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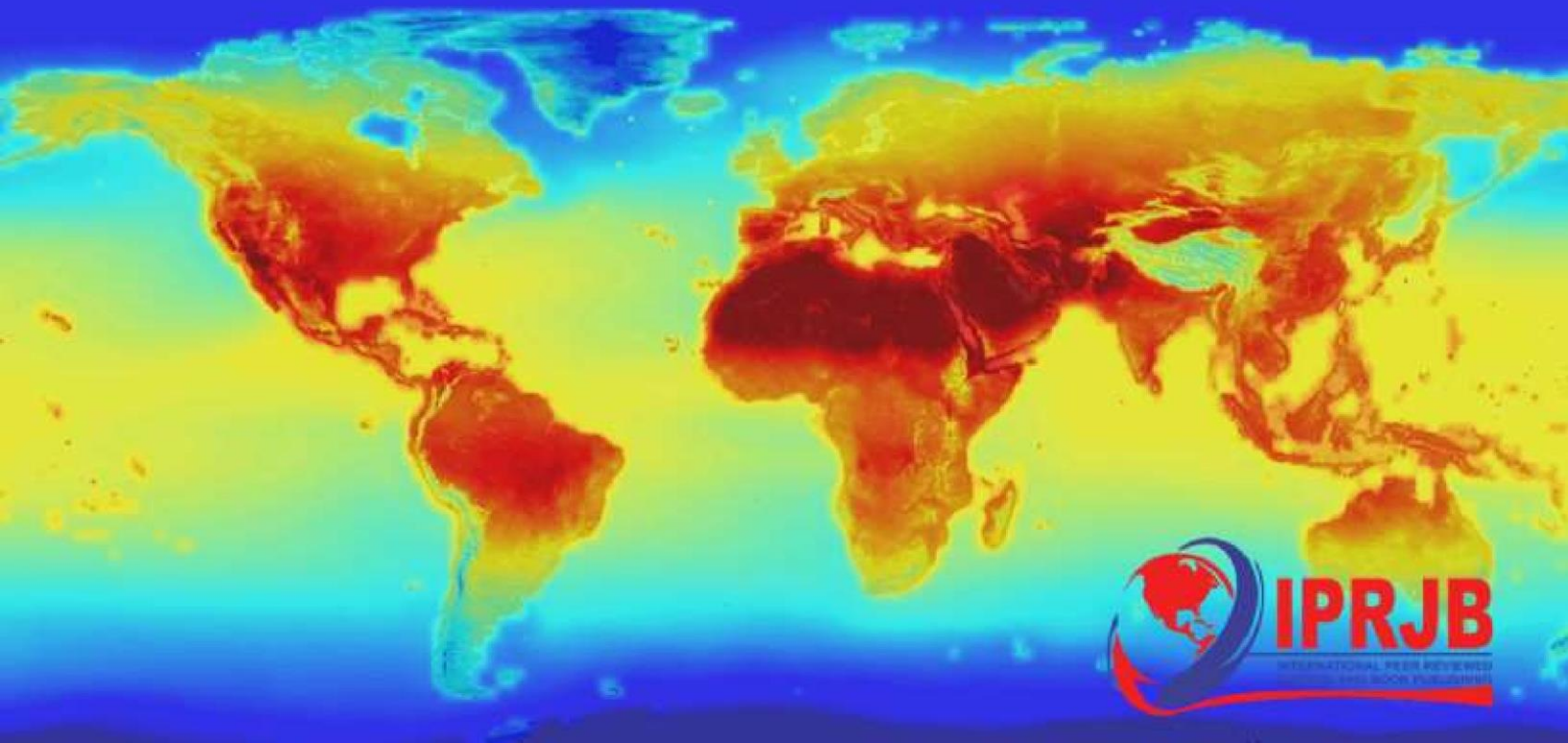

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Abstract

Purpose: The study was carried out to investigate the effect of climate change and weathervariability perception on yam production in Owo Local Government Area of Ondo State, Nigeria. The specific objectives were to: describe the socio-economic characteristics of the respondents in the study area; identify the perceptions of yam farmers on climate change in the study area; identify the adaptation strategies adopted by farmers in the study; determine the cost and return of farmers; determine the effect of climate change variables perception on yam output.

Methodology: Multi –stage sampling procedure was used in the selection of respondents in the study area. A total of 120 respondents were selected for this study. Descriptive statistics, Gross Margin analysis, Likert Rating Scale, Multiple Regression Analysis were used to analyze data collected from the field. The study revealed that 38.0% of the yam farmers fell within the ages of 36 and 45 years. This implies that yam farmers in the study area are relatively young and energetic which enhance sustainable production.

Findings: Gross Margin analysis revealed that yam production is profitable as it leaves a profit margin of ₦31995 for each farmer in the study area. Likert Rating Scale showed that majority of the respondents had a high perception on climate change but there is need for more sensitization of yam farmers on climate change. Multiple Regression Analysis showed that there is a significant relationship between climate change variables perception and yam output which rejects the hypothesis of this study.

Unique Contribution to Theory, Practice and Policy: The study recommended among others that there is need for government to sensitize farmers on climate change and provide them with reasonable adaptation options to mitigate the negative effects of climate change on Agricultural production.

Keywords: *Climate Change, Yam, Farmers, Weather Variables*

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INTRODUCTION

Agriculture has a significant environmental impact in the process of providing food and fiber to humans, and climate is the key factor of agricultural output (Apata *et al.,* 2009). Due to agriculture's critical role in human welfare, federal agencies and others have expressed concern about the possible consequences of climate change on agricultural output. The efficiency of rainfall for agriculture and fish production is determined by temperature values that influence evaporation and transpiration (Rudolf and Harmann 2009). According to Smith and Skinner (2002), climate plays a major role in agriculture, influencing the productivity of physical production elements such as soil moisture and fertility. Climate change is projected to affect crop and livestock output, hydrologic balance input supplies, and other components of agricultural systems, according to a large body of research (Lobell *et al.,* 2008).

The nature of these biophysical consequences, as well as human reactions to them, is, nevertheless, complex and ambiguous. Climate change is expected to have a significant impact on Nigeria, particularly in agriculture, land use, energy consumption, biodiversity health, and water resources (Apata *et al.*, 2009). Nigeria, like all of Sub-Saharan Africa's countries, is extremely vulnerable to the effects of climate change (NEST, 2004, IPCC 2007 and Apata *et al., 2009).* Although attempts have been made to investigate the impact of climate change on agricultural productivity and farmer adaptation in Nigeria's agriculture, data on farmers' perceptions and adaptation strategies has been inadequate (Fakorede and Akinyemiju, 2003). Farmers' ability to notice climate change is also said to be a critical requirement for their decision to adapt (Eboh, 2009). Farmers adapt to climate change based on how they perceive shifting weather patterns. The sense of two concepts being in agreement or disagreement (Locker, 1960). Knowledge is the sum of what is known in an organizational setting, and it exists in people's intelligence and competency.

Nigeria Agriculture is subject to climate change, thus farmers must adapt their practices to either avoid the effects of climate change or fully benefit from it. Climate change is most likely to lead to food insecurity, particularly among the resource poor who are unable to meet their food needs in developing nations such as Nigeria (FAO, 2008). This study will help in suggestive ways of educating and encouraging yam farmers or producers in adapting to climate change. Also, it will assist farmers to identify ways of minimizing against the negative effect of climate change, and this help to improve their productivity and thereby making yam farming reliable and dependable in the study area. The broad objective of the study is to access the effect of climate change and weather-variability perception on yam production in Owo Local Government Area, Ondo State. Specific objectives of the study are to describe the socio-economic characteristics of respondents in the study area; identify the perceptions of yam farmers on climate change in the study area; identify the adaptation strategies adopted by yam farmers in the study area; determine the cost and returns associated with yam farmers in the study area; determine the effect of climate change variables perception on yam output.

METHODOLOGY

The study was carried out in Owo LGA of Ondo State, Nigeria. Owo LGA is one of the eighteen LGAs in Ondo State that is known for crop production with high capacity of forest reserve. The total population of the people in Owo LGA is 196,729 (NPC, 2006). Owo is a single Native Authority sharing boundaries with Akure, Kabba and Benin. Agriculture is the mainstay of the Owo LGA's economy. The area produces crops like cassava, yam, cocoyam, maize, vegetables, cowpea, cocoa, oil palm, plantain and fruits like cashew, mango and orange (citrus). The area is endowed with forest products such as trees like Teak, Mahogany, Messenia, Obeche etc. and animal products like grasscutter, snail, crocodile, monkey etc.

Instrument of Data Collection

Primary source of information was used in this study. The primary data was obtained through the administration of pre-tested and validated structured questionnaire with the respondents was used to obtain qualitative data.

Sampling Technique and Sample Size

Multi-stage sampling technique was used in selecting the respondents for the study. The first stage was purposive selection of Owo LGA due to convenience and predominance of local farming. The second stage involved the random selection of four communities in Owo LGA, the communities are Emure, Ehin-Ogbe, Isijogun and Iyere. The third stage involved random selection of 30 local farmers each from the four communities making a total sum of 120 local farmers.

Data Analysis and Model Specification Descriptive Statistics

This tool consist of frequencies, percentages, charts, mean and standard deviation, and it was used for the analysis of Objective 1. **Model Specification**

Likert Rating Scale Technique

To ascertain the perception of yam farmers to climate change which is the objective 5 of this study, five point Likert rating scale was adopted. The 5-point scale was graded as Very Great Extent = 5, Some Extent = 4, Little Extent = 3, Very Little Extent = 2 and No Extent = 1. The level of perception was ranked using weighted mean (X). The mean score is 5+4+3+2+1 = 15/5 = 3.00 (cut-off point). Therefore, using the cutoff point value of 3.00, any item with mean value of 3.00 and above was regarded as "High" while items with mean value of less than 3.00 was regarded as Low. This tool was also used to analyze the identified adaptation strategies adopted by yam farmers in the study. The weighted mean was used as a point of call i.e. greater than 3.0 was identified as perceived adaptation strategies adopted by yam farmers in the study area.

Gross Margin

This tool was used to analyze objective 4 of this study which is the determination of the cost and return of yam farmers in the study area. This tool consists of fixed cost, variable cost, revenue and their totals

GM = TR - TVC

Multiple Regression Model

Multiple Regression analysis was adopted to analyze the relationship between the climate change variables perception and output of yam farmers in kg, which is the objective 3 of this study. The functional form of the model can be stated implicitly as: $Y= f (X_1 X_2, X_3, X_4, X_5$ .....+ e)..... (Implicit form) Where Y = Estimated value of output in Tonnes.

Three functional forms of the model (linear, semi-log and double log) will be tried and the best fit was selected which represented the lead equation based on the R-square value. The forms are stated in equations 1, 2 and 3 respectively:

$Y = \beta0 + \beta1X1 + \beta2X2 + \beta nXn + ei$……..1 lnY

$= \beta0 + \beta1 lnX1 + \ldots. + \beta2\ lnX2 + \beta nXn + ei$……..2

$Y = \beta^o + \beta1 lnX1 + \ldots. + \beta2\ lnX2 + \beta nXn + ei$……..3

Validity and Reliability of Instrument

Content validity was used out to ensure that the instrument measures what is intended to measure. The instrument was given to experts in field of study to review and necessary corrections was carried out. Reliability test was carried out.

Measurement of Variables

Two categories of variable was measured in this study. They are dependent and independent variable.

Dependent Variable

The dependent variable of this study was output of yam farmers in Owo local Government Area of Ondo State. The output of yam farmers in this study area is dependent on climate change Variables perception.

Independent Variables

$Y = B_0+B_1X_1+B_2X_2+B_3X_3+B_4X_4+B_5X_5+e_i$

Where Y = Quantity of yam produced in kilogram

B_0 = Intercept/Constant term

B_1-B_5 = Regression coefficients of X_1-X_5 to be estimated

And e_i = error term

X_1 = Occurrence of flood (Yes = 1, No = 0)

X_2 = Notice of dry spell (Yes =1, No = 0)

X_3 = Change in Temperature (Increased = 1, Decreased = 2)

X_4 = Change in Rainfall pattern (Increased =1, Decreased = 2)

X_5 = Hours of Sunshine (hours)

RESULTS AND DISCUSSION Socio-Economic Characteristics of Respondents

The study revealed that majority of 58.3% of the yam farmers were male while 41.7% were female. This result goes in line with the findings of Kurukulasuriya. (2006) that showed that majority of practicing farmers were male and only few females engaged in farming.

The study further revealed that 46.7% of yam farmers had household size of 4, 23.3% with household size of 5, 21.7% have household size of 6, 7% of the yam farmers have household size of 7 and 1.7% of the farmers have household size of 8 and 10.

As presented in table 1, 38.3% of the yam farmers were between the ages of 36-35 years while 31.7% were between 26-35 years. This goes with the findings of Ozor, 2009 that people older than 55 years do not really engage in farming anymore.

The result in table 1 shows that majority (70%) of the respondents cultivated 1.0-3.0 hectares of yam farm, the mean yam farm size was 2.8 hectares. This shows that farm sizes are relatively small. This is disadvantageous because to a large extent, farm size determines output level. The finding is in line with Kolawole and Ojo (2007) who noted that Nigerian agriculture involves small scale farmers scattered over wide expense of land areas with small holders ranging from 0.5-3.0 hectares

The result in table 1 shows that about 90% of the farmers claimed that extension agent has not visited while only 10% of the farmers claimed that extension agent visited them. This implies that majority of the respondents in the study area had no access to some recent technologies on the best practices in the study area. This will greatly affect the outputs level of the yam farmers.

As presented in table 1, the result revealed that 28.3% of the yam farmers earned between ₦62000 to ₦92000, 20% of the farmers earned between ₦93000 to ₦123000, 13.3% earn ₦30000 and below, 20% earn between ₦31000 to ₦61000 respectively. The higher the income the higher the productive capacity.

The result in table 1 shows that 58.3% of the farmer's years of experience was below 5years which concur with the findings of Apata *et al.,* 2009 that majority of people do not engage in yam production compare to maize, cassava, and cowpea.

Table 1: Distribution of Farmers According to Socio-Economic Characteristics

Variable	Frequency	%	Mean
Sex			
Male	**70**	**58.3**	
Female	**50**	**41.7**	
Age			
<25	**6**	**5.0**	
26-35	**38**	**31.7**	**28.8**
36-45	**46**	**38.3**	
46-55	**24**	**20.0**	
≥56	**6**	**5.0**	
93000-123000	24	20.0	
≥124000	22	18.3	
Household size			
	110	**91.**	
	10	**8.4**	**5**
Farming Experience			
<5	**70**	**58.3**	
6-11	**44**	**36.7**	**14.9**
12-17	**4**	**3.3**	
>18	**2**	**1.7**	
Farm size			
1.0-3.0	**84**	**70**	
3.5-6.0	**36**	**30**	**2.75**
Access to Extension Agent			
Yes	**12**	**10**	
No	**108**	**90**	

Source: Field survey 2021

Farmers Income			
≤30000	16	13.3	
31000-61000	24	20.0	
62000-92000	34	28.3	
4.00-6.00		**7**	
7.00-10.00			

Multiple Regression

Table 2 shows the regression analysis which shows that the double log functional form had the best fit, based on the values of R (0.725), which means that 72.5% of independent variables (change in temperature, change in rainfall pattern, notice of dry spell, occurrence of flood, hours of sunshine) are jointly explained by the dependent variable (quantity of yam produced in kilogram), the levels and the number of significant explanatory variables and their signs. The Fvalue of (10.640) indicated that the overall equation was highly significant at (1%) t-stat while Durbin-Watson (DW) of 2.257 showed the absence of autocorrelation. Out of the five explanatory variables specified in the model, four were statistically significant at different significance level. They include occurrence of flood, Notice of dry spell, Change in rainfall pattern and change in temperature.

Occurrence of flood by yam farmers was positive and significantly related to the quantity of yam produced at $p<0.10$ level of significance. All things being equal, the increase in occurrence of flood perception by farmers in the study area is expected to increase the quantity of quantity of yam produced. Notice of dry spell by yam farmers was also positive and significantly related to the quantity of yam produced at $p<0.01$ level of significance. These findings agreed with the findings of Muhammed *et al.,* (2017) Increase in the notice of dry spell should increase the quantity of yam produced. The most important among these explanatory variables are change in rainfall pattern and change in temperature. Change in rainfall pattern, and change in temperature perception were positive and significantly related to the quantity of yam produced. Increase in the perception of yam farmers on change in temperature and rainfall pattern increases the quantity of yam produced. This conforms to the findings of Ishaya and Abaje (2008) who found out that perception of farmers on change in temperature and rainfall pattern influenced the productivity of farmers. (-0.722) in semi-log functional form reveals that perception of farmers on hours of sunshine has a no influence on the quantity of yam produced because sunshine has no influence on yam production unlike crops who are sun-loving such as cotton.

Table 2: Multiple Regression Analysis

Climate Change Variables Perception	Linear	Semi-log	(a) Double-log
Occurrence of flood	0.049	1.857*	1.464
	(5.575)	(0.192)	(0.282)
Notice of dry spell	2.406*** (3.280)	0.043	5.407***
		(0.113)	(0.345)
Change in rainfall pattern	2.507*** (5.990)	-1.244	2.963***
		(0.206)	(3.363)
Change in temperature	0.958	0.222	2.492**
	(3.033)	(0.104)	(7.631)
Hours of sunshine experience	-0.289	-0.722	0.545
	(0.999)	(0.069)	(3.631)

R^2	**0.153**	**0.486**	**0.725**
Adjusted R^2	**0.106**	**0.423**	**0.682**
F-value	**3.255**	**5.324**	**10.640**
Durbin Watson	**1.242**	**1.542**	**2.257**
Observation	**100**	**100**	**100**

Source: Field survey 2021, Dependent: Quantity of yam produced in kg
Note: Figures in parenthesis are standard errors
*** denotes t-stat sig @1%, ** denotes sig @ 5%, * denotes sig @ 10% (a)
Is the lead equation based on fitness?

Cost and Return of Yam farmers

Table 3 show the gross margin of yam production in the study area. The Total Fixed Cost is ₦1180099 and Total Variable Cost is ₦392092.2. The farmer is expected to have a profit margin of ₦2659377 and a gross margin of ₦3839476. The gross margin per farmer is ₦31995. This result shows that yam production is a profitable business and it should be ventured to by all and sundry if interested.

Table 3: Gross Margin Analysis of Yam Production

Cost of fixed Inputs	**Total (₦)**	**Cost of Variable Input**	**Total (₦)**
Land	443050.8	Labour	12719.05
Machinery	667272.7	Yam sett	228363.6
Hoes	16676.67	Herbicide	11896.3
Axes	2500	Insectide	20153.85
Cutlass	6233.333	Fertilizer	121147.1
Basket	5205.882	Transportation	10531.25
Spraying Pump	19712.5		
Spade	6302.941		
Wheel barrow	13144.07		
Total Fixed cost	**1180099**	**Total variable cost**	**392092.1**

Source: Field Survey 2021

Total Cost = Total Fixed Cost + Total Variable Cost

Total Cost = **₦ (**1180099 + 392092.1)

Total cost = ₦1572191

Average Return from production = P * Q

P = 78

Q = 54508

Total Return = ₦ (78 * 54508)

Total Return = ₦4231568

Gross Margin = Total Return – Total Variable Cost

Gross Margin = ₦ (4231568 - 392092.1)

Gross Margin = ₦3839476

Gross Margin per farmer = ₦31995.63

Respondent Perceptions of Climate Change

Table 4 shows the distribution of yam farmers based on their perception of climate change. Using 5-point Likert rating scale (5, 4, 3, 2, and 1) where the average is 3.00. A farmer whose mean is above 3.00 is assigned with high perception of climate change while that whose mean is below 3.00 is assigned low perception. The result shows that yam farmers have a high perception on climate change brings about longer growing season, climate change brings about diversification, climate change brings about reduced cost of production, climate change brings about new market flow, climate change brings about increased biodiversity, climate change brings about unpredictable or extreme weather condition and climate change causes crop failure or reduced yield, the farmers had low perception on climate change brings about better prices for produce and climate change brings about better condition for yam production. The result shows that 57% of the yam farmers agreed to a very great extent that climate change causes crop failure or reduced yield, 72% agreed to a great extent that climate change brings unpredictable or extreme weather conditions, 73% of the farmers accepted that there is no way climate change brings about better condition for yam production, 62% of the yam farmers believed climate change brings about increased biodiversity to some extent, 37% of the farmers have a very little extent towards the fact that climate change brings about new market flow, 30% agreed to a little extent that climate change brings about reduced cost of production, 38% of the farmers agreed to a great extent that climate change brings about diversification, 52% of the farmers agreed to a very little extent that climate change brings better prices for produce and 52% of the farmers also agreed to a little extent that climate change brings a longer growing season. Most of the farmers have a low perception about climate change which supports the findings of Ole *et al.*, 2009 in their study on perception of farmers on climate change.

Table 4: Mean Rating of Climate Change Perception of Yam Farmers in Owo LGA

Climate Change Perceptions	Total	NE (%)	VLE (%)	LE (%)	SE (%)	VGE (%)	Total (%)	Mean	S.D
Climate change brings longer growing season	120	0%	3%	52%	15%	30%	100%	3.72**	0.94
Climate change brings about better prices for produce	120	0%	52%	8%	32%	8%	100%	2.93*	1.06
Climate change brings about diversification	120	0%	15%	23%	23%	38%	100%	3.85**	1.10
Climate change brings about reduced cost of production	120	0%	32%	30%	30%	8%	100%	3.15**	0.97
Climate change brings about new market flow	120	0%	37%	32%	13%	18%	100%	3.13**	1.11
Climate change brings about increased biodiversity	120	0%	18%	13%	62%	7%	100%	3.57**	0.87
Climate change brings about better condition for yam production	120	73%	17%	0%	0%	10%	100%	1.57*	1.21

Climate change brings about unpredictable or extreme weather condition	120	3%	5%	0%	20%	72%	100%	4.52**	0.98
Climate Change causes crop failure or reduced yield	120	0%	0%	3%	40%	57%	100%	4.53**	0.57

Source: Field Survey, 2021

NE = No Extent, VLE = Very Little Extent, LE = Little Extent, SE = Some Extent, VGE = Very Great Extent

Conclusion

From this study, it was found that most of the respondents were male in their active working age, majority of who are married and experience in yam production. The level of farmers with high perception of climate change and weather variability was more than those with low perception. The yam farmers however adopted all the identified adaptation strategies in the study area. The farmer is expected to have a profit margin of ₦2659377 and a gross margin of ₦3839476. The gross margin per farmer is ₦31995. Occurrence of flood by yam farmers was positive and significantly related to the quantity of yam produced at $p<0.10$ level of significance. All things being equal, the increase in occurrence of flood perception by farmers in the study area is expected to increase the quantity of quantity of yam produced. Notice of dry spell by yam farmers was also positive and significantly related to the quantity of yam produced at $p<0.01$ level of significance. Change in rainfall pattern, and change in temperature perception were positive and significantly related to the quantity of yam produced. Increase in the perception of yam farmers on change in temperature and rainfall pattern increases the quantity of yam produced.

Recommendations

Based on the findings of this study, the following are recommended:

I. There should be increased awareness on climate change perceptions and the need for farmers to adapt on all media of communication available to the farmers by Government and Non-Government Organizations.

II. Government and private business concerns should provide credit to farmers in order to enhance their adaptive capacities.

III. Farmers should join and participate in cooperative societies or farmers' union to make access to credit, market and climate information easier.

IV. There is need to make education more accessible in rural households by increasing and monitoring investments on education in the study area by Government.

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