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CLIMATE CHANGE ADAPTATION STRATEGIES AMONG GROUNDNUT FARMERS IN SULEJA LOCAL GOVERNMENT AREA OF NIGER STATE, NIGERIA

AJAYI, O.J., *MUHAMMED, Y., YUSUF, L.T. AND AJIJOLA, R.T.
Department of Agricultural Extension and Rural Development, Federal University of Technology, P. M. B. 65, Minna, Niger State
*Corresponding author: mohdyak@futminna.edu.ng

Abstract
This study examined the climate change adaptation strategies among groundnut farmers in Suleja Local Government Area of Niger State, Nigeria. The specific objectives were to describe the socio-economic characteristics of groundnut farmers; identify the climate change adaptation strategies adopted by the groundnut farmers, determine the factors influencing climate change adaptation strategies adopted by the groundnut farmers and identify the constraints faced by the groundnut farmers. Two-stage sampling procedure was used to select 120 groundnut farmers on which structured questionnaire was administered complemented with an interview schedule. Primary data collected were analysed with both descriptive (frequency counts, percentages and mean) and inferential (Tobit regression) statistics. The study revealed that the mean age of the groundnut farmers was 44 year, mean household size was 7 people and mean farming experience was 15 years. Meanwhile, 75.0% of the groundnut farmers were males, 88.3% were married and 96.7% of them had formal education. Mixed cropping (76.7%) and new cropping pattern (73.3%) were the most adopted climate change strategies by the groundnut farmers. Tobit regression result revealed that age (-2.01, p<0.05), household size (1.75, p<0.10), education (3.47, p<0.01), experience (1.90, p<0.10) and income (2.30, p<0.05) statistically influences the groundnut farmers adaptation to climate change. In terms of constraints faced by the groundnut farmers in production, majority (87.5%) of the groundnut farmers indicated lack of Government support, followed by inadequate extension services (74.2%) and low income (66.7%) ranked 1st, 2nd and 3rd, respectively. In conclusion, the groundnut farmers adopted various adaption strategies to mitigate climate change in the course of production. It was therefore recommended that extension agency should provide adequate extension service to the groundnut farmers that will help them overcome the effect of climate change and boost their groundnut production.

Key Words: *Adaptation, Strategies, Climate change, Groundnut farmers*

PC 1992	0 - 15	64.33^{ab}	2.336^{cd}	0.00^{c}
	15 - 30	92.33^{a}	5.67^{a}	2.00^{a}

ND = *Nauclea diderrichii* plantation, PC = *Pinus carribaea* plantation

Introduction

Climate change refers to a change in the statistical distribution of weather patterns for an extended period of time (Adger *et al.,* 2007). It is caused by factors such as biotic processes, variations in solar radiation received by earth, plate tectonics and volcanic eruptions. Climate change is perhaps the most serious environmental threat facing mankind worldwide currently (Agawan and Pastiche, 2011; Shikuku *et al*., 2017). The most immediate impacts are environmental, resulting in increased desertification, drought and floods, shift in arable land and water stress (Shikuku *et al*., 2017). The global climate is warming, as demonstrated by increase in air and ocean temperatures, increased in ice and snow melt and rising average sea level. The risk of extreme weather events is rising (Chinwendu *et al*., 2017) and the trends are expected to continue.

Climatic change which is attributable to natural climate cycle and human activities have adversely affected agricultural productivity in Africa (Khanal, 2009). Nigeria is one of the countries recognized as being vulnerable to climate change (Idowu *et al.,* 2011). The effects of climate change in the country particularly in the study area had been enormous including significant alteration in the rainfall regime and pattern. The temperature and rainfall patterns of the study area provide major problems on primary production, which in turn determines secondary production. According to Idowu *et al.* (2011), increasing variation in temperature and humidity had led to increase in pests and diseases infestation, natural disasters like drought, floods and storms which adversely affects crop production including groundnut production. The issue of climate change has become more threatening not only to the sustainable development of socio-economic and agricultural activities of any nation, but to the totality of human existence (Adejuwon, 2007; Nchuchuwe and Adejuwon, 2012).

Meanwhile, adaptation to climate change which refers to the adjustment in natural or human systems in response to actual or expected climatic stimuli and their effects, helps to moderate harms or exploits beneficial opportunities (Okuneye, 2014). Climate adaptation strategies in agricultural sector include the use of new crop varieties, crop diversification, adoption of mixed cropping, livestock farming system, changing plant dates and irrigation. Maddison (2007) reported that farmers first perceive a change in climate and then device strategies in response to the perceived change. The perception therefore, is an important aspect towards successful adaptation strategies to climate change. According to Onyeneke and Madukwe (2010), planting of late maturing variety, crop diversification, mixing cropping and adoption of new cropping pattern were some of the climate adaptation strategies adopted by groundnut farmers.

Groundnut (*Arachis hypogaea L.*) is the 6th most important oil seed crop in the world as it contains 48 – 50% oil, 26 – 28% protein and 11 – 27 % carbohydrate, minerals and vitamin (Alabi *et al.,* 2009). According to Food and Agriculture Organization (FAO) (2011) reported that production of groundnut is concentrated in Asia and Africa where the crop is grown mostly by smallholder farmers under rain-fed conditions with limited inputs. Nigeria was the third highest producer of groundnut in the world after China and

India with Niger State one of the leading producing States (National Agricultural Extension Research and Liaison Services (NAERLS), 2011). However, increasing temperature in the study area has the tendency of affecting agricultural production including groundnut with implication on food security.

Adverse climatic effects can influence farm outputs at any stage from cultivation to the final harvest (Ayinde *et al.,* 2011). For instance, if there is sufficient rain, its irregularity can affect yields adversely. Recent research efforts on climate change impacts and adaptation have focused on regional and national assessment on the potential effects of climate change in agriculture. Most farmers have adopted various adaptation measures to reduce the adverse effects of climate change on their agricultural productivity.

However, few studies have been conducted in the area of climate adaptation strategies adopted by groundnut farmers to cushion the effect of climate particularly in the study area. This has constituted a gap in knowledge that need to be fill, thus the conceptualization of the study. Furthermore, the worrying rise in the demand for food due to population and real income growth has led to increased global food scarcity – a worsening hunger and malnutrition problems particularly in developing countries like Nigeria. Thus, the effects of climate change on food security status and production as well as its effects on human well-being cannot be over-emphasized.

It is against the backdrop of aforementioned that the study was conceived to determine the adaptation strategies adopted by the groundnut farmers to mitigate against climate change in Suleja Local Government Area of Niger State, Nigeria. Thus, the specific objectives were to:

i. describe the socio-economic characteristics of groundnut farmers in the study area;
ii. identify the climate change adaptation strategies adopted by the groundnut farmer;
iii. determine the factors influencing climate change adaptation strategies adopted by the groundnut farmers, and
iv. identify the constraints faced by the groundnut farmers in the study area.

Methodology

Study Area

The study was conducted in Suleja Local Government Area of Niger State, Nigeria. It is one of the twenty five (25) Local Government Areas of the State grouped into three agricultural zones I, II and III with each of the zone having 8, 9 and 8 Local Government Areas (LGAs), respectively (Ajayi *et al.,* 2016). Suleja LGA which falls under agricultural zone II is located in the Middle-belt region of Nigeria within latitudes 9° 10′ and 50° 12′ North and longitudes 7° 10′ and 48° 80′ East of the equator and has a population of about 216,518 (National Population Commission (NPC), 2006). However, with population growth rate of 3.2% in Niger State, the projected population in the study area for 2019 was 326,084. There are two distinct seasons, namely: the rainy season (from March/April to October/November) and dry season (from October/November to March/April) which could subjected to variation due to climatic conditions. The mean annual rainfall is about 1334 mm^2, while mean annual temperature was 32°C. The vegetation zone is savannah mainly dominated by shrubs, grasses and light

vegetation sparsely populated by trees of moderate height and sizes. Soil weathered from rock in Suleja is very rich in humus and favoured production of crops like guinea corn, groundnut, maize, melon, and yam which can all serve as cash crops and food crops (Ajayi *et al.*, 2016).

Sampling Procedures and Sample Size

Two-stage sampling procedure was used to select the respondents for the study. The first stage was random selection of three communities out of 35 from the LGA, while the second stage involved random selection of forty groundnut farmers from each of the selected villages of the LGA. This gave a total sample size of 120 groundnut farmers used as respondents for the study. Primary data was collected with the aid of structured questionnaire and complimented with an interview schedule. Both descriptive statistics (frequency count, percentages and mean) and inferential statistics (Tobit regression) as well as attitudinal measuring scale such as Likert scale was used to analysed the data collected.

Model Specification

Tobit Regression Model

Tobit regression model was used to determine the factors influencing climate change adaptation strategies adopted by the groundnut farmers in the study area. Different adaption strategies mostly adopted by crop farmers to cushion the effect of climate change as used in literatures (Onyeneke and Madukwe, 2010; Ayinde *et al.*, 2011; Okuneye, 2014) were collated and presented to the farmers in the questionnaire.

The implicit form of the Tobit model is specified as:

$Y = f(X_1, X_2, X_3, X_4, X_6, X_7, X_8, X_9)$

The Tobit regression model in its explicit form is expressed as:

$$Y = \beta_o + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + e$$

Where;

Y = Climate change adaptation strategies adopted by the groundnut farmers measured using adaptive index given as:

$$\frac{\text{number of adaptation strategies adopted by the groundnut farmers}}{\text{total number of adaptation strategies available to the farmers}}$$

X_1 = Age (years)
X_2 = Sex (male = 1, female = 0)
X_3 = Marital status (married = 1, otherwise = 0)
X_4 = Household size (number of people)
X_5 = Education (number of years spent in school)
X_6 = Experience (years)
X_7 = Farm size (hectares)
X_8 = Income (Naira)
X_9 = Knowledge level (perception score)
e = Error term
β_o = Intercept
$\beta_1 - \beta_9$ = Coefficients of the independent variables
$X_1 - X_9$ = Independent variables

Results and Discussion

Socio-economic Characteristics of the Groundnut Farmer

Socio-economic characteristics of the respondents under consideration comprises of the age, gender, marital status, educational status, farming experience, household size and farm size. Table 1 revealed that majority (75.0%) of the groundnut farmers were within the age group of 26 – 55 years with mean age of 44 years. This implies that the respondents were in their most active age where they could increase groundnut production. This agrees with the finding of Asekenye (2012) who reported that mean age of groundnut farmers in their study area was 45 years. More so, 75.0% of the farmers were males implying the dominant gender in groundnut production. This agrees with the findings of Okere and Shittu (2012) who revealed that the males dominated the work force in Nigeria's agricultural communities.

As shown in Table 1, majority (88.3%) of the groundnut farmers were married implying that they are responsible individuals with sense of responsibility to provide for the needs of their families. This is in agreement with the work of Olayemi *et al.* (2012) who posited that groundnut production were dominated by married people. Most (65.0%) of the farmers had household size from 6–10 people with mean household size of 7 people implying a relatively large household size which is very important in agricultural production, while 61.7% and 25.0% of the groundnut farmers acquired secondary and tertiary education, respectively. This implies that majority of the groundnut farmers in the study area had a satisfactory level of education, hence could read and write which could easily influence their decision to adopt climate adaptation strategies. This agrees with Asogwa *et al.* (2012) who reported that higher educational status could positively influence a person's competence to use technology.

Furthermore, about half (47.5%) of the groundnut farmers had been into farming between 11–30 years with mean farming experience of 15 years. This implies that the respondents are experienced which is an asset in farming as it inspires farmers' rational decision–making with respect to inputs utilization. This is in line with Anyoha *et al.* (2010) who posited that farming experience enables farmers set realistic production goals within the limit of available resources. In addition, 43.3% of the farmers had farm size between 1.1 – 3.0 hectares with mean farm size of 2.5 hectares which implies that majority of the groundnut farmers are predominantly small-scale producers.

Table 1: Socio-economic characteristics of the respondents (n = 120)

Variables	Frequency	Percentages	Mean
Age (years)			
< 26	5	4.2	44
26 – 35	30	25.0	
36 – 45	36	30.0	
46 – 55	24	20.0	
> 55	25	20.8	
Gender			
Male	90	75.0	
Female	30	25.0	
Marital Status			
Single	9	7.5	
Married	106	88.3	
Widowed	5	4.2	
Household Size			
< 6	37	30.8	7
6 – 10	78	65.0	
> 10	5	4.2	
Education Status			
Tertiary	30	25.0	
Secondary	74	61.7	
Primary	12	10.0	
No Formal	4	3.3	
Experience (years)			
< 11	54	45.0	15
11 – 20	44	36.7	
21 – 30	13	10.8	
> 30	9	7.5	
Farm Size (hectares)			
< 1.1	53	44.2	2.8
1.1 – 3.0	52	43.3	
> 3.0	15	12.5	

Climate Change Adaptation Strategies Adopted by the Groundnut Farmer

Climate change adaptation strategies adopted by the groundnut farmers are presented in Table 2. Among the strategies adopted farmers to mitigate the effect of climate change in the study area include mixed cropping (76.7%), adoption of new cropping pattern (73.3%) and crop diversification (65.8%) ranked 1st, 2nd and 3rd, respectively. This implies that these are the adaptation strategies adopted mostly adopted by the farmers to cushion the effect of climate change. Others adaptation strategies adopted by the farmers are mixed farming (64.2%), irrigation farming (54.2%), adjustment in planting date (49.2%) and use of early maturing varieties (40.8%) ranked 4th, 5th, 6th and 7th, respectively. Mixed farming allows for the integration of crop and livestock production where crop output could be used to feed livestock and animal wastes serves as manure. The irrigation farming makes up for adverse effect of rainfall and temperature thereby making

food available all season. Adjustment in planting dates and planting of early maturing varieties is a strategies for coping with unfavourable climatic conditions that could negatively affect groundnut production. This finding is in line with the work of Onyeneke and Madukwe (2010) who reported that most of the respondents in his study adopted planting early/late maturing varieties, crop diversification, mixing farming and a new cropping pattern as adaptation strategies to mitigate climate change. However, the least adaptation strategies adopted by the groundnut farmers are soil conservation (39.2%) and planting of cover crops (26.9%) ranked 8th and 9th, respectively.

Table 2: Climate change adaptation strategies adopted by the groundnut farmers

Strategies	Frequency*	Percentage	Rank
Mixed cropping	92	76.7	1st
Adoption of new cropping pattern	88	73.3	2nd
Crop diversification	79	65.8	3rd
Mixed farming	77	64.2	4th
Irrigation farming	65	54.2	5th
Adjustment in planting date	59	49.2	6th
Use of early maturing varieties	49	40.8	7th
Soil conservation	47	39.2	8th
Planting of cover crops	15	12.5	9th

*Multiple responses

Factors Influencing Adaptation Strategies Adopted by the Groundnut Farmer

Tobit regression model was used to determine the factors influencing the climate change adaptation strategies adopted by the groundnut farmers in the study area and the result is presented in Table 3. The regression analysis result revealed log likelihood ratio of 21.5779 and pseudo R^2 value of 0.8229 implying that about 82% variation in the adoption of climate change adaptation strategies was explained by the specified explanatory variables in the model, while 18% unaccounted for could be due to some externalities beyond the control of the researcher. The chi-square value of 39.17 at 9 degree of freedom and statistically significant at 1% level of probability shows the goodness of fit of the regression model.

Table 3: Regression estimate on the factor affecting adaptation to climate change

Variables	Coefficient	Std. error	t –value
Age	0.0048	0.0024	2.01**
Gender	0.0523	0.0447	1.17
Marital status	0.0434	0.0455	0.95
Household size	0.0179	0.0102	1.75*
Education	0.0185	0.0053	3.47***
Experience	0.0075	0.0039	1.90*
Farm size	0.0138	0.0129	1.07
Income	1.68e-06	7.31e-07	2.30**
Knowledge	-0.0531	0.0388	1.37
Constant	0.1841	0.0951	1.94*
LR chi^2	39.17		
Pseudo R^2	0.8229		
Log likelihood	21.5779		

Note: *** implies significant, ** implies significant at 5% and* implies significant at 10%

Out of the nine predictor variables included in the model, five (age, household size, education, experience and income) were found to be statistically significant at 1%, 5% and 10% levels of probability. The t-value of age (-2.01) was negative and statistically significant at 5% probability level, implying that a unit increase in the age of the groundnut farmers will decrease the climate change adaptation strategies adopted. This could be due to the fact that aged farmers do not have the capacity to expand their production thereby not greatly affected by climate change.

The t-value of household size (1.75) was positive and statistically significant at 10% probability level, implying that a unit increase in household size of the groundnut farmers will lead to an increase in the climate change adaptation strategies adopted. This is because larger household sizes could influences adoption of strategies that will help increase production output for the needs of family members.

The t-value of education (3.47) was positive and statistically significant at 1% probability level, implying that a unit increase in educational status of the groundnut farmers will lead to an increase in the climate change adaptation strategies adopted. This means that education tends to expose individual farmers to the importance and benefit of adopting climate change adaptation strategies for increased production. This agrees with the findings of Ndambiri *et al.* (2012) who observed that higher education could enhance access to information on climate change adaptation strategies for increase production.

The t-value of experience (1.90) was positive and statistically significant at 1% probability level, implying that a unit increase in experience of the groundnut farmers will lead to an increase in the climate change adaptation strategies adopted. Experienced farmers have better knowledge and information on changes in climatic conditions, thus could adopt suitable strategies to mitigate climate change. This agrees with the findings of Nchuchuwe and Adejuwon (2012) who reported farming experience is positively related to adoption of recommended practices.

The t-value of income (2.30) was positive and statistically significant at 5% probability level, implying that a unit increase in the income of the groundnut farmers will lead to an increase in the climate change adaptation strategies adopted. One of the main objectives of farmers all over the globe is to ensure increased income. As farmers' income increases, to attain more efficient in groundnut production, he may want to invest on adaptation strategies that could mitigate the effect of climate change.

Constraints Faced by the Groundnut Farmers

The constraints faced by the groundnut farmers in the study area are presented in Table 4. The major constraints faced by groundnut farmers are lack of government support as indicated by 87.5% of the groundnut farmers, followed by inadequate extension service (74.2%) and low income (66.7%) ranked 1st, 2nd and 3rd, respectively. This implies that in order to mitigate effect of climate change in groundnut production there is need for government intervention to provide relevant information to farmers on climate variability. This services are usually through extension agents which is adequately lacking. This finding is in agreement with the work of Ajayi *et al.* (2017) who reported that majority of their respondents indicated that they lacks government support to control pests and diseases as well as lack funds to seek information on groundnut production. Other constraints indicated by the respondents include small farm size (65.8%), lack of improved seed (61.7%), lack of credit facilities (55.0%) and lack of capital (55%) ranked 4th, 5th and 6th, respectively.

Table 4: Constraints faced by the groundnut farmers

Constraints	Frequency	Percentage	Rank
Lack of government support	105	87.5	1st
Inadequate extension services	89	74.2	2nd
Low income	80	66.7	3rd
Small farm size	79	65.8	4th
Lack of improved seed	74	61.7	5th
Lack of credit facilities	66	55.0	6th
Lack of capital	66	55.0	6th

Conclusion and Recommendation

Based on the empirical evidence from the findings of this study, it could be concluded that majority of the respondents were males, married and educated. The respondents adopt various adaptation strategies to cushion the effect of climate change with mixed cropping, adoption of new cropping pattern and crop diversification the most adopted strategies. Age, household size, education, experience and income of the groundnut farmers influences the climate change adaptation strategies adopted, while they are constrained majorly constraints by lack of government support, inadequate extension service and low income. It was therefore recommended that, adequate extension services on various climate change mitigation strategies should be provided by relevant extension agency, to help the groundnut farmers overcome effect of climate change and boost their groundnut production. Government

should provide enabling environment for public and private extension agents to thrive and ensure wide coverage/dissemination of information on climate variability. The farmers should be encourage to form cooperative societies that would help them have access to extension services, credit facilities and information on various climate change adaptation strategies.

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