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ASSESSMENT OF PERCEIVED EFFECTS OF CLIMATE CHANGE ON YAM PRODUCTION IN BENUE STATE, NIGERIA

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Abstract

The study assessed the perceived effects of climate change on yam production among farmers in Benue state Nigeria. Stratified, purposive and simple random sampling techniques were used to select 150 yam farmers. Primary data were collected using structured questionnaire. Data were analyzed using descriptive and inferential statistics. The study found that 59.7% of the respondents were male with the mean age of 40 years, 56.3% of the respondents were married with the mean household size of 10 persons, 90.3% of the respondents had formal education with the mean of 12 years spent in school. Farming (64.6 %) was the major occupation of the respondents with the mean of 20years of farming experience. Results revealed that the mean farm size was3hectares, the mean annual income of the respondents stood at ₦261131.94 per annum. Major sources of information on effects of climate change were from personal observation (80.6%), radio (72.2%) and from friends/relations/neighbours (50.0%). The result revealed that majority of the respondents adopted early planting (91.7%), mulching (90.3%), crop rotation (86.1%), early harvesting (83.3%) prompt weeding (76.4%) and application of organic manure (50.0%), were some of the agronomic practices adopted by farmers to cope with the changing climate in the study area. The result of Chi-square test embedded in logit regression revealed that selected socio-economic characteristics of yam farmers have significant effects on climate change adaptation and mitigation measures adopted among farmers in the study area. It is recommendedthat aforestation and reforestation should be practiced so that plants will help to remove the high concentration of carbondioxide in the atmosphere.

Keywords: Effects, Climate change, Yam, Production, Farmers

Introduction

Climate change is a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties that persist for an extended period typically decades or longer (Elijah *et al.,* 2018). Climate change is the most serious environmental threat facing mankind World Wide (Obinne, 2010). In recent times, various countries have been threatened by changes in climatic conditions ranging from drought, delayed rainfall, continuous melting of the polar region causing severe flood in some countries and speculation about the acid (Food, Agriculture and Natural Resources Policy Network (FANRPAN), 2010). Generally, Africa has been described as one of the most vulnerable continents of climate change and climate variability (Intergovernmental panel on climate change (IPCC), 2007). Local knowledge indicates that climate change impacts are leading to significant negative effects on livelihoods in Africa, particularly among subsistence and small-scale agricultural communities (Simms, 2015). In Nigeria, the pattern of rainfall has already altered, affecting the commencement of the planting season and resulting in poor harvest. Climate changepresents significant threats to the achievement of the sustainable development goals (SDGs) especially those related to eliminating poverty hunger and promoting environmental sustainability (Enete, 2014). Given the adverse effects of climate change, there is need to guard against this phenomenon by ways of mitigation and adaption. This is more important to farmers whose occupation heavily depend in climate for performance

Yam is an annual tuber and monocot plant. It belongs to the genus "Dioscorea" and the family "Dioscoreaceae". The plant (yam) comprises over 600 species out of which ten species produce edible tubers and only six are cultivated in Africa (Musa *et al*., 2011). Out of these, Dioscorearodundata (white yam) and Dioscoreaalata (water yam) are species widely grown in the coastal region of rainforest, Wood Savanna and Southern Savanna habitats(Udemezue and Nnabuife, 2017). According to International Institute of Tropical Agriculture (IITA), Nigeria is recognized as leading producer of yam in the world, the country accounted for about 70 percent of the world population. Yam production in Nigeria and Benue State in particularis entirely dominated by small-scale farmers (Odjugo, 2008).

Yam is becoming an important commercial crop in Nigeria for food and exports, it is becoming more expensive and relatively unaffordable in urban areas as production growth leading to demand exceeding supply (Francis, 2017). Population of Nigeria is growing, hence the need for increased agricultural production to meet the demand for agricultural produce. As

the population of Nigeria is growing, hence climate change may greatly hamper the genuine efforts by farmers to bridge the gap between rising population and increased demand for agricultural production in Nigeria, particularly in Benue state with more than 80 percent of its population having their livelihood in the agricultural sector (Francis, 2017). Inspite of the efforts made by government of ensure that there is adequate dissemination of information on ways of mitigation and adaptation of climate change by establishment of meteorological stations for weather forecast, research institutions and provision of extension services, climate change is still a serious environment threat facing agricultural production. Climate change affect yam at all stages of production such as decay of yam seeds and tubers due to excess rainfall and high temperature, wilting of yam plant as a result of prolonged drought and increased pests and diseases infestation as a result of excess rainfall and humidity. This leads to continuous losses of yam by farmers, which in turn lead to food insecurity. This development is a worrisome issue for agricultural resources sustainability and food sufficiency. The research questions that guided this study are;

i. What are the socio-economic characteristics of the yam farmers in the study area?
ii. What are the farmers' sources of information on the effects of climate change in the study area?
iii. What are the measures taken to address the effects of climate change in the study?

The broad objective of the study was to assess perceived effects of climate change on yam production among farmers in Benue state, Nigeria. The specific objectives of the study were to:

i. describe the socio-economic characteristics of the yam farmers in the study area;
ii. identify the farmers' sources of information on the effects of climate change in the study area; and
iii. identify the measures taken to mitigate the effects of climate change by yam farmers in the study area.

Statement of the Hypothesis

$H0_1$:Socio-economic characteristics of yam farmers have no significant effects on the climate change adaptation and mitigation measures adopted among farmers in the study area.

Methodology

The study was carried out in Benue State, Nigeria. Benue State is located in the middle belt of Nigeria with Makurdi as its State capital. Geographically, the State lies between

longitude $7^{0}47^{1}$ and $10^{0}\ 0^{1}$ East of the Greenwich meridian and latitude $6^{0}25^{1}$N to $8^{0}\ 8^{1}$ North of the Nasarawa to the North, Taraba to the East, Cross River to the South-East, Enugu to be South-West and Kogi to the West. The Southern part of the State also shares boundary with the Republic of Cameroon (Benue State Agricultural and Rural Development Authority (BNARDA), 2018).

The State has a total land mass of about 30, 955 kilometers square with a population of 4, 253,641 persons (National Population Census, 2006) and 23 local Government Areas (LGAs). The State is agriculturally divided into three agricultural zones namely: Zone A (Katsina-Ala, Ukum, Logo, Ushongo, Kwande, Vandekya and Konshisha Local Government Areas), Zone B (Gboko, Tarka, Buruku, Gwer-West, Gwer-East, Guma and Makurdi Local Government Areas) and Zone C (Ado,Agatu, Apa, Otukpo, Ohimini, Okpokulu, Ogbadibo, Obi and Oju Local Government Ares) by the Benue State Agriculture and Rural Development Authority (BNARDA). The State has favourable agro-climate ecologies for arable crops, tree crops and livestock production and it has two district seasons; raining season, beginning from April to October and dry season, which starts from November to March. Farming is the major occupation of the state populace, farming in the state is dominated by the middle-aged men who marry several wives to boost their farming activities (Okwuand Daudu, 2011). The major inhabitants or tribes in the state are Tiv, Idoma, Igede and Etulo.

The population of this study consisted of all yam farmers in the three agricultural zones of Benue State, Nigeria. Due to the enormity of this population, a sample size of 150 respondents was selected using stratified, purposive and simple random sampling techniques.

Firstly, the defined population of this study was stratified into three zones based on the existing agricultural zones in Benue State namely, Zones A, B and C. Secondly, one Local Government Area from each of the three zones were purposively selected based on their relative high level of yam production which a total of three LGAs. The selected Local Government Areas were Ukum from Zone A, Gboko from Zone B and Apa from Zone C. Thirdly, two yam farming communities were randomly selected from each of the Local Government Areas. Finally, a sampling frame was developed from each of the farming communities then, using a proportion of 5% (0.05) across board was used to obtain the total size of 150 respondents for the study.

Data for this study were collected from primary sources using structured questionnaire alongside interview techniques. However, out of 150 copies of questionnaire distributed for the study, 144 copies were returned and used for the study. Data for this study were analyzed using

both descriptive statistics such as frequency, percentage and mean score and inferential statistics such as Student t-test.

Results and Discussion

Socio-economic Characteristics of the Respondents

Results in Table 1 revealed that 59.7% of the respondents were male while 40.3% were female. This shows that men dominate in yam production, though the female farmers have their own roles to play, especially, in the maintenance, harvesting, storage and marketing; Francis (2017). The finding agrees with that of Fabusoro (2006) who found that there are more males in farming than females. The result, also reveals that majority (63.2%) of the respondents were between the ages of 21 and 40 years. The mean age of respondents was 40 years. This means that yam farmers in the study area are in the economically productive age and the respondents were old enough to give reasonable responses on climate change issues experienced over the years. This result agrees with the finding of Okoedo-Okojie (2015) who found that only those farmers within the productive age group of 20 and 50 are likely to possess the necessary strength to carryout farming operations. The finding also agrees with that of Obinne (2010) who found that most active Nigerian farmers and agricultural extension agents were people within the age range of 24-40 years. With respect to marital status, the result showed that 56.3% of the respondents were married. This implies that married people are more involved in yam farming in the study area. The findings agree with Francis (2017) who reported that majority of yam farmers were married. The reason for this is not farfetched as family labour is a predominant sources of labour in subsistence agriculture in Nigeria. The married farmers may receive assistance from their spouse and children in carrying out some activities on the farm. In terms of education, the study revealed that 9.7% of the respondents did not have formal education while 90.3% of the respondents had formal education with the mean of 12 years spent in school. This implies that the respondents were literate enough to be aware of climate change, adopt agricultural technologies and measures to mitigate the effects of climate change in the study area.

The result in Table 1 reveals that the farmers have a mean household size of approximately 10 persons. This indicate a fairly large household size implying that more family labour will be readily available for use in yam production against short falls in supply of farm labour. This result is in line with Sule*et al.* (2002) who stated that household size has a great role to play in family labour provision in the agricultural sector. Results on occupation of

the respondents shows that majority (91.7%) of the respondents major occupation was farming. This implies that farming is the major occupation of the respondents in the study area of the respondents in the study area. The result in line with the finding of Agbulu and Ujah (2006) that the main occupation of more than 70% of the population of the rural people in Nigeria is farming at subsistence level. Table 1 further reveals that majority (63.2%) of the respondents had farm size of less than 2.6 hectares. The mean farm size stands at approximately 3 hectares. This implies that majority of the respondents in the study area were small-scale farmers. This result agrees with the finding of Francis (2017) who reported that the mean farm size of yam farmers in Benue State stands at 3hectares. The mean years of farming experience was approximately 20 years. This findings shows that the respondents in the study area had stayed long enough in farming enterprise and could therefore have noticed significant change in climate as its affects their farming activities. Experienced farmers have more knowledge and information about climate change and agronomic practices that they can adopt in response (Maddison, 2006). The study revealed that majority (79.2%) of the respondents earned between ₦5000l and ₦400,000 per annum. The mean annual income of the respondent stood at ₦261, 131.94 per annum. The results show that the annual income of the respondents was low. This is in line with the study carried out by Bello (2007) which reported that annual farm income of rural farmers in Nigeria is low due to the primitive/local methods of farm management practices, low knowledge of improved technologies and low capital investment among other factors. These lead to low income generation and low living condition among rural farmers in Nigeria.

Table 1: Distribution of Respondents according to their Socio-economic characteristics (n = 144)

variables	Frequency (F)	Percentage (%)	Mean (⁇)
Sex			
Male	86	59.7	
Female	58	40.3	
Age(years)			
= 20	2	1.4	
21 – 40	91	63.2	
41 – 60	48	33.3	40.4
> 60	3	2.1	
Marital Status			
Single	40	27.8	
Married	81	56.3	
Divorce	10	6.9	
Widow/widower	13	9.0	
Level of Education			
Non formal	14	9.7	
Primary	24	16.7	
Secondary	59	41.0	
Tertiary	47	34.6	
Years Spent in School			
= 6	40	27.8	
7 – 12	41	28.5	11.66
13 – 18	49	34.0	
>18	14	9.7	
Household Size			
= 10	110	76.4	
11 – 20	38	19.4	
21 – 30	3	2.1	9.45
>30	3	2.1	
Major Occupation			
Farming	93	64.6	
Civil Service	17	11.8	
Trading	29	20.1	
Others	5	3.5	
Farm Size(hectares)			
= 2.5	91	63.1	
2.6 – 7.5	52	36.1	2.49
>7.5	1	0.7	
Farming Experience (years)			
=5	18	12.5	
6 – 15	49	34.0	20.40
16 – 25	29	20.1	
>25	48	33.3	
Annual Income (Naira)			
= 50, 000	13	9.0	
50001 – 400, 000	114	79.2	261,131.94
400, 001 – 750, 000	10	6.9	
>750, 001	7	4.9	

Source: Field Survey (2019)

Source of Information on the Effects of Climate Change

Results of respondents' sources of information on the effects of climate change presented in Table 2 indicated that the major sources of information were personal observation (80.6%), followed by radio (72.2%), 50% from friends/relations/neighbors, 46.5% through handsets, 45.8% from television and 34.7% from newspapers. Smaller proportion of the respondents sourced information on climate change from farmers' association (33.3%), internet (21.5%), religious leaders (20.1%), extension agents (18.1%) and opinions leaders (9.7%). This means that these respondents received information on climate change from formal and informal sources. The result implies that majority of the respondents did not have access to extension services which is supposed to be a major source for disseminating information to farmers on improved technologies. This is in line with Okoro (2012) who identified personal observation, friends/relations, radio and television as rural farmers' sources of information on climate change.

Table 2: Distribution of respondents according to sources of information on the effects of climate change (n = 144)

Sources of Information	Frequency*	Percentage (%)
Newspaper	50	34.7
Radio	104	72.2
Television	66	45.8
Internet	31	21.5
Handset	67	46.5
Friends/relations/neighbours	72	50.0
Extension agents	26	18.1
Opinion leaders	14	9.7
Personal observation	116	80.6
Farmers' association	48	33.3
Religious leaders	29	20.1

*Multiple responses

Source: Field Survey (2019)

Measures Taken to Mitigate the Effects of Climate Change by the Respondents in the Study Area

Table 2 revealed that majority (91.7%) of the respondents adopted early planting, followed by mulching (90.3%), crop rotation (86.1%), early harvesting (83.3%), prompt weeding (76.4%), application of organic manure (50.0%), about 36.8% of the respondents adopted mixed cropping. However, bush fallowing (29.9%), making of ridges (25.7%) and

planting of cover crops (20.8%) were the least adopted measures used by the respondents in the study area. The results agreed with the findings of Francis (2017) who reported that several measures help farmers to mitigate the effects of climate change. Some of the more prominent measures aresoil conservation, crop rotation, improved crop varieties, irrigation, early planting/harvesting, mixed cropping, making of ridges among other measures available to farmers. The result also agreed with the findings of Elijah *et al.* (2018) whose work found that most of the farmers depend solely on farming and do not have enough land to practice bush fallowing. This may be as a result of increased population.

Table 3: Distribution of Respondents according to Measures taken to Mitigate the Effects of Climate Change in the Study Area (n = 144).

Adaptation Measures	Frequency*	Percentage (%)
Practice of bush fallowing	43	29.9
Practice of crop rotation	124	86.1
Early planting	132	91.7
Early harvesting	120	83.3
Planting of cover crops	30	20.8
Mixed cropping	53	36.8
Prompt weeding	110	76.4
Mulching	130	90.3
Application of organic manure	72	50.0
Making of ridges	37	25.7

*Multiple responses
Source: Field Survey (2019)

Test of Hypothesis

Hypothesis one which stated that socio-economic characteristics of yam farmers have no significant effects on climate change adaptation/mitigation measures adopted among farmers in the study area was tested using chi-square embedded in logit regression and the result obtained is presented in Table 3. The result of Chi-square test of model coefficient was 23.191, which was significant at 1% probability level. Based on the Chi square result, the result revealed that year of farming experience had a positive coefficient of (3.953) was significant at 1% level. This implies that increase in farming experience will increase the probability of the respondents to adopt high to climate change adaptation and mitigation measures. Experienced farmers would be more efficient and have a better knowledge to

climatic conditions and measures of coping with its consequences (Francis, 2017). Maddison (2006) stated that experienced farmers have more knowledge and information about climate change and agronomic practices that they can adopt in responses.

Annual income was also found to have positive coefficient (10.227) and was significant at 5% level. This implies that farmers with high income have the probability to adopt high to climate change adaptation and mitigation measures than low income earned farmers. Onyekale and Madukwe (2010) reported that climate change adaptation measures are very costly which means fund hindered farmers from getting necessary resources that could facilitate adaptation of changing climate.

Based on the Chi-square result, the null hypothesis was rejected and the alternative which states that selected socio-economic characteristics of yam farmers have significant effects on the climate change adaptation and mitigation measures adopted among farmers in the study area was accepted.

Table 4: Binary Logistic Results of Socio-economic Characteristics of Respondents affecting Climate Change Adaptation and Mitigation Measures

Variables	B	Wald	Sig.	Exp(B)
Age	-0.042	0.582	0.446	0.959
Gender	-0.320	0.244	0.622	0.726
Marital Status	0.882	1.724	0.189	2.415
Years in School	0.059	1.059	0.303	1.061
Household Size	0.046	0.546	0.460	1.048
Occupation	-19.437	0.000	0.999	0.000
Farm Size	0.045	0.087	0.768	1.046
Years of Farming	0.101	3.953**	0.047	1.106
Annual Income	0.000	10.227***	0.001	1.000
Training	-0.740	0.857	0.354	0.477
Constant	21.149	10673.263	0.994	153093675354

Chi-Square Test of Model Coefficient (X^2) = 23.199***
Negelkerek (R^2) = 0.289
Hosmer and Lemeshow Chi Square = 4.590

*** = Significant at 1 % level
** = Significant at 5 % level
Source: Field Survey (2019).

Conclusion and Recommendations

The study revealed that yam farmers in the study area were in their active age and yam production is male dominated. Majority of the farmers were married with a fairly large household size. Farming was the major occupation and they have vast farming experience. Some of the agronomic practices adopted by farmers to cope with the changing climate in the study area were mulching, early planting/harvesting, crop rotation, prompt weeding, mixed cropping, application of organic manure among others.

Based on the findings of the study, the following recommendations were made:

One of the predominant challenges in the study area is lack of access to extension services. To redress this, the government should employ more extension agents to improve extension service delivery in the study area in order to boost their productivity.

Afforestation and reforestation should be practiced so that plants will help to remove the high concentration of carbon dioxide in the atmosphere.

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