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Farmers Utilization of Climate Change Adaptation Strategies Across Selected Agro-Ecological Zones in Nigeria

Olufunmilayo Grace Adenaiye[1,a,*], Simeon Dada Yomi Alfred[1,b], Oluwatosin Oluwasegun Fasina[1,c]

[1]*Department of Agricultural Extension and Communication Technology, School of Agriculture and Agricultural Technology, The Federal University of Technology, Akure, Ondo State, Nigeria.*
[*]*Corresponding author*

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ABSTRACT

This study examined farmers' level of use of climate change adaptation strategies across selected agro-ecological zones in Nigeria. Edo and Ondo States were selected for the study with three major agro-ecological zones. A multi-stage sampling procedure was used. The correlation analysis revealed a significant relationship between year of education and level of use of adaptation strategies (r = 0.15, P = 0.02). The result of Analysis of Variance (ANOVA) revealed that significant differences existed in most of the adaptation strategies employed except planting different varieties (F = 1.672, P = 0.190), intercropping (F = 0.646, P = 0.525), crop rotation (F = 2.436, P = 0.090) and migration to different sites (F = 0.661, P = 0.517). The study recommended that the issue of climate change should not be taken lightly by all stakeholders as its effect differs among various agro-ecological zones.

[a] *fogunbo@yahoo.com* *https://orcid.org/0000-0002-1777-2328*
[b] *sdyalfred@futa.edu.ng* *https://orcid.org/0000-0001-8789-0664*
[c] *oofasina@futa.edu.ng* *https://orcid.org/0000-0002-9974-9526*

Introduction

Agriculture in Nigeria is a major branch of the economy providing employment for 70 percent of the population and is the main source of food (Mayong et al., 2005). Agriculture contributes about 40% of the Gross Domestic Product (GDP) (Ozor, 2009) and plays an important role in generating household income, provision of raw materials for agro-based industries, attaining food security and impact on the overall economic growth of the country (Stewart, 2000; Oluigbo, 2012).

This research intends to examine the adaptation measures utilized in improving productivity across some selected agro-ecological zones under consideration. Specifically, the study examined the socio-economic characteristics of the food crop farmers in the study area and examines farmers' utilization of climate change adaptation strategies across the selected agro-ecological zones in Nigeria.

Literature Review

Ozor (2009) refers to climate change as any change in climate over time, whether due to natural variability or as a result of human activity and is widely recognized as the most serious environmental threat facing our planet today. In low-income countries, the climate is the primary determinant of agricultural productivity and adaptive capacities are low (Apata et al., 2009). The adverse effect of climate change can influence farming outputs at any stage from cultivation through the final harvest, even, if there is sufficient rain, its irregularity can affect yield adversely if rain fails to start during the crucial growing stage of crops (Molua and Lambi, 2007). The continued dependence of agricultural production on some climatic factors, such as temperature, moisture, sunlight, wind, evaporation and the significant magnitude as well as the rapid rate of climate change take into account the need for a comprehensive consideration of the potential impact of

climate on global agriculture (Rosenweig et al., 1994). In essence, any climate change will subsequently impact the agricultural sector in particular and further reflect on socio-economic activities. The effects could be measured in terms of effects on crop growth, availability of soil water, health, availability of farm labour, soil fertility, soil erosion, sea-level rise, incidents of pests and diseases (Nwaijuba, 2002). Climate change has been identified as one of the most crucial factors that negatively affect sustainable agricultural production and the scope for reducing poverty in Nigeria (Obioha, 2009). Many African countries including Nigeria, which have their economies largely based on weather-sensitive agricultural production systems, are particularly vulnerable to climate change (Dinar et al., 2006). Also, Nigerian agriculture is facing varying climate change impacts which mainly worsens production conditions and adversely affects its economies (MOEFRN, 2003). The adverse consequent effects of climate change will take an irreplaceable toll on food production and as well as food security in developing countries like Nigeria which has a low capacity to cope and adapt to these challenges (Fisher et al., 2009).

Adaptation is widely recognized as a vital component of any policy response to climate change because, it helps farmers achieve their food, income and livelihood security objectives in the face of changing climatic and socio-economic conditions (Kandlinkar et al., 2000). Without adaptation, climate change is generally detrimental to the agricultural sector (Smit et al., 2002). Kreft et al. (2010) defined adaptation as an initiative approach, measures, practices to reduce the menace or vulnerability of natural and human resources to climate change. Adaptation is also identified as one of the policy options to reduce the negative impact of climate change (Kurukulasuriya et al., 2006).

Information about adaptation methods and factors influencing the choice of adaptation methods help in enacting policy to handle the challenges climate change is imposing on Nigerian farmers. Hence, supporting the adaptation strategies of local farmers through appropriate public policy, collective actions and investments can help increase the adaptation measures that will reduce the negative consequences of predicted changes in future climate with great benefits to vulnerable rural communities (Hassan et al., 2008).

The location, size and characteristics relief in Nigeria gives rise to a variety of climate change, ranging from tropical rainforest climate along the coasts to the Sahel climate in the northern part of Nigeria, each being differentiated by its annual precipitation, sunshine and other climatic elements (Adejuwon, 2004). The diverse nature of biological diversity results mainly in seven vegetation zones: the Mangrove swamp, Fresh water swamp, Tropical rainforest, Guinea savannah, Derived savannah, Sudan savannah and Sahel savannah (Adejuwon, 2004).

Hypotheses

The study tested the following hypotheses at the 0.05 level of significance

- There is no significant relationship between socio-economic characteristics and use of adaptation strategies across agro-ecological zones,
- There is no significant difference in the level of use of adaptation strategies across agro-ecological zones.

Methodology

The study was carried out in Nigeria having so many agro-ecological zones. The population of the study comprises all food crop farmers in the study area.

A multi-stage sampling procedure was used in selecting the respondents in this study. The first stage involved a purposive selection of two (2) states having the three (3) major agro-ecological zones namely mangrove zone, Guinea savannah zone and rainforest zone. The second stage involved a proportionate (1/6) sampling selection of three (3) local government areas (LGAs) out of the 18 LGAs in each state. Hence, a total number of six (6) local government areas (LGAs) were sampled in the two states which fall into the identified agro-ecological zone. Local government areas with the highest production level were selected using the Agricultural Development Programme (ADP) data on production output of cassava, maize and rice in both states. The third stage involved random selection of four (4) communities from each of the LGAs and was identified through the help of ADP officers in both states. The last stage involved a purposive selection of ten (10) food crop farmers from each of the communities selected. The selection was based on farmers growing the three crops given one hundred and twenty (120) respondents in each state and a total number of two hundred and forty respondents (240) for the research work.

Both quantitative and qualitative methods of data collection were used in obtaining information from the selected respondents. The instrument for data collection was subjected to face and content validity. The reliability of the instrument was determined through the test–retest reliability method. Data collected were analysed using descriptive and inferential statistical tools. Chi-square test and Pearson Product Moment Correlation (PPMC) were used for hypothesis one while Analysis of Variance (ANOVA) was used to test for hypothesis two.

Results and Discussion

Socio-Economic Characteristics of Respondents

The results in Table 1 reveals that the number of male respondents (73.8%) was higher than that of the female farmers (26.2%), which implies that more males were involved in farming in the study area. This is in agreement with Osikabor et al. (2011) indicated that male participates more than female in agricultural production. The mean age of the respondents was 49.6 years, which means most of the respondents were middle-aged and were proactive. This agrees with that of Adejare and Arimi (2013) who reported that the majority of the agricultural labour force in Nigeria falls within 35 – 50 years.

The majority (85.4%) of the respondents were married. Adebayo et al. (2008) posited that more married are involved in farming. The study reveals that only 11.7% had no formal education hence indicates a high level of literacy among respondents and this could have implications for agricultural production. According to Allison et al. (2009), the vulnerability and adaptation of a nation to climate change impact depends on the level of education of its citizens.

Table 1. Distribution of Respondents' Socio-Economic Characteristics

Variables	Frequency(n=240)	Percentage (%)	Mean
Sex			
Female	63	26.2	
Male	177	73.8	
Age (years)			49.6
30 years and below	10	4.2	
31-40	35	14.6	
41-50	86	35.8	
51-60	79	32.9	
Above 60 yrs	30	12.5	
Marital status			
Single	12	5.0	
Married	205	85.4	
Widowed	21	8.8	
Divorced	1	0.4	
Separated	1	0.4	
Educational Level			
No formal education	28	11.7	
Attempted primary school	17	7.1	
Completed primary school	46	19.2	
Attempted secondary school	26	10.8	
Completed secondary school	88	36.7	
Attempted tertiary school	9	3.7	
Completed tertiary school	26	10.8	
Year of Education			9
0	28	11.7	
1-6	63	26.2	
7-12	114	47.5	
>12	35	14.6	
Household size			7
1-3	8	3.3	
4-6	111	46.3	
7-9	89	37.1	
≥ 10	32	13.3	
Farming experience (years)			12.3
≤ 10 years	51	21.3	
11-20	93	38.7	
21-30	44	18.3	
31-40	29	12.1	
>40	23	9.6	

Source: Field Survey, 2018

The mean household size of the respondents was approximately seven persons. This implies a moderate household size. According to Kayunze (2000), large household size is an important asset in working together to reduce vulnerability to the effects of climate change. The mean farming experience of the respondents was approximately twelve years which implies that most farmers are relatively young in the farming business. Adesina and Zinnah (1993) postulated that younger farmers have greater tendencies to improve and adapt to new technologies because they are relatively more knowledgeable, more open to risk-taking and have longer planning horizons than their older counterpart.

Utilization of Adaptation Strategies

The study revealed major adaptation strategies practiced were as follows; use of agrochemical products (93.7%), use of pest/diseases resistant varieties (91.2%), planting of different varieties (90.0%), planting of the early maturing crop (87.7%), use of improved varieties (87.0%) and changing in planting and harvesting period (84.6%). Also, 78.3% used increased frequency of weeding as adaptation strategies while 72.5% used organic manure as shown in Table 2.

The study as shown in Table 2 also indicated the number of years respondents had practiced these adaptation strategies. Adaptation practices with the highest number of years of practice were; mulching (7.13 years), planting of different varieties (6.65 years), increased use of agrochemicals (6.47 years), use of organic manure (6.37 years), use of improved crop varieties (6.23 years). The average mean score of years of adaptation strategies was 4.18 years which indicated that these adaptation strategies had been used by farmers for more than 4 years and thus considered relatively too recent.

The study, furthermore, identified the level of improvement as perceived by the respondents in the use of adaptation strategies as in reducing the perceived effects of climate change as shown in Table 2. The grand mean of the measures is 0.99, with all the measures having high-level improvement and low-level improvement by the respondents.

Table 2. Distribution of Respondents According to Adaptation Strategies

S/N	Adaptation strategies	Frequency	Percent%	Mean of years	MLI	Decision	Ranking
1	Increased use of agro-chemical (herbicides/pesticides)	225	93.7	6.47	1.60	High	1
2	Use of pest and diseases resistant varieties	219	91.2	5.60	1.54	High	2
3	Use of improved crop varieties	204	87.0	6.23	1.50	High	3
4	Planting of different varieties	216	90.0	6.65	1.41	High	4
5	Planting early maturing crops	210	87.7	5.58	1.40	High	5
6	Increase use of labour	194	80.4	5.30	1.33	High	6
7	Increased weeding	188	78.3	5.50	1.31	High	7
8	Changing in planting/harvesting periods	203	84.6	5.20	1.23	High	8
9	Adoption of new technologies	159	66.2	3.74	1.15	High	9
10	Increase use of organic manure	174	72.5	6.37	1.12	High	10
11	Intercropping (planting main crop with legumes)	165	68.7	4.26	1.02	High	11
12	Increase use of fertilizer	139	57.9	4.02	1.01	High	12
13	Increased farm size	159	66.2	4.67	1.00	High	13
14	Mulching	150	62.5	7.13	0.93	Low	14
15	Shifting cultivation	115	47.9	3.37	0.89	Low	15
16	Crop diversification	116	48.3	2.63	0.70	Low	16
17	Migration to different sites	106	44.2	2.30	0.69	Low	17
18	Cover cropping	109	45.4	2.43	0.65	Low	18
19	Crop rotation	101	41.9	2.55	0.60	Low	19
20	Afforestation (tree planting)	97	40.4	2.50	0.50	Low	20
21	Mixed farming (crop/animal production)	74	30.8	1.69	0.47	Low	21
22	Increased use of irrigation (Fadama irrigation practices)	58	24.2	1.34	0.43	Low	22
23	Shift from farming to non-farming activities	51	21.2	0.77	0.30	Low	23

Source: Field Survey, 2018. MLI: Mean of level improvement, *Grand mean of level of improvement is 0.99

Table 3. Chi-Square Analysis of Socio-Economic Characteristics and the Level of Use of Adaptation Strategies

Socio-economic characteristics	Calculated χ^2	Df	p-value	Decision
Sex	2.92	2	0.23	Not significant
Marital status	4.68	8	0.79	Not significant
Religion	6.72	4	0.15	Not significant

Source: Field Survey, 2018 Level of significance = 0.05

Table 4 Result of Correlation Analysis between Socio-Economic Characteristics of Respondents and the Level of Use of Adaptation Strategies

Socio-economic characteristics	Correlation (r-value)	p-value	Decision
Age	0.04	0.54	NS
Years of education	0.15	0.02	S
Household size	-0.08	0.24	NS
Farming experience	-0.06	0.36	NS

Source: Field Survey, 2018

The increased use of agrochemicals ($\bar{x}$ =1.60) was ranked first among the adaptation strategies as having high-level improvement in production. This is likely because inorganic fertilizers have a direct effect on output by increasing soil nutrients and other agrochemicals like pesticides and herbicides provide favourable environment for crops to grow. The second strategy that had high-level improvement on crop production is the use of pest and disease-resistant varieties ($\bar{x}$=1.54), while the use of improved crop varieties ($\bar{x}$ =1.50), planting of different varieties ($\bar{x}$=1.41) were ranked third and fourth respectively.

Test of Hypotheses

The result of the chi-square analysis presented in Table 3 reveals that socio-economic characteristics such as sex (χ^2 = 2 .92, P = 0.23), marital status (χ^2 = 4.68, P = 0.79) and religion (χ^2 = 6.72, P = 0.15), were not significant with the level of use of adaptation strategies at the 0.05 level of significance. Hence, their level of use of adaptation strategies was not influenced by these socio-economic characteristics.

Table 4 further analysis reveals that only the educational level which was positively and significantly related to the level of use of adaptation strategies, such that the higher the years of education, the higher the level of use of adaptation (r = 0.15, P = 0.02), Hence farmers that are educated were more likely to adjust to climate change than non educated farmer. This agreed with the finding of Aemro et al. (2010), who posited that there was a positive and strong relationship between education and utilization of adaptation strategies.

Ho_2: There is no significant difference in the level of use of adaptation strategies across agro-ecological zone.

Table 5. Summary of Analysis of Variance (ANOVA)

S/N	Adaptation strategies	Source of variation	Sum of squares	df	Mean square	F	p- value	Decision
		Between groups	551.573	2	275.788			
1	Years mulching	Within groups	15388.675	237	64.931	4.247	0.015	S
		Total	15940.250	239				
		Between groups	325.908	2	162.954			
2	Years organic manure	Within groups	10348.087	237	43.663	3.732	0.025	S
		Total	10673.996	239				
		Between groups	62.308	2	31.154			
3	Years different varieties	Within groups	4415.987	237	18.633	1.672	0.190	NS
		Total	4478.296	239				
		Between groups	87.300	2	43.650			
4	Years planting and harvesting	Within groups	2677.100	237	11.296	3.864	0.022	S
		Total	2764.400	239				
		Between groups	20.908	2	10.454			
5	Years intercropping	Within groups	3833.075	237	16.173	0.646	0.525	NS
		Total	3853.983	239				
		Between groups	154.225	2	77.113			
6	Years mixed farming	Within groups	2035.337	237	8.588	8.979	0.000	S
		Total	2189.562	239				
		Between groups	162.133	2	81.067			
7	Years use irrigation	Within groups	1605.850	237	6.776	11.964	0.000	S
		Total	1767.983	239				
		Between groups	285.808	2	142.904			
8	Years afforestation	Within groups	2624.188	237	11.073	12.906	0.000	S
		Total	2909.996	239				
		Between groups	442.268	2	221.129			
9	Years crop varieties	Within groups	5322.138	237	22.456	9.847	0.000	S
		Total	5764.396	239				
		Between groups	378.133	2	189.067			
10	Years use of fertilizers	Within groups	3619.800	237	15.273	12.379	0.0003	S
		Total	3997.933	239				
		Between groups	155.808	2	77.904			
11	Years agrochemicals	Within groups	2907.988	237	12.270	6.349	0.002	S
		Total	3063.796	239				
		Between groups	213.808	2	106.904			
12	Years weeding	Within groups	4538.187	237	19.148	5.583	0.004	S
		Total	4751.996	239				
		Between groups	181.608	2	90.804			
13	Years maturing crop	Within groups	3508.888	237	14.805	6.133	0.003	S
		Total	3690.496	239				
		Between groups	75.600	2	37.800			
14	Years crop rotation	Within groups	3677.800	237	15.518	2.436	0.090	NS
		Total	3753.400	239				
		Between groups	299.325	2	149.662			
15	Years technologies	Within groups	2803.138	237	11.828	12.654	0.000	S
		Total	3102.463	239				
		Between groups	54.308	2	27.154			
16	Years farming to non farming	Within groups	650.625	237	2.745	9.891	0.000	S
		Total	704.933	239				
		Between groups	180.700	2	90.350			
17	Years diversification	Within groups	3163.550	237	13.348	6.769	0.001	S
		Total	3344.250	239				
		Between groups	270.025	2	135.013			
18	Years pest diseases	Within groups	3723.575	237	15.711	8.593	0.000	S
		Total	3993.600	239				
		Between groups	160.133	2	80.067			
19	Years labour	Within groups	3514.662	237	14.830	5.399	0.005	S
		Total	3674.796	239				
		Between groups	177.808	2	88.904			
20	Years cover cropping	Within groups	2889.125	237	12.190	7.293	0.001	S
		Total	3066.933	239				
		Between groups	26.108	2	13.054			
21	Years migration different sites	Within groups	4677.875	237	19.738	0.661	0.517	NS
		Total	4703.983	239				
		Between groups	183.658	2	91.829			
22	Years shifting cultivation	Within groups	6142.075	237	25.916	3.543	0.030	S
		Total	6325.733	239				

Source: Field Survey, 2018

The result of Analysis of Variance (ANOVA) in Table 5 revealed that significant differences existed in most of the adaptation strategies employed except planting different varieties (F = 1.672, P = 0.190), intercropping (F = 0.646, P = 0.525), crop rotation (F = 2.436, P = 0.090) and migration to different sites (F = 0.661, P = 0.517). Therefore, the null hypotheses which stated that there is no significant difference in the level of adaptation strategies employed across the three agro-ecological zones were rejected.

Conclusions and Recommendation

The conclusion of the findings indicated that farmers had been using different adaptation strategies to reduce the negative effect of climate change. It is important to aggressively pursue the issue of climate change as its effect differs along agro-ecological zone to achieve increase productivity of food crops in all agro-ecological zones in Nigeria. The issue of climate change should not be taken with negligence from all stakeholders.

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