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RESEARCH ARTICLE

Perceived Effects of Climate Change Adaptation Strategies on Yam Farmers in Niger State, Nigeria

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ABSTRACT

Climate change is one of the issues bordering stake holder all over the world most especially as it affects agricultural activities. The study was conducted in order to have insight on the various adaptation strategies yam farmers use to curtail the effect of climate change as regards to yam production in Niger state with the specific objectives of the study was to assess the socio-economic characteristics of yam farmers. Climate related constraints, the adaptation strategies employed by farmers, and level of yam farmers' level of knowledge on climate change. A four-stage random sampling procedure was employed to choose 112 participants. first stage, zone II was purposively selected (due to large scale production of yam in the area under review). In the second stage, two local governments Area. (Bosso and Paiko) were chosen out of the nine local governments. In the third stage, two communities where randomly picked and in the fourth stage, sampling of yam farmers was done using yamane's formular. The data were collected through interview descriptive statistics (frequency, distribution, and percentage) Probit regression model were used to analyse data collected. Results from the analysis showed that male farmers were the majority in the study area with an average age of 44 years. Married farmers account 74.0% of all the farmers, with a mean household of 7persons. A good number of the farmers have adequate information on the reasons for climate change. These reasons include deforestation (100%), applications of surplus subsistence on the farm like agrochemicals (100%). Furthermore, the major perceived effects of climate change are yam spoilage ($\bar{X}$ =2.82) and high rate of weed growth ($\bar{X}$ =2.77). Various strategies by yam farmers include purchase of agricultural insurance ($\bar{X}$ =3.13), weather resistant variety ($\bar{X}$ =2.82), Mulching (2.75), other strategies include of intercropping ($\bar{X}$ =2.70). factors affecting the rate of climate change include age (.03093), size of land (.0031627), Access to information (1.284348), Training (.1205591).Major constraints yam farmers face in adopting climate change, inaccessibility to credit ($\bar{X}$ =2.74), lack of information ($\bar{X}$ =2.72), shortage of labour ($\bar{X}$ =2.72). the study recommends increase training of the farmers cause of climate change, how to reduce the effects of climate change, environmental protection and how to enhance continuous production of yam in the study area.

1. Introduction

Climate change is said to be an alteration in respect to climate that lasts for several decades or more and may be detected by statistical tests based on variations in the mean and variability of its attributes. The problem of climate change towards agriculture is fast becoming a source of worry worldwide, with many studies highlighting the adverse effects on crop production and food security [1]. The fourth Assessment report of the Intergovernmental Panel on Climate Change (IPCC)(2), has reported that the

heat wave as a result of climate change is now unmistakable and that the major cause is as a result of indiscriminate human activities (carbon emission). Climate change has grave consequences on smallholder farmer's production and amount of rainfall [3]. More so, agricultural activities have been greatly affected due to loss of land, reduced season of rainfall, variable in unset of rain, about the type and varieties of crops to plant. These problems have consequently lead to increase shortage of food to feed the ever increasing population and increases cases of malnutrition [4]. Numerous environmental, socioeconomic, and associated sectors are impacted by climate change, including aqua cultural organisms, cultivation of crops, hunger, disease, relationships between living organisms land and life in coastal zones [5]. The four major West Africa countries that produce yam include, Nigeria, Benin, Ghana, and Côte d'Ivoire. They account for more than 90% of the world's output. They jointly cultivated about 8.8 million hectares of land and produced 75 million tonnes of tubers of yam in 2021 [6,7].

Rainfall patterns in Nigeria have already changed, which has an impact on when the planting season begins and lowers harvest yields. Yams are cultivated for its edible tubers are members of the genus Dioscorea (family Dioscoreaceae). Yams are native to warmer parts of both hemispheres, and in the tropics, a number of species are grown as reliable food crops. They're mostly grown underground and sub- Saharan Africa grow about 95% of the world's total yam output. Yam is a great source of carbohydrates and fiber. Nigeria's yam industry is mostly driven by large, small-scale farmers. critical source of livelihood for farmers in Niger state, and to the national economy [8]. The production of this crop is affected by factors varying from physical, economic to cultural. Reduced soil fertility, an increase in pests and illnesses, and a decline in yam productivity all linked to the consequences of climate change pose a great threat to farmers livelihoods hence the need for this study. The study's specific goals are to describe the socioeconomic traits of yam producers in the research region, identify the reasons for climate change in the study area, identify yam farmers' perception on variation strategies to mitigate the effect of climate change in the study area, determine the factors affecting the rate of adoption of climate change variation approaches among yam farmers in the study area and identify constraints yam farmers face in accepting climate change variation approaches in the area under review.

2. Materials and Methods

The Niger States was the study's location. Niger State is situated amid latitudes 8 0 11' N and 110 20' N and longitudes 40 30' E and 70 20' E [9]. The 2006 census conducted via National Population Commission (NPC), the State has a population of 3, 950,249 people and a projected land area of 76,363 square kilometers [10]. However, based on a 3.4% growth rate, the estimated population in 2017 is 7,141,7331. Due to its agrarian nature and suitable climatic conditions, the soil in the state is good for the cultivation of crops like cowpea. mango, citrus, cashew vegetables, rice, melon, millet, yam, and, banana, groundnuts, soybeans cassava, sorghum, maize and pawpaw. Livestock reared in the state include cattle, sheep, goats, and poultry are also raised by the state's residents.

For the purposes of this study, a 4-stage sampling approach was used to choose respondents. Due to the extensive yam production in the region, Zone II was purposefully picked in the first stage. Of the nine LGA in the zone, two LGAs Bosso and Paikoro were chosen in the second stage. To create a total of six 6 communities, two communities were randomly chosen in the third stage from each of the three LGAs that had previously been selected. Using [15] formula, a proportionate sampling of yam farmers was conducted in the fourth step [11].

$$n = \frac{N}{1+N(e)^2} \quad \ldots\ldots (1)$$

Where n= sample size N= sample frame, 1=constant e = limit of tolerate error at 0.05 probability level.

$n = \frac{N}{1+N(e)^2}$ Where: n = sample size N = finite population

e = limit of tolerable error (level of significance = (0.07)

1 = constant

Table 1: Sampling of yam producers

Zones	LGAs	Name of Communities/Villages*	Sample Frame	Sample Size
II	Bosso	Bosso	55	16
		Chanchaga	36	10
	Paikoro	Paiko	183	51
		Tungan mallam	126	35
Total	2	4	400	112

Source: *[12]

Primary sources were exploited to elicit data for this research. In addition to interview schedules for the nonliterate respondents, questionnaires were used to collect the primary data. Well trained enumerators were employed to assist the researcher in the data collection. Combination of descriptive (percentages, frequency, Likert scale and mean) was employed to objective I, II, III and V while inferential statistics (Probit regression model) was employed objective IV. The study used Probit model because it has the capability to compel the utility value of the decision to join variable to lie within 0 and 1, and its ability to resolve heteroscedasticity issues [13]. The dependent variable which is the Socioeconomic variables *inducing adoption* of adaptation techniques for change in climate among yam farmers in the study area (Y) considers

just two variables: 1 for an effective strategy and 0 for an ineffective plan.

Model Specification

The following is an implicit specification of the model:

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8 \text{----------} X_{14})$ (2)

Y = (Effective =1, Not effective=0) X_1 = age (yrs) X_2 = Status of marriage (1=married, 0=not married) X_3= Size of household (Number) X_4 = Educational attainment (yrs) X_5 = farming experience (yrs) X_6= Herbicides and pesticides (₦) X_7 = Farm Area (Ha)

X= Fertilizer (₦) X9= Labor (if employed,=1, otherwise,=0) X10= Credit amount (N) X11= Association membership (1=yes, 0=no). X12= Visit ext (Number)

X13= Information access (1=yes, 0=no).

X_{14}= Training received on climate change (number) b_1-b_{14}= regression coefficient

X's = as already defined above e = error term

3. Results and discussion

3.1 Socio-economic Characteristics

From Table 2, the result revealed that the mean age of yam farmers was 44 years with 97% of them being male and married (74%). This result concur with finding of [14] who found housed hold head being married had an important effect on accepting to plant of crops that drought resistance varieties as away of coping the effects of climate change while [8] who worked on farmers adaptation strategies said that most yam producers were men. Additional findings showed that the respondents' average dependent count was 7. Because farmers have a duty to provide for their families, the size of their household can affect the resources they have available. More so, large household size in some instances translates to more labour to work on the farm lands. Six years was the mean number of years spent in school. In addition, 28% of respondents had no formal schooling 27% ended at the secondary level and 1% stopped at junior secondary. Of the respondents, 45% stopped at the primary level.

Table 2 Socio-economic characteristics of the respondents

Variables	Freq	Perc(%)	Mean
Age(yrs)			
25-35	8	7	44
35- 45	45	40	
45-55	54	48	
55-65	4	4	
65-75	0	0	
75-85	0	0	
85-95	1	1	
Sex			
Male	109	97	
Female	3	3	
Marital Status			
Single	16	14	
Married	74	66	
Widow	13	12	
Seperated	8	7	
Divorce	1	1	
Household size			
0-5	23	21	7
5-10	64	57	
10-15	21	19	
15-20	2	2	
20-25	2	2	
Farming experience			
0-5	52	46	6
5-10	15	13	
10-15	33	30	
15-20	12	11	
Level of Education			
Non educated	30	28	
Primary	50	45	
Junior secondary	2	1	
Secondary	30	27	

Source: Field survey, 2023

Table 3: Yam farmer's familiarity on the reasons of climate change

Origin of Climate change	Responses	Freq (%)
Falling of trees	Yes	112 (100.0)
Uses of excess chemicals in farming like agrochemicals	Yes	112 (100.0)
Bush burning	Yes	112 (100.0)
High rainfall intensity	Yes	109 (97.3)
Use of generator	Yes	112 (100.0)
Gas released	Yes	112 (100.0)
Cooking with firewood	Yes	112 (100.0)
Late Onset rainfall	Yes	107 (95.5)
Abandoned deities	Yes	68 (60.71)
Gas flaring	Yes	111(99.1)
Emission of carbon	Yes	112 (100.0)

Source; field survey 2023 Multiple responses recorded

Table 4: Perceived effects of Climate Change

Variables	VS	S	NS	WS	WM(X)	Rank	D
Yam spoilage in the soil	85(255)	27(54)	0	316	2.82	1st	S
High rate of weed growth	87(261)	25(50)	0	311	2.77	2nd	S
Disease and pest infestations	92(276)	20(40)	0	309	2.75	3rd	S
Premature ripening of crops	56(168)	56(112)	0	298	2.66	4th	S
Increase erosion	66(198)	46(92)	0	290	2.58	5th	S
Low crop yield	59(177)	53(106)	0	283	2.52	6th	S
Reduction in soil nutrients	74(222)	38(76)	0	282	2.51	7th	S
Destruction of field crop by heavy wind	59(177)	52(104)	1(1)	280	2.5	8th	S
Excessive soil moisture	53(159)	55(110)	4(4)	273	2.43	9th	S

Source; Field Survey 2023 Note: VS= Very sever, S= Sever, Not Sever, Weighted Sum, Weighted Mean, Decision

Results on Table 3 shows that deforestation/cutting down of trees, gas flaring, gas released, bush burning. The result implies that most of the causes of climate change are man-made. Result of this study finds support in the study of [15] who found that climate change may be resulting from human activity-induced as a result increases in the quantities of greenhouse gases in the Earth's atmosphere. More so, [16] reported that respondents' overestimation of the negative effects that knowledge of climate change may have on farmers' behavior and efforts to address the issue of climate change and consequently output.

3.2 Perceived effects of Climate Change

The finding of the study as displayed in Table 3 shows that some of the climate change's implications on yam production include yam spoilage before harvesting ($\bar{X}$ = 2.82), high rate of weed growth ($\bar{X}$ =2.77), disease and pest infestations ($\bar{X}$ = 2.75), premature ripening of crops ($\bar{X}$ =2.66), increase erosion ($\bar{X}$ = 2.58), low crop yield ($\bar{X}$ =2.52), reduction in soil nutrients ($\bar{X}$ =2.51), destruction of field crop by heavy wind ($\bar{X}$ =2.5) and excessive soil moisture ($\bar{X}$ = 2.43). This result shows that yam producers were severely impacted by climate change, which could have a harmful financial effect on them and eventually damage the nation's ability to produce enough food. Thus, in order to guarantee appropriate yam management, climate change adaptation strategies must be implemented. The study find support in the works of [17,14] who reported that insufficient ability to adjust towards consequences of change in climate has lead to widespread hunger (an issue that continues to be of concern).

3.3 Perception of yam farmers on ways to avert the effects of change in climate

The results shown in Table 4 describe the different approaches taken by yam growers in the research region to deal with climate change. The results showed that, between the adaptation options used by yam farmers in the research area, planting early-maturing crop types and using weather-resistant kinds were more effective, with means of 3.13 and 2.82. This suggests that a good number of the yam farmers nave adequate information on the risk of climate change and inconsistency could pose to them and their entire household if weather-resistant varieties and early maturing crop

planting are not adopted as strategies. These risks include reduced crop yield, which could increase global food demand and deplete food reserves. Other strategies include use of Mulching ($\bar{X}$ =2.75), migration to other location ($\bar{X}$ =2.74), intercropping yam with other crops ($\bar{X}$ =2.70), planting of cover crop (X =2.67), use of irrigation system ($\bar{X}$ =2.61), use metrological information ($\bar{X}$ = 2.61), Diversification into other activities (Mean=2.60), listening to information about climate change ($\bar{X}$ = 2.56) and collecting rainwater to use in the dry season ($\bar{X}$ = 2.47). However, changing of plant dates($\bar{X}$ = 2.45)and changing the use of farm size ($\bar{X}$ = 2.42). This outcome supports the observations made by [18], who noted that crop and livestock development is hindered by climate change and variability, which also influences crop variety selection and other farm management decisions. More so, [19] reported majority of the farmers altered their planting and cropping schedules, which included timing the planting of their crops according to the start of the rains.

3.4 Collecting rainwater to use in the dry season

Make use of farm insurance

Factors affecting the rate of implementation of practices that can reduce the effect of climate variation

Probit regression model was utilized to investigate the variables influencing how quickly climate change adaption measures are adopted among yam farmers. The findings reveal that the coefficient of age is favorable and noteworthy with a 10% chance level. This suggests that as the participants in the increases, the rate of acceptance of climate change variation tactics will also increase. The finding concurs with the result of [20] who suggested that greater household sizes may have an impact on the adoption of techniques meant to boost productivity so as take care of family affiliates.

Results also reveal that the coefficient of household size of the farmers is positive at 1% probability level. This suggests that the rate of adoption of the respondents' dependents rise the rate of acceptance of practices that can help reduce the effect of climate variability among yam farmers also increases. This also implies that increase labour from family members is grantee, thereby minimizing the cost of labour through hire labour holding others factors constant. The result finds support in the study of [14] who reported that age and family size affect the rate of adoption of climate change adaptation strategies. More so, the coefficient of size of land of the farmers is substantial and positive at the 1% probability level. This suggests that the rate of acceptance of change in climate variation increases with the respondents' land size. At the 1% probability level, education was likewise favorable and significant. This suggests that the adoption of new technologies and techniques that provide people with the necessary knowledge of where and how to earn a living, as well as how to choose excellent agronomic methods and inputs as a farmer, are significantly influenced by one's educational attainment. The outcome is consistent with research by [20], who found that education generally makes farmers mindful of the value and advantages of implementing climate change adaptation techniques for higher yields. The results also showed that training and information availability are optimistic and important at one per cent and ten per cent probability stages, suggesting that raising either of these factors will accelerate the adoption of measures for adapting to variation in climate. Farmers will be able to adjust to climate change and variability strategies with the support of increased information availability and appropriate training, which will probably result in increased crop and livestock output. The results are consistent with [21] findings, which stated that farmers' adaptation strategies depend on a variety of factors, including educational attainment, sex, age, farming knowledge, capital, family head, family size, farm size, access to markets, accessibility of credit and extension services, availability of climate information, and presence of favorable agricultural policies.

3.5 Constraints yam farmers face in adopting climate change adaptation strategies

Table 7 recaps the limitations farmers experience in adopting climate change adaptation strategies. Inaccessibility to credit ($\bar{X}$ =2.74), lack of information ($\bar{X}$ =2.72), shortage of labour ($\bar{X}$ =2.72), poor potential irrigation ($\bar{X}$ =2.59), poverty ($\bar{X}$ =2.52) and lack of information on adaptation options ($\bar{X}$ =2.48) where some of the identified constraints. This result contradicts the study of [22], who pointed out inadequate training and extension services as the main obstacles to the adoption of new technology.

Table 5: Perception of yam farmers on adaptive tactics to lessen the impact of climate change

Variables	NE	E	VE	WS	WM	Rank	D
Use of early maturing crop varieties	0(0)	45(90)	87(261)	351	3.13	1	E
Use of weather-resistant variety	0(0)	20(40)	92(276)	316	2.82	2	E
Mulching	1(1)	26(52)	85(225)	308	2.75	3	E
Migration to other location	0(0)	29(58)	83(249)	307	2.74	4	E
Intercropping yam with other crops	0(0)	27(54)	83(249)	303	2.70	5	E
Change of planting	0(0)	37(74)	75(225)	299	2.67	6	E
Planting of cover crop	0(0)	42(84)	70(210)	294	2.62	7	E
Use of Irrigation System	2(2)	39(78)	78(213)	293	2.61	8	E
Using metrological information	0(0)	43(86)	69(207)	293	2.61	8	E
Diversification to non- farm activity	0(0)	44(88)	68(204)	292	2.60	10	E
Listening to information about climate change	1(1)	47(94)	64(192)	287	2.56	11	E
C**ollecting rainwater to use in the dry season**	4(4)	51(102)	57(171)	277	2.47	12	E
Farm insurance	0(0)	50(150)	62(124)	274	2.45	13	E
Changing farm Size	1(1)	60(180)	45(90)	271	2.42	14	E

Source; Field study 2023 Note: NE=Not effective, E= Effective VE = Very effective , Weighted Sum, Weighted Mean, Decision

Table 6: Factors affecting the rate of adoption of climate change

Variables	Coefficient	Std Err	Z-value	P-value
Age	.03093	.0172502	1.79	0.073**
Marital status	-.0071149	.0407259	-0.17	0.861
Household size	.072042	.0219111	3.29	0.001***
Years in school	-.0000838	.0000466	-1.80	0.072**
Farming experience	-.0897945	.03051	-2.94	0.003***
Size of land	.0031627	.0012365	2.56	0.011*
Extension visit	.0713903	.1307132	0.55	0.585
Access to information	1.284348	.5184062	2.48	0.013***
Pesticides	.1205591	.4140159	0.29	0.771
Training	-.0000195	.0000112	-1.74	0.082*
Constant	-2.661157	1.167556	-2.28	0.023*
Number	112			
LR $chi^2(10)$	46.35			
Prob > chi^2	0.0000			
Pseudo R^2	0.3194			
Log likelihood	-49.388043			

Source; Field Survey 2023 *** Implies significant at 1% , ** significant at 5% , * significant 10% .

Table 7: Constraints yam farmers face in adopting climate change

Variables	VS	S	NS	WS	WM(X)	Rank	D
Inaccessibility to credit	83(249)	29(58)	0	2.74	307	1st	S
Inadequate information on climate variation	81(243)	31(62)	0	2.72	305	2nd	S
Shortage of labour	81(243)	31(62)	0	2.72	305	2nd	S
Poor potential irrigation	67(201)	45(90)	0	2.59	291	4th	S
Poverty	59(117)	53(106)	0	2.52	283	5th	S
Inadequate information on adaptation options	52(162)	57(114)	1(2)	2.48	278	6th	S
Shortage of land	52(156)	60(120)	0	2.46	276	7th	S

Source; Field survey 2023

4. Recommendations

Based on the findings of this study, it was recommended that: -

(1). Training on climate variation issues is necessary, particularly for extension workers and non-governmental organizations operating in rural areas.

(2). Seed council of Nigeria should help make available early maturing and good yielding variants of crops to farmers at subsidized rate and at the right time.

(3). Governmental, Non-governmental and well to do individuals who sell agricultural products should provide financial facilities and incentives to farmers in order to encourage them to produce more.

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