = if diversified (diversified1 and not diversified 0)

The dependent variable is livelihood diversification index

The independent variables were:

X_1 = Age (in Years)

X_2 = Age Square (in Years)

X_3 = Sex (1 = male, 0 = Female)

X_4 = Marital status (1 = Married, 0 = Otherwise)
X_5 = Level of Education (Years of formal Schooling)
X_6 = Farming Experience (in Years)
X_7 = Farm income (Naira)
X_8 = Non-Farm Income (in Naira)
X_9 = Household size (No)
X_{10} = Membership of Association (1 = Yes, 0 = No)
X_{11} = Access to Credit (Amount in Naira)
X_{12} = Access to Extension Support (No of Contacts)
X_{13} = Farm Size (in Hectares)
X_{14} = Land Ownership (1= Yes, 0 = Lease)
U_i = Error term
Where β_0 = Intercept or constant
b_1 = Vector of parameter estimates.

RESULTS AND DISCUSSIONS

From table 1, 85% of the respondents in the guinea savannah were male and 66.8% were male in the rainforest AEZ. The high variation in the ratio of male to female maize farmers' can be attributed to the fact that men always have greater access to land as a productive resource than women. Since there is great disparity between female and male in the size of landholdings, the mode of women participation in maize farming in the two AEZs will definitely vary with the land-owning status of households (Onuk *et al.*, 2015) [26]. The study revealed that more women (33.2%) were involved in maize farming in the rainforest AEZ compare to in 15.0% guinea savannah AEZ. This actually butresses the fact that men in the rainforest AEZ will likely give more attention to cash crops such as cocoa and allow their women to be involved in maize farming. The men in rainforest AEZ will definitely like to take advantage of the regular and steady rainfall to plant cash crops and other viable economy crops that actually require regular water such as plantain.

The Table reveals further that majority of the respondents in both guinea savannah AEZ (87.8%) and rainforest AEZ (79.4%) are in their active economic age bracket. The mean productive age of 49.2 years in guinea savannah and 50.9 years in the rainforest buttress this. The result is in tandem with Olayemi (2015) [22] who opined that for farmers to be productive in farm chores, they must be young and active in order to contribute meaningful labour input into all the stages of production for efficient output realization which in turn results in consumptive and income opportunities with proportional household welfare. However, the percentage of those in active age in the guinea savannah was more than that of the rainforest AEZ. This is likely going to be, because most youths in the guinea savannah were involved in the cultivation of maize compared to their counterparts in the rainforest. Since rainforest AEZ is mainly known for cash crops such as cocoa, there is likelihood for most farmers in the AEZ to devote most of their time and energy to cash crops production (Burkard, 2007) [6].

The number of years put in by the sampled farmers as shown in table 1 reveal that the mean farming experience of the respondents in the guinea savannah zone was 18.9 years with 6-10 years being the modal distribution. In the rainforest AEZ, the mean farming experience was 16.6 years with 6-10 years being the modal distribution. This implies that maize farming is not a new enterprise in the two AEZs; experience gained on farm first hand is better than theory read in schools or from seminars and workshops (Thompson and Amos, 2010) [31]. In the two zones, an overwhelming majority (>90.0%) of the farmers have farming experience of six years or above. The overall average farming experience of over 17.8 years imply that most farmers in both AEZs have adequate farming experience in maize production. Therefore, the respondents were not novices in maize farming.

91.7% of the respondents in the guinea savannah were married and 83.3% in the rainforest were also married as shown in Table 1. Hence, there is tendency for most of the maize farmers in both AEZs to rely on family labour to augment seemingly fizzled-out hired labour thereby reducing the cost of labour. This finding supports Ogunwande's (2014) [19] claim that marriage increased the

number of households' members, making more labour available for farming.

Table 1. Socio-economic Characteristics of Rural Farmers' in the Study Area

Socio-economic Characteristics	Southern Guinea Savannah Ecological Zone		Rain Forest Ecological Zone		Pooled	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Sex						
Male	153	85	120	66.8	273	75.8
Female	27	15	60	33.2	87	24.2
Total	**180**	**100**	**180**	**100**	**360**	**100**
Age in years						
≤ 20	4	2.2	7	3.9	11	3.1
21-30	20	11.2	10	5.6	30	8.3
31-40	17	9.4	11	6.1	28	7.8
41-50	53	29.4	62	34.4	115	31.9
51-60	68	37.8	60	33.3	128	35.6
≥ 61	18	10	30	16.7	48	13.3
Total	**180**	**100**	**180**	**100**	**360**	**100**
Farming Experience in years						
≤ 5	6	3.3	17	9.4	23	6.4
6 – 10 years	60	33.3	62	34.4	122	33.9
11 – 15 years	22	12.2	28	15.6	50	13.9
16 – 20 years	33	18.3	26	14.4	59	16.4
> 20 years	59	32.9	47	26.2	106	29.4
Total	**180**	**100**	**180**	**100**	**360**	**100**
Marital Status						
Single	3	1.7	10	5.6	13	3.6
Married	165	91.7	150	83.3	315	87.6
Divorced	4	2.2	3	1.7	7	1.9
Widowed	8	4.4	17	9.4	25	6.9
Total	**180**	**100**	**180**	**100**	**360**	**100**
Education Attained						
No formal Education	25	13.9	31	17.2	56	15.6
Adult Education	6	3.3	21	11.7	27	7.5
Primary School Education	29	16.1	59	32.8	88	24.4
Secondary School Education	59	32.8	45	25.0	104	28.9
Tertiary Education	61	33.9	24	13.3	85	23.6
Total	**180**	**100**	**180**	**100**	**360**	**100**
Mean Age	**49.2**	**50.9**	**50.1**			
Mean Farming Experience	**18.9**	**16.6**	**17.8**			

Source: Computed from Field Survey, 2017

In other words, marriage increases a household's productive labour and in turn boosts farm activities. Furthermore, the spouses would likely assist in the marketing of maize output. The offspring of such maize farmers could also assist in the production process thereby reducing labour wage and ultimately production cost.

As shown in the Table, reasonable percentage (50%) of the respondents in the rainforest AEZ were not educated since the percentage of those who had no formal education and primary school education is half and those who had adult education, secondary school and tertiary education were also 50%. Since education is important for sound decision making in all human endeavours, these results suggest that extension workers need to do more to sensitize farmers on the need to be educated in the AEZ. Since more than half of

the farmers in the guinea savannah could read and write, introduction of new technologies and its adoption may not be a challenge compared to their counterparts in the rainforest AEZ. From the Table, farmers in the guinea savannah AEZ appear to be more literate than their counter parts in the rainforest AEZ. It provides reading ability, consciousness and awareness, which enable good decisions to be made. Therefore, the higher the level of a farmer's education, the better his decision making ability, especially in the adoption of new technologies and other innovations.

From Fig.2., 33.3% of the respondents in the guinea savannah AEZ belong to at least one farmers' organization. However, in the rainforest AEZ, 52.8% of the respondents claimed membership of farmers' organizations. The result revealed that high percentage of the respondents in the guinea savannah were not members of any farmer organization. The implication here is that only a few farmers would have access to credit facilities through cooperative organizations compared to their counterparts in the rainforest AEZ. According to Amos, (2014) [2] membership of association is of immense benefits to members, it gives opportunity for bulk purchase of inputs at discounted rates and helps members secure credit facilities as at when due. In addition, lending agencies will prefer to give credit to a cooperative body rathern than to an individual.

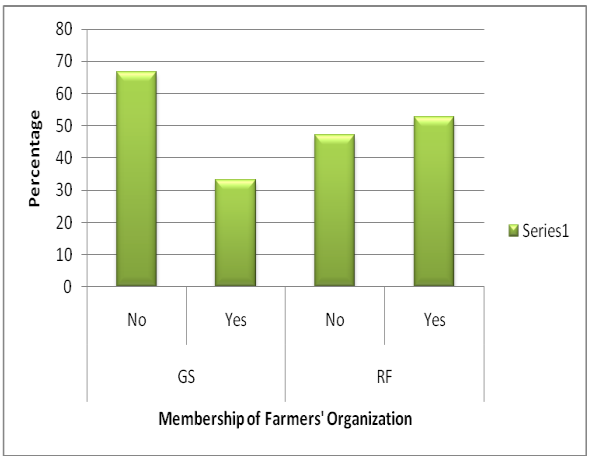

Fig. 2. Rural Farmers' Membership of Farmers' Organization in the Study Area
GS = Guinea Savannah
RF = Rainforest

The implication is that only a few farmers in the guinea savannah would have access to credit facilities (Develtere and Pollet, 2012) [8]. Moreover, there will be limited forums to reach out to farmers that do not belong to an association since most developmental organizations and extension agents distribute inputs to the farmers at a subsidized price through farmer organizations (Bagchee, 2004) [5].

In the guinea savannah AEZ, 30.0% of the respondents had less than 1ha, 46.7% had between 1 and 5ha, 10.0% had between 6 and 10ha and 13.3% had more than 10ha. In the rainforest AEZ, 47.8% had less than 1 hectare, 43.9% had between 1 and 5ha, 2.2% had between 6 and 10ha and 6.1% had above 10ha. The mean farm size of 4.4ha in the guinea savannah and 2.3ha in the rainforest AEZs revealed that the maize farmers' in both AEZs were into small scale farming (Kang, 2011) [14]. The average household size of about 7 people in both zones is relatively large enough considering the average farm size of 4.4ha and 2.3ha which perhaps will necessitate the use of family labour by most of the respondents for maize production. Also, from the Table, the rainforest AEZ mean farm size of 2.3ha compared to 4.4ha of the guinea savannah may likely due to the fact that the heavy rainfall also predisposes soil to leaching; while the big trees and rugged topography make land clearing more difficult and expensive, hence the subsistence nature of maize farming in the rainforest AEZ (Sowunmi and Akintola, 2010) [30]. Again, the major difference in the average farm size may be due to the pressure of urbanization on availability of farm land; urban settlement being more prominent in the rainforest zone than in the guinea savannah zone (Amujoyegbe and Alabi, 2012) [3].

Figure 3 reveals that 18.3% of the respondents in the guinea savannah AEZ, had access to credit facilities and 40% of the respondents in the rainforest AEZ had access to credit facilities. According to Fasoranti (2006) [10], poor access to credit facilities coupled with non-membership of cooperative societies by farmers may account for the poor financial

base of farmers and hence their inability to employ modern farm implements, resulting in poor productivity by the farmers.

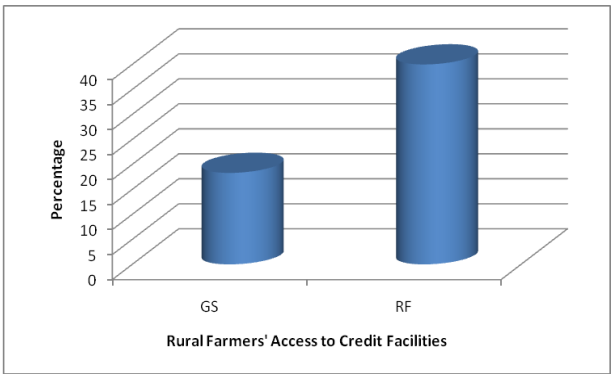

Fig. 3.Rural Farmers' Access to Credit Facilities in the Study Area
GS = Guinea Savannah
RF = Rainforest

As shown in Figure 4, 17.8% of respondents in the guinea savannah AEZ had access to extension agents at least twice a month while 82.2% had access to extension agents less than twice a month. In the rainforest AEZ, 30.6% of the respondents had access to extension agents at leat twice in a month and 69.4% had access to extension agents less than twice in a month. Therefore, in both zones 75.8% of maize farmers had limited access to extension education that can enhance their productivity. Therefore, few maize farmers' in the study area had access to information and new production techniques. Since the extension agents serve as intermediary between the government and the farmers. Through whom the government distributes improved varieties of inputs to the farmers (Jiggins, 2007) [13].

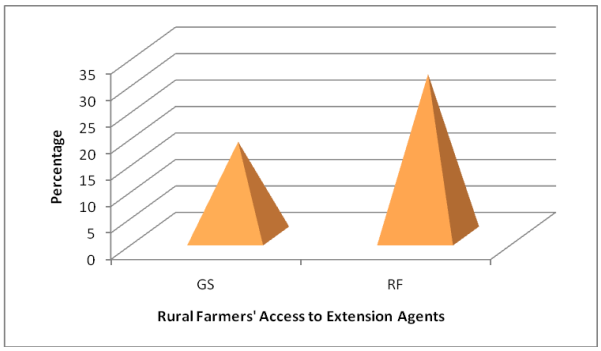

Fig. 4. Rural Farmers' Access to Extension Agent in the Study Area
GS = Guinea Savannah
RF = Rainforest

The responses of the rural farmers' in the guinea savannah ecological zone to the perception statement of what they understand by climate change revealed in table 2 that they had positive perception towards high intensity of sun, high degree of temperature, frequent rainfall (i.e. Unpredictable) and unusual drought statements with the grand mean values (X) of 3.88, 3.88, 3.52 and 4.18 respectively indicating agreed to all the above statement. The zone is characterized by low rainfall and long dry period compared to rain forest ecological zone. This probably accounts for the reason why the rural farmers in this zone perceived climate change as, high intensity of sun, high degree of temperature and unusual drought.

Table 2. Rural Farmers' Perception of Climate Change in Guinea Savannah

S/N	Perception Statements	Responses						
		SA *f/(%)*	A *f/(%)*	U *f/(%)*	D *f/(%)*	SD *f/(%)*	Mean Rating X	Remark
1	High intensity of sun	81 (45.0)	57 (31.7)	0 (0)	24 (13.3)	18 (10.0)	3.88	**A**
2	High degree of temperature	66 (36.7)	51 (28.3)	42 (23.3)	18 (10.0)	3 (1.7)	3.88	**A**
3	Frequent rainfall (Unpredictable)	60 (33.3)	45 (25.0)	21 (11.7)	39 (21.7)	15 (8.3)	3.52	**A**
4	Incessant flood	3 (1.7)	9 (5)	45 (25)	75 (41.7)	48 (26.6)	2.13	**D**
5	Unusual drought	90 (50)	63 (35)	- -	24 (13.3)	3 (1.7)	4.18	**A**

Source: Field Survey, 2017

Also, Table 3 reveals the responses of the rural farmers' in the Rainforest AEZ to the perception statements of what they perceived as climate change. The rural farmers had positive perception towards the third (Frequent rainfall (i.e. Unpredictable)) and forth (i.e. Incessant flood) statements with the grand mean values (X) of 3.76 and 3.78 indicating agreed to the above statements, undecided about the second (i.e. High degree of temperature) statement and negative perception towards the first (i.e. High intensity of sun) and fifth (i.e. Unusual drought) statement with the grand mean value (X) of 2.45 and 2.13 indicating disagreed to the above statement. This zone is characterized with frequent rainfall and has an average annual rainfall and temperature of 1489mm and 26.5ºC respectively (Omotosho, 2009) [25]. Therefore, it is not surprising that farmers from this zone perceived climate change as frequent rainfall and have no basis to perceive it as unusual drought.

Table 3. Rural Farmers' Perception of Climate Change in Rain Forest Ecological Zone

S/N	Perception Statements	Responses						
		SA *f/(%)*	**A** *f/(%)*	**U** *f/(%)*	**D** *f/(%)*	**SD** *f/(%)*	**Mean Rating X**	**Remark**
1	High intensity of sun	9 (5)	21 (11.7)	38 (21.1)	52 (28.9)	60 (33.3)	2.45	**D**
2	High degree of temperature	15 (8.3)	12 (6.7)	60 (33.3)	36 (20)	57 (31.7)	3.42	**U**
3	Frequent rainfall (Unpredictable)	54 (30)	63 (35)	6 (3.3)	33 (18.3)	24 (13.3)	3.76	**A**
4	Incessant flood	36 (20)	63 (35)	24 (13.3)	30 (16.7)	27 (15)	3.78	**A**
5	Unusual drought	6 (3.3)	21 (11.7)	36 (20)	87 (48.3)	30 (16.7)	2.13	**D**

Source: Field Survey, 2017.

Table 4 shows the adaptive capacity of the maize farmers' in both the Guinea savannah and Rainforest AEZ. The measure of income diversification that takes into account the variations in the income shares which is the Herfindahl index concentration was used in this section to measure the adaptive capacity of the maize farmers' in the study area. From the Table, 19.4% of the respondents in the guinea savannah AEZ 80% income was from maize farming. While the remaining 20% income is from other sources (i.e. diversified). That is why they are considered very low adaptive capacity according to Koshti, (2014) [16].

In the same AEZ, 12.8% of the respondents 60% income is from rural farming and the remaining 40% is from other sources, so their adaptive capacity is low. The Table revealed that in guinea savannah, 18.9% of the respondents income from maize farming accounted for the 40% of their total income, the remaining 60% is from other sources. Such adaptive capacity was considered as moderate, since other sources of income will reduce the effects of climate change risks on maize production. 23.3% of the respondents in the AEZ agreed that above 80% of their income was from other sources and that is why they are regarded as very high adaptive capacity according to Koshti, (2014) [16].

Again, the Table revealed the adaptive capacity of the maize farmers' in the Rainforest AEZ. From the Table 14.4% of the respondents 80% income is from maize farming and 20% is from other sources. Also, from the AEZ, 11.1% of the respondents agreed that 60% of their income is from maize farming and 40% is from other sources. In the same AEZ, 13.9% of the respondents said that 40% of their income is from maize farming and the remaining 60% is from other sources. 48.4% of the respondents in the rainforest AEZ agreed that less than 20% of their income is from maize farming and above 80% is from other sources. The income diversification pattern as revealed in table 4 shows that maize farmers from the rainforest AEZ have other sources of income (i.e. income diversification) compare to their

counterpart from the Guinea savannah. Since there is likelihood that of most of the respondents in the rainforest AEZ are into production of other arable crops and cash crops like cocoa. The AEZ is suitable for such crops compare to the guinea savannah. Therefore, they have their income diversified even from farming activities (Ellis, 2000) [9]

.Adaptive Capacity (i.e. Livelihood Diversification) of the Rural Farm Households in Both Guinea Savannah and Rainforest in South-western Nigeria.

Table 4. Adaptive Capacity of the Rural Farming Households in the Study Area

	Guinea Savannah AEZ			Rainforest AEZ	
Category	**Index**	**Frequency**	**Relative frequency Percent**	**Frequency**	**Relative frequency Percent**
Very Low Adaptive Capacity	0.20	35	19.4	26	14.4
Low Adaptive Capacity	0.40	23	12.8	20	11.1
Moderate Adaptive Capacity	0.60	34	18.9	25	13.9
High Adaptive Capacity	0.80	46	25.6	22	12.2
Very High Adaptive Capacity	>0.80	42	23.3	87	48.4
	Total	**180**	**100**	**180**	**100**

Source: Computed from field Survey, 2017

The results of logit regression model were used to determine the factors influencing the adaptive capacity (livelihood diversification) of maize farmers in the study area. In the guinea savannah, seven out of thirteen postulated independent variables were significant. These are age square, level of education, farm experience, farm income, access to credit, farm size and land ownership. Likewise, in the rainforest AEZ, four out of thirteen postulated independent variables were significant at 5%. These are age, age square, level of education and farm income. Table 5 indicates that in the rainforest AEZ, age was significant at 5%. In the AEZ, the age of the respondents influenced the livelihood diversification. It is possible for a farmer in his/her active age to be involved in many agro-enterprise ventures. Such a farmer can plant two or more crops at the same time. Also, in many cases, such a farmer can get engaged in non-farm activities such as carpentry and barbing.

The age square of the maize farmers in both the guinea savannah and rainforest AEZ negatively affects their livelihood diversification. This suggests that elderly maize farmers in both AEZs may not be willing to diversify from maize farming. A farmer, who is used to cultivating maize over the years, may be difficult to convince to cultivate other crops or pick up other jobs like barbing and carpentry. Younger maize farmers in the same AEZs may be willing to take up cultivation of other crops or venture into non-farming activities to increase his/her portfolio of income. Also, level of education was significant at 5% level in both AEZs. The coefficient was negative, implying that the higher the level of education, the lower the level of livelihood diversification of the maize farmers' in the study area. Education is an important factor influencing the level of livelihood diversification *(*Okere and Shittu, 2013) [21]. Educated farmers tend to have a sustainable livelihood, thus having a less diversified income portfolio.

The explanation of this is that respondents with formal education (especially those educated up to tertiary level) are engaged in well-paid salary jobs than those without formal education. They are less likely to combine two or more jobs (multiple job holding). This is because education enhances

the potential of respondents and makes them grab available opportunities with little or no stress. Furthermore, in both AEZs, the regression analysis shows that farm income was significant at 5%. The coefficient was negative implying that farm income negatively affects the adaptive capacity (i.e. livelihood diversification). As farm income from maize farming increases, maize farmers in either zone would not see any need to diversify income especially from non-farming activities. As the income from maize farming increases, farmers would tend to give more attention to their farm than getting engaged in other activities, since they would be sure that reasonable income will come from their maize farming.

In the guinea savannah, farming experience of maize farmers was significant at 5% and the coefficient was negative, implying that as farmers' years of experience increases, such farmer will be less diversified. Specialization in planting of certain crops as a result of experience reduces the chances of farmers diversifying his/her portfolio (Idowu *et al*., 2015) [11]**.** Also, access to credit influences the maize farmers' adaptive capacity positively in the guinea savannah and it was significant. Therefore, access to credit in the AEZ is a critical factor that will influence diversification. Farmers can combine other agribusiness such as selling farm inputs if they have access to credit. It will be possible for them to increase their adaptive capacity by diversifying their livelihood, reducing their dependence on maize production.

Table 5. Estimates of Parameters of Logit Regression Model of Factors Influencing Livelihood Diversification among Maize Farming Households in the Study Area

Variables	**Agricultural-Ecological Zones**			
	Guinea Savannah		**Rainforest**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**
Age (in years)	-0.158	-0.557	-0.574**	-0.218
Age Square (in years)	-4.207**	1.604	-3.702**	1.412
Sex	10.448	2474.3	4.702	1113.4
Marital Status	23.790	7306.8	12.608	2557.9
Education (Years of Formal Schooling)	-4.055**	1.774	-1.460***	0.639
Farming Experience (in years)	-3.836**	1.140	-12.5	13.75
Farm Income (in Naira)	-0.005**	0.002	-0.002**	0.000
Household Size (Nos)	-0.299	0.443	-0.009	0.005
Membership of Association	3.478	3.058	2.295	2.018
Access to Credit	3.890***	0.169	3.052*	2.683
Access to Extension Support	10.468	3215.0	9.002	2765.1
Farm Size (in Ha)	15.563***	0.675	0.125	0.075
Land Ownership	3.572***	0.639	0.368	0.304
R^2		92.9		90.3
Adjusted R^2		89.7		88.1

Source: Computed from Field Survey, 2015
***1%, **5%, *10%

Also, in the guinea savannah, the size of the farm and land ownership affected the adaptive capacity of the maize farmers positively and they were both significant. If the farmers had access to large hectares of land and they were the owner of such land, then it would be possible for them to plant other crops that required longer periods of gestation. So farm size and ownership of land are critical variables that can be used to influence the livelihood diversification of maize farmers in the AEZ. In the guinea savannah, large farm

size and land holding ability will increase the adaptive capacity of the maize farmers. This is in tandem with the finding of Amos (2014) [2] on the positive correlation between land holding size and farmers' efficiency because land ownership influences the type of crops to be planted (i.e. cash crops or arable crops) (Sadiq *et al*., 2013) [29]. So maize farmers' adaptive capacity will be enhanced if they have access to larger farm size and if they owned such land.

CONCLUSIONS

From the study, maize farming was male dominated farming enterprise in the study area. Frequent unpredictable rainfall and incessant flooding was perceived to be the pronounced climate change phenomenon by the maize farmers' in the rainforest AEZ. Likewise, from the study, maize farmers in the rainforest AEZ had a high adaptive capacity compare to their counterpart in the guinea savannah AEZ. It was therefore recommended that extension agents should be supported by both government and NGOs to visit the maize farmers regularly and orientate them about climate change and how to mitigate its effects on their productivity. Again, maize farmers' adaptive capacity in the study should be enhanced by government at all levels by providing credit facilities to them at a single-digit interest rate.

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