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ARABLE CROP FARMERS' ADAPTATION PRACTICES TO CLIMATE CHANGE RISKS IN RIVERS STATE, NIGERIA

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Abstract

This study appraised arable crop farmers adaptation strategies to climate change in Rivers State, Nigeria using survey design. The study objectives were: ascertain the socio-economic characteristics of farmers in the study area, examine the farmers' knowledge of climate change, identify the farmers' sources of information on adaptation strategies to climate change, ascertain the farmers perceived effects of climate change, identify the adaptation strategies to climate change used by farmers, identify the constraints that militate against the use of adaptation strategies to climate change by farmers. The study used descriptive statistics to analyse survey data. Results of the study indicated that majority of the farmers are females (56.7%) and are 40 years and above, with an average age of 44 years. The survey result also showed that most of the farmers (83%) have formal education. Access to extension service was low in the study area (29.2%). The study revealed that farmers have the knowledge of climate variability and always use adaptation strategies in the study area. The study findings disclosed that the major sources of information on climate were radio, fellow farmers and friends/neighbours/relatives. The survey result also discovered that the perceived effects of climate change in the study area were reduced yield, reduced income, loss of nutrients due to leaching, increased cost of inputs, high rate of spoilage of farm produce, etc. The research findings further revealed the adaptation strategies adopted by arable crop farmers in the study area as use of cover crop/mulching, use of improved/tolerant varieties, mixed cropping, use of disease/pest resistant varieties, use of organic manures, etc. Constraints that militated against the use of adaptation measures include poor extension services, low farm income, high cost of farm inputs, inadequate weather information, etc. Based on the result of this study, the following recommendations are made: extension services should be strengthened to enlighten farmers about climate change adaptation strategies, in addition, affordable climate change adaptation technologies should be appropriated and developed for resource-poor farmers to adopt, and credit facilities should be extended to the farmers to enable them purchase appropriate technology necessary for climate change adaptation.

Introduction

Several research reports have indicated changes in Nigeria's weather pattern and environmental conditions, these changes include: increase in temperatures; heavy rainfall; delayed and shorter rainy seasons; longer rainy seasons; unreliable rainfall patterns; significant decline in amount of rainfall from the normal averages, drought and flooding (Tasie and Ojimba, 2016) which have negatively impacted the lives and livelihoods of smallholder farmers. Climate change has been identified as one of the greatest challenges to the persistent low agricultural productivity amidst myriads of efforts by

government and other stakeholders to control it (Nwaiwu *et. al.*, 2013). Many studies have shown the ravaging effects of climate change on agricultural productivity (Orebiyi, *et al*., 2014).

These trends in climate change and variability are projected to continue due to increased concentrations of greenhouse gases in the atmosphere (Branca, *et al*., 2012). The literature demonstrates that without appropriate adaptation strategies the changing climate can be especially challenging for agricultural production units and food security, but with the implementation of adaptive farming measures and practices, potential challenges to achieving smallholder farmer household food security and income can be significantly reduced (Elijah, Osuafor and Anarah, 2018). In the same vein, Falola and Achem (2017) assert that climate change is gradually taking a catastrophic dimension given the associated impacts in the key socio economic sectors in recent time. According to Direct Gov., (2010), the earth's average surface temperature had been on the rise by about $0.74^{O}C$ since the last six decade. Most researchers agree that global temperatures will rise further (by how much depends on future emissions of green house gases) and if the temperature rise is high, changes are likely to be so extreme that it will be difficult to cope with them (Ozor and Nnaji, 2011). Sono, Wei and Jin (2021) noted that countries in Sub-Saharan Africa, including Nigeria are more vulnerable to the vagaries of climate because of their geographical location, wide spread poverty, low incomes, and low institutional capacity, weak response to climate change effects as well as their heavy reliance on climate-sensitive or rain – fed agriculture.

Climate variability has brought Nigeria's agricultural system under serious threats and stress. This implies that food and nutrition security in Nigeria is under serious threat as crop production is a significant aspect of agricultural activities in Nigeria (Ayinde *et al*., 2011). Extreme climatic events such as excessive rainfall, droughts, floods and forest fires have become a regular occurrence which results in tragic crop failure, increased hunger, malnutrition, pests and diseases and reduced agricultural productivity (Odjugo, 2010). In Rivers State, agricultural production is largely non-mechanized; therefore weather and climate variables assume prominence in every stage of production. Farmers depend largely on climate signals as major determinants of their farming activities. Farmers had encountered series of loses as a result of change in climate (Orebiyi, *et al*., 2014). Though, crops like cassava, yam and maize are known to tolerate drought to a reasonable extent, are still adversely affected by the variability in climate. All stages of crop production are affected by the variations in climate. Unfortunately, scientists have it that variations in climate may not be avoided entirely because of inability of countries like Nigeria to stop the emission of green house gases. Therefore the basic way to mitigate it is by building up resilience or adaptation strategies to help farmers cope with the effect of this change. Bearing the commercial and nutrition importance of food crops in the study area, it becomes very imperative to inquire on the extent and aspect these variations in climate affect the production of crops as well as identify the climate – smart coping strategies used by these farmers. This will surely help them to cope with the variability in climate thereby enhancing their production activities. It is against this background that this paper assessed the perceived effects of climate change on crop production in Rivers State and the climate - smart measures used by the farmers. Mitigation and adaptation are ways of improving farmers ability to cope with change in climate conditions across time scale from short term (e.g. seasonal to annual) to the long-term (e.g decades to centuries) (Okezie and Simonyan, 2011).

Climate change affects agriculture in several ways, one of which is its direct impact on food production. It brings additional perspective to the national challenges of increasing agricultural production to keep pace with the rising population while keeping high standards of environmental protection (Oparaeke, 2009). Responding to climate change through mitigation will take time and even with reductions in greenhouse gas (GHGs) emission, global temperatures are expected to increase and sea level will

continue to rise. Hence, development and use of adaptation strategies to deal with these effects are regarded as a necessary complement to mitigation actions (IPCC, 2001). Some adaptation strategies to current climate variability are taking place. However, this may be insufficient for future changes in climate (IPCC, 2007). Unless, farmers' knowledge about climate change, the adaptation strategies used by farmers, the effects of climate change and the constraints that militate against the use of adaptation strategies to climate change are known, government support on adaptation strategies to climate change may be ineffective. Moreover, few studies have addressed these stated issues especially in Rivers State.

Considering the above, it is pertinent to assess farmers' adaptation strategies to climate change in Rivers State, Nigeria. To achieve this, the following research questions were asked: What are the socio-economic characteristics of farmers in the study area? Are farmers aware there is climate change? What are farmers' sources of information on adaptation strategies to climate change? What are farmers perceived effects of climate change? What are the adaptation strategies to climate change used by farmers? What constraints militate against the use of adaptation strategies to climate change by farmers'?

METHODOLOGY

Study Area

The study was conducted in Rivers State, Nigeria. Rivers State has principally three agricultural zones (Rivers State Agricultural Development Programme (RSADP), 2014 and Iyagba, 2013). The three Agricultural zones in the state with the accompanying Local Government Areas are as follows:

Zones	**Local Government Area (LGAs)**
Zone 1	Eleme, Gokana, khana, Tai, Obio/Akpor, Port Harcourt, Oyigbo, and Okrika.
Zone 2	Degema, Abua/Odual, Bonny, Andoni, Asari-Toru, Akuku-Toru, Opobo/Nkoro, and Ogu/Bolo.
Zone 3	Ikwerre, Emohua, Ahoada-East, Ahoada-West, Ogba/Egbema/Ndoni, Omuma, and Etche

The survey design was used in conducting this study. The study was conducted in two agricultural zones (Zone 1 and 3) because these zones are the cropping zones, while zone 2 is the fishing zone. The period of research was October, 2019 to September, 2020. The study used primary and secondary data. Primary data were generated through questionnaire administered to farmers. Secondary data was based on published and unpublished literature.

All the arable crop farmers in Rivers State formed the population of the study. Sample for the study was drawn through a multistage sampling technique. In the first stage, Three LGAs were randomly selected from each of the two agricultural zones used for the study making six LGAs in all. In the second stage, two communities each from the six LGAs were randomly selected to give 12 communities in all. In the third stage, 10 respondents were randomly selected from each of the twelve communities. This gave a total 120 farmers who served as respondents for the study.

The objectives of the study were achieved using descriptive statistics such as frequency, percentages and mean. To identify adaptation strategies to climate change used by farmers, the respondents were asked using a three-point Likert-type scale of always = 3, rarely = 2, never = 1 and to indicate the scale that agreed with their opinion. The mean computation was achieved and a discriminating index was arrived at by dividing the value of the rating scales by the number of scales, thus: (R+O+N)/3 = 3+2+1/3 = 2.0 (discriminating index). Choosing an interval 0.5, upper limit of 2+ 0.5 = 2.5, lower limit = 2- 0.5 = 1.5. All items with $X \geq 2.5$ were considered 'always' while $X < 2.4$ but $X \geq 1.5$ were considered 'rarely' and $X < 1.5$ were considered 'never'.

To analyze farmers' perceived effects of climate change, the respondents were asked to indicate their perceived effects of climate change from a list of possible effects of climate change obtained from literature and personal observation measured on a three point Likert-type scale of high = 3, moderate = 2, low = 1.

The mean computation will be achieved with the formula: $X=f(X)/N$

Where:

X = the value by which farmers perceived effects of climate change are to be judged.

f = frequency

$\sum X$ = sum of the various perceived coefficient obtained

N = sample size

Grand mean = Sum of means/no. of items

Standard deviation = $\sum f(X-X)/N$

A discriminating index was arrived by dividing the sum of the value of the rating scales by the number of scales, thus: (H+M+L)/3=(3+2+1)/3 = 2.0 (discriminating index). Choosing an interval 0.5, upper limit of 2+ 0.5 = 2.5, lower limit = 2 - 0.5 = 1.5. All items with $X \geq 2.5$ were considered 'high' while $X < 2.4$ but > 1.5 were considered 'moderate' and $X<1.5$ were considered 'low'

RESULTS AND DISCUSSION

Socio-economic Characteristics of Respondents

Table 1: Socio - economic characteristics farmers

Variables	Freq.	%	Mean

Sex			
Male	52	43.3	
Female	68	56.7	
Total	**120**	**100.0**	
Age			
20 - 29	12	10.0	
30 - 39	21	17.5	44
40 - 49	60	50.0	
50 - 59	22	18.3	
60 - above	5	4.2	
Total	**120**	**100.0**	
Marital Status			
Single	23	19.2	
Married	97	80.8	
Total	**120**	**100.0**	
Level of Educational (Years)			
No formal Education	17	14.2	
Primary Education	18	15.0	
Secondary Education	77	64.2	
Tertiary Education	8	6.6	
Total	**120**	**100.0**	
Household Size			
1 – 5	20	16.7	

6 – 10	91	75.8	8
11 – 15	9	7.5	
Total	**120**	**100.0**	
Farming Experience (Years)			
1 - 5	5	4.2	
6 - 10	11	9.2	15
11 - 15	45	37.5	
16 - 20	46	38.3	
21 - above	13	10.8	
Total	**120**	**100.0**	
Membership of social organization			
Member	75	62.5	
Non - member	45	37.5	
Total	**120**	**100.0**	
Sources of Credit			
Relatives/Neighbours/Friends	41	34.2	
Religious Organizations	14	11.7	
Social Organizations	25	20.8	
Formal lending schemes/Institutions	19	15.8	
Informal lenders	21	17.5	
Total	**120**	**100.0**	
Farm Size (Hectares)			
≤ 1.0	50	41.7	

1.0 – 2.0	42	35.0
2.0 – 4.0	28	23.3
Total	**120**	**100.0**
Extension Visits		
Yes	35	29.2
No	85	70.8
Total	**120**	**100.0**
Cropping System		
Sole cropping	22	18.3
Mixed cropping	98	81.7
Total	**120**	**100.0**

Source: Field Survey, 2020

The result in Table 1 showed distribution of farmers by sex which indicates that most (56.7 percent) of farmers were females and 43.3 percent were males. The result showed that female farmers dominated arable crop farming in the study area. The results also showed that majority of the farmers were in the age bracket of 40 – 49 years with an average age of 44years. This implies that the farmers were of average age and therefore in their active and productive years. Thus, the farmers would therefore be expected to show positive disposition in willingness to use adaptation strategies.

The survey results showed the marital status of the farmers and depicts that most of the farmers were married. They will favourably be disposed to embrace technologies that would raise their standard of living such as adaptation strategies to climate change. They are mature with high responsibility and expectation to meet up with the household demand (Eze, 2016). The result in Table 1 indicate that majority of the farmers were educated and would easily understand the role technologies play in their farming activities which might affect their willingness to use them.

The survey result further showed the distribution of farmers based on household size. The result revealed that most of the farmers (83.3%) have large household size with a mean of 8 persons per household. This could be an advantage in terms of farm labour supply. On farming experience, the result indicated that majority of the farmers (86.6%) are well experienced in their farming activities with a mean farming experience as 15 years. The result in Table 1 showed that most of the farmers (62.5%) belong to social organisations. Social organisations are channels of creating awareness

and disseminating vital information about adaptation to climate change. Furthermore, Table 1 showed the distribution of farmers based on sources of credit. The result showed that Relatives/Neighbours/Friends, social organisations and informal lenders are the major sources of credit to finance climate change adaptation. The survey result in Table 1 also revealed that all the farmers are micro and small holder farmers with majority of the farmers (50%) having one hectare or less in terms of land holding. Tasie (2020) and Agbola (2014) posit that those landholdings of 10 hectares of land and less fall within the micro and small farm holding. Table 1 also showed the distribution of farmers based on extension visits. It revealed that majority of the farmers (70.8%) never had any extension visit while (29.2%) had extension visits. This implies poor agricultural extension services in the study area and had deprived farmers of access to the requisite information and knowledge of latest innovation on climate change adaptation strategies. The result of Table 1 showed that majority (81.7%) of farmers were into mixed cropping and 18.3% of farmers were into sole cropping. Mixed cropping was the predominant activity in the study area. Farmers practice this system of farming to reduce the risk of crop failure due to environmental and climatic stress. This finding agrees with the finding of Eze (2016), who asserts that mixed cropping is a guard against crop failure.

Farmers Awareness/Knowledge of Climate Change

Table 2: Distribution of Farmers According to Awareness/Knowledge of Climate Change

Climate Change Variable	Frequency	Percentage (%)
High Atmospheric Temperature	110	91.7
Low Atmospheric Temperature/cold	107	89.2
Heavy Rainfall	115	95.8
Low Rainfall	46	38.3
Longer Dry Season	51	42.5
Shorter Dry Season	48	40.0
Longer Rainy Season	116	96.7
Shorter Rainy Season	38	31.7
Delayed onset of Rains	45	37.5
Early cessation of Rains	44	36.7
Intensive sunshine	107	89.2
Strong wind	98	81.7
Stormy weather	101	84.2
Flooding	110	91.7

*Multiple responses

Table 2 showed the distribution of farmers based on their knowledge of climate change. The result in the Table 2 revealed that majority of the farmers (96.7%) know about long rainy seasons, 95.8% had knowledge of heavy rainfall, 91.7% experienced high atmospheric temperature and flooding, 89.2% had intensive sunshine and low atmospheric temperature (cold), 84.2% experienced stormy weather, and 81.7% know about strong wind. Few farmers experienced early cessation of rain (36.7%), delay of onset of rain (37.5%), low rainfall (38.3), longer dry season (42.5%), etc. The survey result in the Table 2 showed that farmers in the study area know that there is climate change. This finding agrees with Tasie and Ojimba (2016), who in their study of awareness and adaptation to climate change in Emohua L.G.A in Rivers State noted that farmers are aware of climate change.

Sources of Information on Climate Chang

Table 3: Distribution of farmers based on sources of information on climate change

Information Sources	Frequency	Percentage (%)	Rank
Friends/Neighbours/Relatives	95	79.2	3rd
Farming Colleagues	97	80.8	2nd
Extension Agents	56	46.7	7th
Research Institutes/Universities	40	33.3	10th
Radio	116	96.7	1st
Television	90	75.0	4th
Internet	54	45.0	8th
Newspapers/Magazines	49	40.8	9th
Social Organizations	87	72.5	5th
Cooperative societies	79	65.8	6th

Multiple responses

The survey result in Table 3 showed the distribution of farmers based on sources of information on adaptation strategies. The result revealed that majority of the farmers (99.1%) had radio as their main source of information. Second on the Table is farming colleagues (80.8) and the third major source information on climate change adaptation is friends/neighbours/relatives (79.2). Other sources include: Television (75.0 %), social organisations (72.5%), cooperatives societies 65.8), extension agents (46.7%), internet (45.5%), newspapers/magazines (40.8%) and research institutes (33.3%). Table 3 shows that farmers in the study area used various information sources and this contributed to their knowledge of climate change and use of adaptation strategies to climate change. This agrees with the study of Farauta *et al*., (2011) that mass media has the tendency in reaching large audience at a faster rate. The implication of this finding is that there is need for extension services to rise up to the challenge of information dissemination especially as regards the issues of climate change.

Farmers Perceived Effects of Climate Change

Table 4: Perceived Effects of Climate Change

VARIABLES	High	Moderate	Low	Std Dev.	MEAN	REMARK
Reduced yield	75(62.5)	30(25.0)	15(12.5)	1.4	3.38	High
Reduced income	62(51.7)	37(30.8)	19(15.8)	1.3	3.07	High
Flooding	52(43.3)	42(35.0)	25(20.8)	0.9	2.89	Moderate

Loss of farm land to erosion	34(28.3)	37(30.8)	39(32.5)	0.8	2.64	Moderate
Loss of nutrients due to leaching	57(47.5)	41(34.2)	26(21.7)	1.2	3.06	High
Weed infestation	50(41.7)	25(20.8)	45(37.5)	1.6	2.67	Moderate
Stunted growth	59(49.2)	40(33.3)	20(16.7)	1.1	2.97	Moderate
Increased drought	52(43.3)	40(33.3)	35(29.2)	1.4	1.98	Low
Increased cost of inputs	51(42.5)	39(32.5)	30(25.0)	1.2	3.09	High
High rate of spoilage of farm produce	50(41.7)	35(29.2)	35(29.2)	1.3	3.04	High
Late maturity of crop	49(40.8)	45(37.5)	26(21.7)	1.4	3.13	High

The result in Table 4 showed the distribution of the farmers based on perceived effects of climate change. The Table indicates that reduced yield (X = 3.36), late maturity of crops (X = 3.13), increased cost of inputs (X = 3.09), reduced income (3.07), loss of nutrients due to delay leaching (3.06), high rate of spoilage of farm produce (3.04), flooding (2.89), weed infestation (2.67), loss of farm land due to erosion (2.64), and increased drought (1.98). The Table implied that some of the perceived effects are high and some moderate. The effects of climate change, therefore brings about the low productivity of arable crops in the study area. This result supports the findings of Tasie and Ojimba (2016), Eze (2016) and Albert and Okidin, (2014).

Adaptation Strategies to climate change

Table 4: Farmers' adaptation strategies to climate change

Adaptive Strategies	Always	Rarely	Never	Std dev.	Mean	Decision
Use of cover crop/mulching	70(58.3)	30(25.0)	15(12.5)	0.7	2.89	Always
Use of improved/tolerant varieties	55(45.8)	32(26.7)	19(15.8)	0.9	3.07	Always
Mixed cropping	42(35.0)	38(31.7)	25(20.8)	0.8	3.38	Always
Agro–forestry/Tree planting	34(28.3)	37(30.8)	31(25.8)	0.7	2.64	Always
Use of disease/pest resistant varieties	51(42.5)	35(29.2)	26(21.7)	0.9	3.06	Always
Crop rotation	35(29.2)	25(20.8)	45(37.5)	0.7	2.67	Always
Changing planting/harvesting dates	49(40.8)	35(29.2)	20(16.7)	0.9	2.97	
Frequent weeding	40(33.3)	40(33.3)	35(29.2)	0.8	2.98	Always
Switching to non-farm activities	47(39.2)	31(25.8)	35(29.2)	0.8	2.98	Always
Planting early maturing varieties	51(42.5)	39(32.5)	20(16.7)	0.7	3.09	Always

Increase in the use of family labour	50(41.7)	31(25.8)	25(20.8)	0.9	3.04	Always
Changing the time of land preparation	49(40.8)	45(37.5)	18(15.0)	0.8	3.13	Always
Use of Organic manures	55(45.8)	38(31.7)	20(16.7)	0.9	3.18	Always,
Use of Pesticide	32(26.7)	31(25.8)	48(40.0)	0.7	2.72	Always

Survey result in Table 4 showed the adaptation strategies adopted by farmers in Rivers State. All the listed strategies or technologies were always used as adaptation strategies to climate change. This is attributed to the understanding that people sought and have access to information from different sources. This finding is in agreement with Tasie and Ojimba (2016).

Constraint to Farmers Adaptation Strategies to Climate Change

Table 5: Distribution of farmers based on constraints to adaptation to climate change

Constraints	*Frequency	Percentage
Poor extension services	110	91.7
Low farm income	115	95.8
High cost of farm inputs	104	86.7
Inadequate weather information	110	91.7
Lack of credit facilities	114	95.0
High cost of farm labour	90	75.0
Inadequate knowledge of climate change	92	76.7
Poor access to improved technology	103	85.5

***Multiple responses**

The survey result in Table 5 showed the constraints to adaptation to climate change among the farmers in Rivers State. The result in Table 5 indicated that all the constraints were serious constraints because of the high percentage of response for each constraint. The Table revealed that low farm income (95.8%), lack of credit facilities (95%), poor extension services (91.7%) and inadequate weather information (91.7%) were the major constraint facing farmers adaptation to climate change in the study area. This findings is in consonance with the study of Ijioma and Osondu, (2015) and Eze (2016) that smallholder farmers have low resource and finance base and as such they are vulnerable to climate variability and less able to adapt with the effects of climate change and also have less likelihood of accessing weather information or capacity to develop technologies on their own.

Conclusion

This study appraised arable crop farmers adaptation strategies to climate change in Rivers State, Nigeria, using survey design. The study showed that farmers have the knowledge of climate variability and that there were perceived effects of climate change on arable crop farming such as reduced yield, reduced income, flooding, etc. and the farmers always use various measures like use of cover crop/mulching, resistant crop varieties, mixed cropping, etc. to adapt to the changing climate in the study area. Constraints that militated against the use of adaptation measures include poor extension services, low farm income, high cost of farm inputs, inadequate weather information, etc.

Recommendations

Based on the result of this study, the following recommendations were made: (1) extension services should be strengthened to enlighten farmers about climate change adaptation strategies (2) In addition, affordable climate change adaptation technologies should be appropriated and developed for resource-poor farmers to adopt (3) credit facilities should be extended to the farmers to enable them purchase appropriate technology necessary for climate change adaptation and (4) climate and weather information from Nigerian Meteorological Agency (NiMet) should be disseminated to the farmers through relevant public and private agencies.

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