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ASSESSMENT OF CLIMATE CHANGE ADAPTATION STRATEGIES USED BY RURAL FARMERS IN EDO STATE, NIGERIA

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ABSTRACT

The study was undertaken to assess the climate change adaptation strategies used by rural farmers in Edo State, Nigeria. A multi-stage sampling procedure was used to select 240 respondents for questionnaire administration and interviews. Descriptive statistics and Chi – square tests were used for data analysis. Results showed that the respondents were majorly male (81.3%) and married (62.5%) with a mean age of 38 years. Respondents were educated (82.0%), had a mean household size of 9 persons with farming experience of 14 years. About 93% of the farmers practice mixed cropping and all sourced their information on climate change from fellow farmers. Mixed farming (mean-3.76), increased use of fertilizer or other technologies to increase yield (mean=3.36), use of improve variety/early maturing plant (mean=3.36), use of irrigation (mean=3.32), use of drought tolerant crops or livestock (mean=3.07), planting cover crops (mean=3.06) and of soil and water conservation methods (mean=3.06) were the leading climate change adaptation strategies used by the farmers. The respondents' socioeconomic characteristics had significant association with the adoption of climate change adaptation strategies adopted by the farmers. It was concluded that the farmers have experienced the effect of climate change on their production, as such took some steps further to source information on climate change through various sources. It was recommended that extension service providers should expose farmers in the study area to improved climate change adaptation practices and to also provide necessary funds that will enable the farmers execute these improved practices.

Keywords: Climate change; rural farmers; adaptation strategies

INTRODUCTION

Food is a basic need of man and every nation of the world target being self-sufficient in food production (Igene, Onyemekonwu and Belownu, 2019). There is no doubt that agriculture, which is the basis for food production, depends majorly on favorable climatic conditions for the effective growth and productivity of crops and animals. Climate is an

important resource to crop and animal production in Nigeria, especially in the rainforest zone where farmers depend majorly on rainfall for agricultural production.

Direct links exist between environmental changes and global food insecurity. In developing countries where environmental changes compounded with poverty, has led to the reduction in the production performance of farmers in terms of yield and income. Climate change has affected most crucial development issues regarding food security, resulting from crop and animal losses and low productivity. These growing harms related to climate change are gradually threatening the economic development, social well-being and human survival in general (Adejuwon, 2006). Agricultural output in Nigeria has continued to suffer a precipitous decline resulting from changes in climate change indices such as precipitation and rainfall patterns. Climate change effect becomes more due to poor awareness of climate change effects among farmers, poor human resources and infrastructural support for the implementation of adaption strategies, poor knowledge of climate change related issues such as vulnerability and adaption options and better management options (Enujeke and Ofuoku 2012).

Studies reveal that Africa's agricultural production is badly affected by climate change, making farmers adopt various mechanisms for reducing the destructive effects passed by climate change (Okunlola *et al*., 2018). However, the climate adaptation strategies and the factors responsible for the choice of specific climate change adoption strategies is not yet unidentified in the study area. Hence, the study provides answer to the following objectives, describe the socio-economic characteristics of the rural farmers in the study areas, identify the major crops grown by the farmers and the cropping pattern adopted, identify the climate change adaption strategies adopted by the rural farmers and assess the socio-economic determinants of rural farmers' adoption of climate change adaptation strategies.

Null Hypothesis of the study states that there is no significant relationship between famer's socio-economic characteristics and the adoption of climate change adaptation strategies.

METHODOLOGY

Study Area

The study was carried out in Edo State, Nigeria. Edo State is one of the nine states of the Niger Delta area of Nigeria. The State is made up of eighteen (18) Local Government Areas and divided into three agricultural zones, namely: Edo North, Edo Central and Edo South agricultural zones. It covers a land area of 19,639.7 square kilometers and lies roughly between Latitude 6^0 32.6286'N and Longitude 5^0 53.9228 E. (Zwiefelhofer, 2008). Its administrative headquarter is in Benin city located in Edo South agricultural zone with other major towns such Epkoma in Edo central and Auchi in Edo North. The State is known for the high level of small-scale agricultural production. Major crops grown in the area include cassava, yam, maize, pineapple, and pawpaw.

Sampling Procedure

Multi-stage sampling procedure was adopted as follows:

Stage 1: This involved the purposive selection of twelve (12) local government areas across the three (3) agricultural zones i.e., four (4) LGAs from each agricultural zone, because of the high intensity of farming activities.

Stage 2: This involved a purposive selection of two (2) communities each from the selected LGAs, given a total of 24 communities.

Stage 3: This involved the random selection of ten (10) farmers from the selected twenty-four (24) communities given a total of 240 respondents.

Table 1: Sampling frame

Agricultural zones	LGAs	Communities	Number of respondents
Edo North	Etsako East	Okpekpe	10
		Okpella	10
	Owan East	Warrake	10
		Ivhiaro	10
	Akoko Edo	Ibillo	10
		Lampese	10
	Etsako west	Apana	10
		Ikabigbo	10
Edo Central	Esan central	Udowo	10
		Ugbohare	10
	Esan West	Emuhi	10
		Emaudo	10
	Esan North East	Emu	10
		Ugbuha	10
	Esan North East	Ubierumu	10
		Unuwazi	10
Edo South	Ovia North East	Okada	10
		Isiuwa	10
	Ovia South West	Ugboque	10
		Usien	10
	Orhonmwon	Urhonigbe	10
		Igbanke	10
	Uhunmwonde	Ugbiyoko	10
		Orhua	10
Total	12	24	240

Data Collection

Primary data were collected from the respondents with the use of questionnaire and interview schedule. This was done by researchers and trained enumerators who understand the local dialect of the farmers.

Measurement of Study Variables

Age: measured in years
Sex: measured as males or females.

Household Size: measured based on total number of persons in the households.
Educational Level: This was categorized based on level of education as no formal education, primary education, secondary education, tertiary education, others
Farming experience: This was measured by the number of years spent in farming
Farm Size: measured in hectares.
Income: measured based on annual income in Naira.
Climate adaptive strategies: this was measured by asking the respondents to indicate the climate adaptive strategy they carry out based on their level of importance.

Data Analysis

Data collected were analyzed using both descriptive (mean, frequencies, and percentages) and inferential statistics (Chi square test of association).

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Respondents

Sex: Results in Table 2 shows that the majority (81.3%) of the farmers were male while few (18.85%) of them were female, indicating the dominance of male involvement in farming activities in the study area. This finding corroborates the study of Onyemekonwu *et al.* (2019) who reported 85.5% of males and 14.5% of females for farmers in Delta State, Nigeria.

Marital status: The marital status of the farmers as presented in Table 1 shows that high proportions (62.5%) were married, 18.8% were single, while 1.25% respectively were divorced and widowed. The fact that a high proportion of the farmers were married suggests a sense of responsibility among the farmers as marriage is highly valued in the study area (Osifo *et al.*, 2016).

Age: The age of the farmers (Table 1) reveals that a higher proportion (32.1%) of the farmers fell into the age bracket of 41-45 years with a mean age of 40 years. This suggests that the farmers were in their productive age with adequate strength required for agricultural production, by implication if provided with adequate input for production, especially the needed facilities to cope with climate change effects, these farmers are capable to produce enough food to guide against food insecurity. A similar result was reported by Idu *et al.* (2019) who reported a mean age of 39 years for farmers in Bwari Area Council of Federal Capital Territory, Nigeria.

Educational attainment: The result on educational status indicates that majority (81.2%) of the farmers had formal education and by implication, they can read and write information regarding improved technologies and therefore enhance their acceptance of innovation. A similar result was reported by Okoedo-Okojie (2016) who found that 90% of farmers studied in Edo state had formal education.

Household size: The household size of the farmers revealed a mean household size of 8 persons, suggesting that the farmers could use family labour for production activities, and this could enhance their production performance. This result validates the study of Alakpa and Onemolease (2014).

Farming experience: The farmers had some experience in farming with farming experience of the farmers being 13 years, with this number of years, it is expected that the

farmers had gathered reasonable experience in farming. This agrees with Abdullahi and Danwanka (2019) who equally reported a farming experience of 14 years for farmers in Plateau State, Nigeria.

Farm size: The result on the farm size operated by the farmers revealed that 33.0% of the farmers cultivated a farm size of 1-4 ha with the mean farm size cultivated by the farmers being 6.1 hectares. This result validates the result of Osifo *et al*. (2016) who reported a mean farm size of 6 hectares for farmers in Edo state, Nigeria.

Table 2: Socio-economic characteristics of the respondents (n = 240)

Variables	Categories	Frequency	%	Mean
Sex	Male	195	81.3	
	Female	45	18.8	
Marital status	Single	45	18.8	
	Married	150	62.5	
	Divorced	3	1.2	
	Widowed	3	1.2	
Age (years)	35 and below	21	8.8	
	36-40	90	26.8	40.8
	41-45	108	32.1	
	46-50	12	3.6	
	51 and above	9	2.7	
Education	No formal education	6	18.0	
	Primary	144	42.9	
	Secondary	63	18.8	
	Tertiary	27	8.0	
	Others	3	.9	
Household size	4 and below	12	3.6	
	5-8	93	27.7	8.6
	9-12	132	39.3	
	13 and above	3	.9	
Farming experience (years)	10 and below	57	33.3	
	11-20	165	65.3	13.8
	21 and above	18	5.4	
Farm size(ha)	1-4	111	33.0	
	5-9	72	21.4	
	10-14	57	17.0	
	15 and above	0	0.0	

Major Food Crops Grown

The major food crops grown by the respondents are presented in Table 3. The result reveals that the leading food crops cultivated by the farmers were cassava (76.0%), maize (75.0%) and yam (70.0%). Other food crops grown by the farmers were pineapple (61.3%), plantain (60.0%) and melon (56.0%). This result suggests that the farmers were not restricted to the cultivation of a particular food crop, although some were cultivated more than the others. It is possible that the food crops cultivated were more adapted to the agro-ecological

zone of the study area or had more market value, thereby making farmers more interested in their cultivation.

Major Cash Crops Grown

The major cash crops cultivated by the farmers (Table 3) reveals that cocoa (31.3%), rubber (28.8%) and oil palm (23.8%) were the major cash crops cultivated by the farmers. none of the farmers was found to involve in cash production. This result suggests that the farmers were engaged in cashew crop production. However, the cultivation of cash crops among the farmers is limited to few crops. It is possible that the farmers are not exposed to other cash crops as such they stick to the ones, they had awareness of.

Table 3: A distribution of the major crops grown by famers

Crops grown	Frequency	%
A. Food Crops		
Cassava	183	76
Maize	180	75
Yam	168	70
Pineapples	123	61.3
Plantain	144	60
Melon	135	56
B. Cash Crops		
Cocoa	75	31.3
Rubber	69	28.8
Oil palm	57	23.8
Cashew	0	0.0

*Multiple responses observed

Cropping Pattern

The cropping pattern carried out by the farmers is presented in Table 4. The result shows that the majority (92.5%) of the farmers practice mixed cropping as their cropping pattern, 7.6% practice monoculture while none of the farmers was found to be practicing continuous cropping and mono cropping. This result suggests that the farmers grow varieties of crops. This may be a means of guiding against crop failure from the effects of climate change, believing that when there is failure on one crop, other crops could be used as compensation. This result agrees with Adejuwon (2006) that majority of rural farmers engage in mixed cropping in order to guide against crop failure.

Table 4: A distribution of cropping pattern practiced by farmers

Cropping pattern	Frequency	Percentage
Mixed cropping	222	92.5
Mono cropping	18	7.6
Continuous cropping	0	0
Monoculture	0	0

Adaptive Strategies Adopted by Farmers

The adaptive strategies adopted by the farmers are presented in Table 5. From the Table climate change adaptive strategy with mean ≥ 2.50 are classified as important climate change adaptive strategy while the ones with mean below ≤ 2.50 were classified as not important. The result shows that the important climate change climate change adaptive strategies were mixed farming (mean=3.76), increased use of fertilizers or other technologies to increase yields (mean=3.43), use of improve variety/early maturing plants (mean=3.36), use of irrigation (mean=3.23), use of drought tolerant crops or livestock (mean=3.07), planting cover crops (mean=3.06) and use of soil and water conservation methods (mean=3.02). Other climate change adaptive strategies important to the farmers are diversification i.e., farming plus non farming activities (mean=2.97), use of disease-tolerant crop/livestock (mean=2.93), ridging across the slope (mean=2.90), change of cropping calendar (mean=2.73) and change of cropping location (mean=2.66). Climate change adaptive strategies such as planting trees around and within farm (mean=2.35), shifting from crop to livestock or vice versa (mean=1.86), construction of canals/channels to divert flood from fish farm (mean=1.60), relocation of fish farms from river banks/flood plains (mean=1.52) and use of improved animal breed (mean=1.48) were seen not to be important climate change adaptive strategies by the farmers. This result suggests that the farmers have adopted various climate adaptation strategies which have aided their farm operations. In a similar study, the result is in line with Idoma *et al.* (2017) which identified rice farmers' climate change adoption strategies in Benue State to include the use of climate tolerant varieties, early planting of rice, diversification of livelihoods and application of fertilizers.

Table 5: Adaptive strategies employed by respondents (n = 240)

Adaptive Strategies (copping strategies)	Very important		Important		Less important		Not important		Mean
	F	%	F	%	F	%	F	%	
Mixed farming (crop plus livestock production)	210	87.5	21	8.8	0	0.0	9	3.8	3.76
Increased use of fertilizer or other technology to increase crop yield	171	71.3	39	16.3	12	5.0	18	7.5	3.43
Used of improved variety/early maturing plant	150	62.5	69	28.8	0	0.0	21	8.8	3.36
Use of irrigation	69	28.8	81	33.8	69	28.8	21	8.8	3.23
Use of drought tolerant crops or livestock	108	45.0	99	41.3	3	1.3	30	12.5	3.07
Planting cover crops	162	67.5	21	8.8	12	5.0	45	18.8	3.06
Use soil and water conservation methods	171	71.3	12	5.0	3	1.3	54	22.5	3.02
Diversification (farming plus non farming activities)	117	48.8	72	30.0	15	6.3	36	15.0	2.97
Use of disease-tolerant crop/livestock	105	43.8	87	36.3	12	5.0	36	15.0	2.93
Ridging across slope	123	51.3	66	27.5	3	1.3	48	20.0	2.90
Change cropping calendar	69	28.8	81	33.8	69	28.8	21	8.8	2.73
Change cropping location	60	25.0	69	28.8	96	40.0	15	6.3	2.66
Planting trees around and within farms (crops)	63	26.3	66	27.5	57	23.8	54	22.5	2.35
Shift from crop to livestock or vice versa	33	13.8	78	32.5	33	13.8	96	40.0	1.86
Construction of canals/channels to divert flood from fish farm	27	11.3	9	3.8	9	3.8	195	81.3	1.60
Relocation of fish farms from riverbanks/flood plains	18	7.5	18	7.5	0	0.0	204	85.0	1.52
Use of improved animal breed	66	27.5	24	10.0	9	3.8	141	58.8	1.48

Mean ≥ 2.50 important

Association between Farmers' Socio-economic Characteristics and the Adoption of Climate Change Adaptation Strategies

The Association between farmers' socio-economic characteristics and adoption of climate change adaptation strategies (Table 6) reveals that all the socio-economic variables of the farmers tested had significant relationship with the adoption of climate change adaptation strategies by the farmers. The socio-economic variables include sex (Chi-square=79.100; p>0.005), marital status (Chi-square=160.250; p>0.005), age (Chi-square=22.000; p>0.005), education (Chi-square=47.750; p>0.005), household size (Chi-square=69.500; p>0.005) and farming experience (Chi-square=47.725; p>0.005). This result suggests that the farmers' socio-economic characteristics have influenced their adoption of climate change adaptive strategies. It is possible that the farmers adopted these strategies based on the experience in farming that they have gathered in farming. It could also be that the educated farmers have learnt these adaptive strategies in the cause of education. Studies have found a significant relationship between farmer's socio-economic characteristics and the adoption of farm practices (Alakpa and Onemolease, 2014; Okoedo-Okojie, 2016).

Table 6: Relationship between farmer's socio-economic characteristics and the adoption of climate change adaptation strategies

Variable	Chi-square	Df	P-value
Sex	79.100	3	0.00*
Marital status	160.250	4	0.00*
Age	22.000	4	0.00*
Education	47.750	4	0.00*
Household size	69.500	4	0.00*
Farming experience	47.725	12	0.00*

* Significant at 5% level ($p \leq 0.05$)

CONCLUSION

Based the findings of the study, it was concluded that the farmers in the study area grows varieties of food and crops; in so doing they have encountered the effect of climate change, and as such they employed diverse climate adaptive strategies in the production. However, some of these adaptive strategies were important to the farmers in their production, although these adaptive strategies may be farmer oriented and pass from farmer to farmer. Therefore, there is need for the farmers to be exposed to improved adaptive strategies that can enhance their production. Notwithstanding, the adoption of climate change adaptive strategies by the farmers was influenced by certain socio-economic characteristics of the farmers.

It was recommended that extension service provider should expose farmers in the study area to improved climate change adaptation practices; extension agencies should links farmers to available sources of fund that will enable them execute these improved practices; agricultural extension programmes planners should endeavor to capture information flow through farmers when planning programmes relating to climate change as farmers to farmer flow of information is the more effective in the study area.

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