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FACTORS INFLUENCING CLIMATE CHANGE ADAPTATION STRATEGIES AMONG ARABLE CROP FARMERS IN OSUN STATE, NIGERIA

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Abstract

This study assessed the determinants of the strategies adopted by the arable crop farmers in coping with climate change in Osun state, Nigeria. A multistage sampling technique was used to select 120 arable crop farmers as samples for the study. Data for the study were collected with a structured interview schedule. Data were analysed with descriptive and inferential statistical tools; frequency distributions, means, standard deviation, percentages, and Pearson's Product Moment Correlation (PPMC). Descriptive results reveal that most (87.5%) of the sampled farmers were male, and married (63.00%). The average age, household size, and years of formal education were 53.6 years, 10.15 persons, and 5.20 years respectively. Perceived significant variables influencing climate change were fluctuating rainfall patterns and extreme temperature with weighted mean scores (WMS) of 4.55 and 4.47 respectively. The major climate change adaptation strategy and constraint to adaptation were late or early planting, and unavailability of capital with WMS scores of 4.54 and 2.80 respectively. Significant factors influencing climate change adaptation strategies were age, household size, years of formal education, and farming experience. The study concluded that farmers were aware of the effects of climate change and have adopted coping strategies, especially planting their crops early or late in line with emerging rainfall patterns. Thus, extension services must be tailored towards awareness and adoption of improved agronomy practices and planting materials, especially early maturing and drought-resistant varieties of crops that would mitigate climate change effects on crop productivity. Also, farmers should be encouraged to insure their crops against failure due to the effects of climate change.

Key words*: *arable crop farmers, climate change, adaptation strategies

INTRODUCTION

The thirteenth sustainable development goal is centered on climate action. Changing climate is of serious concern globally to farmers, especially in tropical Africa [15]. It is the primary determinant of agricultural productivity among rural households in Africa [8]. Evidence abounds that climate change has impacted adversely on agricultural output, and there is a need to arrest this critical situation. Farmers in Sub-Saharan have a higher vulnerability to climate change than their counterparts in other parts of the globe.

According to [20] climate change has come to stay posing a severe threat to the development of agriculture and other non-farm activities. However, the vulnerability is higher in agricultural production relative to other sectors of the economy. The two basic factors that triggered climate change are bio-geography and human anthropogenic activities. Apart from the inherent climatic factors, external natural factors outside the climate system such as volcanic eruptions, the intensity of solar radiation, and the earth's rotation around the sun have impacted the climate on a short-term basis [7]. According to Intergovernmental Panel on Climate Change (IPCC) report, the United Nations Framework Convention on Climate Change (UNFCCC), defined climate change as alterations in climatic elements induced by direct or indirect human activities(anthropogenic) resulting in global atmospheric changes and climatic variability observable over compared periods of time.

According to [4] relevant research has shown that Africa's vulnerability to climate change is attributed to poor or badly implemented agricultural policies and programmes, low adoption of improved technology, abject poverty extreme weather conditions, and social and economic challenges.

Climate changes have negatively impacted people and their means of livelihood and the ecosystem. These have constituted a serious developmental challenge globally, especially for the vulnerable poor in developing economies [12]. Adaptation or agronomy practices and farm strategies are already in place [5].

In order to meet the continuously growing food demand of the populace in Nigeria, there is a need to modify food production and systems in order to mitigate the increasing effects of climate change. Evidence abounds that there are significant changes in farming technologies and systems in response to climate change effects in the region [1].

In recent times, sub-Sahara Africa is the center of focus on the probable impacts of climate change on agricultural production, economic growth, and sustainable all-around economic growth. This can be attributed to persistent drought induced by surging temperatures and a significant reduction in the amount of rainfall. Indicators of changing climate in the region include; a significant reduction in soil moisture resulting in declining soil quality, crop resilience, prolonged growing seasons, persistent rise in sea levels, decline in yields of crops and animals, prolonged farm drought, and weed resurgence among others [18]. This has negatively affected agriculture; the mainstay of the African economies. The situation is exacerbated by adjoining factors such as abject poverty, inequality in land distribution, inadequate access to capital and technology, dilapidated public infrastructure such as road networks, and inadequate research and extension.

A few researchers studied the factors influencing the adoption of climate change mitigation measures and concluded that the main ones are: "age of the farmer, farming experience, tenancy status, farm size, years of education, extension contact, income, access to credit and membership of farmers' association" [11, 19].

Climate change has recently attracted global attention as an emerging threat to sustainable global development affecting all the sectors of the world economy. The continuous global increase in greenhouse emissions has triggered higher climate change impacts. Emissions from agricultural production have contributed significantly to climate change ranking third behind emissions from energy consumption and chlorofluorocarbon. production and contributing about 15% of the total anthropogenic greenhouse gases emission.

This study, therefore, attempted to describe the socio-economic characteristics of the arable crop farmers, examine farmers' perceived effects of climate change, examine the level of use of adaptation strategies, and constraints limiting the use of adaptation strategies among the arable crop farmers in the study area.

Hypothesis of the study

There is no significant relationship between selected socio-economic characteristics of the arable crop farmers and their climate change adaptation strategies

MATERIALS AND METHODS

The study was conducted in the Ife-Ijesha Agricultural Zone of Osun State, Nigeria. The zone shares a boundary in the North with Kwara State, Ekiti and Ondo States in the South, and Ogun and Oyo States in the West.

Important cities and towns in the Ife-Ijesha zone include the ancient kingdom capitals of

Ile-Ife, Ilesha, and Ijebu-Jesha. Osun State occupies a land mass of approximately 14,875 square kilometers which was taken out of the old Oyo state on the 27th of August, 1999.

Data were collected on information relevant to the study from the sampled arable crop farmers using a well-structured interview schedule. A multistage sampling procedure was used for selecting the respondents. Based on Osun State Agricultural Development Programme (OSSADEP) delineation, Ife/Ijesha Agricultural zone consists of ten Local Government Areas which are equivalent to ten blocks. The first stage of sampling involved the purposive selection of four (4) Local government areas (Ife North, Oriade, Ife East, and Atakumosa East) from the ten (10) local government areas present in the zone as a result of the preponderance of farming activities in the area. The second stage involved random sampling of three (3) rural communities from the selected local government areas based on field experience. Ultimately, ten (10) arable crop farmers were selected from the communities using a random sampling technique to make a total of 120 arable crop farmers as a representative sample for the study. The collected data were analysed with both descriptive and inferential statistical tools.

RESULTS AND DISCUSSIONS

The result in Table 1 shows that the age of 85.00% of the arable crop farmers' age ranged between 41-70 years, with a mean of 53.67 years, implying that the sampled farmers were adults, and mature enough to perceive the effects of climate change on arable crop production, and the ability to mitigate and adapt to the effects in order to improve their crop output in the study area.

This finding corroborates with that of [3] that older and more experienced farmers have the ability and capability to cope with the adverse effects of climate change relative to the younger and inexperienced farmers.

The majority (87.5%) of the respondents were males while only (12.5%) were females.

This corroborates [17] that the implication of males' greater proportion may be that productivity is expected to be higher because males have a tendency to be more labour efficient.

Furthermore, larger percentages (63.3%) of them were married. This is in line with the findings of [16] who reported that married people tend to be responsible for the needs of their family at all times.

The household size reveals that the majority (77.3%) of them had between 3 and 5 persons and the mean household size is 5 persons. This finding agrees with that of [3] that households with large members tend to be more efficient than households with small members in coping with the delirious effects of climate change on crop production.

Furthermore, the mean years of formal education are 10.45 years, implying that the sampled farmers are literate enough to perceive the effects of climate change. This corroborates [3] who postulated that the acquisition of formal education may enhance adaptation strategies against the effects of climate change. Farming is the primary occupation of most (71.4%) of the sampled arable crop farmers.

Also, 40. 00% of the arable crop farmers had between 21 and 30 years of experience in arable crop production. The mean years of production experience was 25.6±11.98 years. This result is in tandem with that of [6] which stated that a good farming experience could help farmers in making good decisions and choices in their crop production process hence, has a positive implication for crop productivity.

A larger proportion (40.0%) of the farmers had between 4.5 and 6.5 acres while the mean farm size was 6.39 acres.

However, putting more land into cultivation may not really translate into increased productivity, especially when farmers have to face climate change outcomes.

This conforms with [10] that the likelihood to adapt to climate change increases with an increase in farm size.

In addition, most (89.20%) of the arable crop farmers sourced their capital from cooperative societies.

Table 1. Distribution of the respondents according to their socio-economic characteristics (n=120)

	Frequency	Percentage	Mean
Age			
21	3	2.5	53.6±10.15
31-40	4	3.3	
41-50	57	47.5	
51-60	17	14.2	
61-70	28	23.3	
Above 70	11	9.2	
Gender			
Male	105	87.5	
Female	15	12.5	
Marital status			
Single	16	13.3	
Married	76	63.3	
Widowed	9	7.5	
Separated and divorced	19	15.9	
Household size			
3-5	85	77.3	4.80±2.045
6-9	22	20.0	
Above 9	3	2.7	
Years of education			
0	30	25.0	10.45±5.226
1-6	7	5.8	
7-12	45	37.5	
Above 12	38	31.7	
Primary occupation			
Farming	85	71.4	
Trading	5	4.2	
Artisan	28	23.5	
Civil servant	2	1.7	
Years of farming experience			
1-10	12	10.0	25.6±11.98
11-20	33	27.5	
21-30	48	40.0	
31-40	10	8.3	
Above 41	17	14.2	
Farm size (acres)			
0.5-2.5	1	0.8	6.39±4.57
2.5-4.5	32	26.7	
4.5-6.5	48	40.0	
6.5-8.5	24	20.0	
8.5-10.5	10	8.3	
Above 10.5	5	4.2	
Source of capital			
Personal savings	91	75.8	
Cooperative association	107	89.2	
Family and friends	32	26.7	
Annual income(₦'000)			
1-500	53	44.2	125,327.7 ± 113,244.1
501-1,000	23	19.2	
1,001-1,500	8	6.7	
1,501-2,000	5	4.2	
2,001-2,500	14	11.7	
2,501-3,000	5	4.2	
Above 3,000	12	10.0	

Source: Field survey, 2021.

Lastly, data in the table shows that some (44.2%) of the sampled arable crop farmers had an income of between ₦1,000 and ₦500,000 while 19.2% of them had an income of between ₦501 and ₦1,000 while 11.7% of them had between ₦2,001,000 and ₦2,500,000.

The mean annual income of the respondents is N125,327.70, implying that the farmers' farm income may be sufficient to meet their significant farm needs.

Perceived effects of climate change

The perceptions of the sampled arable crop farmers on climate change are presented in Table 2. Results in the Table shows that farmers perceived inconsistent rainfall pattern (WMS=4.55), extreme temperature (WMS =4.47), and late onset of rainfall as the major causes of climate change in the study area. This is in conformity with [9] who observed negative global effects of climate trends on wheat and maize yields in many regions. The result also shows that reduced rainfall (WMS = 3.82) and long dry season (WMS = 3.70) were considerably major effects.

Table 2. Distribution of respondents according to their perceived effects of climate change

Perception	WMS	RANK
Non consistent rainfall pattern	4.55	1st
Extremes in temperature	4.47	2nd
Rainfall starts late	4.37	3rd
Reduced rainfall	3.82	4th
Long dry season	3.70	5th
High intensity rainfall	1.91	6th

Source: Field survey, 2021.
WMS= Weighted Mean Score

[2] lend credence adding that delay in rainfall commencement and high temperatures result in stunted growth and eventual death of some young plants. This is in accordance with [13] who stated that significant effects of climate change are manifested in the form of more erratic and decreased volume of rainfall, protracted drought, and surge in ambient temperature.

Climate change adaptation strategies used by the respondents

Table 3 presents the arable crop farmers' distribution according to their level of use of adaptation strategies. Using the weighted mean score (WMS), in ranking various strategies in order of importance reveals that following rainfall patterns, planting their crops early or late, embracing mixed copping, and use of good cultural practices scored the highest WMS score of 4, 54, 4.43 and 4.39 respectively. In consonance with [14], the main adaptation strategies of arable crop farmers include a change in crop types, planting short-season varieties, changing planting dates, and crop diversification. Furthermore, planting cover crops, wetland farming, pests and disease-resistant cropping, and use of proper drainage channels had a WMS score of 2.95, 2.74, 2.68, and 2.15 respectively and these were the least used adaptation strategies among the farmers in the study area. In addition, the use of cover crops, farming on wetlands, planting of disease and drought resistance varieties of crops (WMS = 1.93), shifting cultivation (WMS = 1.90), irrigation of farmland (WMS = 1.73), cultivation on floodplains and valleys (WMS = 1.68) and alley farming (WMS = 1.34) were 2.74, 2.68 and 2.15, respectively were in low usage as adaptation strategies among the arable crop farmers in the study area. The result further showed that drought tolerant crop varieties (WMS = 1.93), shifting cultivation (WMS = 1.90), irrigation of farmland (WMS = 1.73), cultivation on floodplains and valleys (WMS = 1.68) and alley farming (WMS = 1.34) were ranked least of all the adaptation strategies.

Table 3. Distribution of arable crop farmers according to their adaptation strategies

Adaptation strategies	Very High	High	Moderate	Low	Very low	WMS	Rank
Targeting rainfall to plant, leading to either early or late planting	89(74.2)	19(15.8)	5(4.2)	2(1.7)	5(4.2)	4.54	1st
Good cultural practices	78(65.0)	22(18.3)	12(10.0)	5(4.2)	3(4.2)	4.39	2nd
Mixed species cropping	77(64.2)	32(26.7)	1(0.8)	6.(5.0)	4(3.3)	4.43	3rd
Farming of several varieties	15(12.5)	44(36.7)	35(29.2)	21(17.5)	5(4.2)	3.35	4th
Planting cover crops	10(8.3)	17(14.2)	61(50.8)	22(18.3)	10(8.3)	2.95	5th
Wetland/Fadama farming	5(4.2)	10(8.3)	66(55.0)	27(22.5)	12(10.0)	2.74	6th
Pest and diseases resistant crop	6(5.0)	10(8.3)	60(50.0)	28(23.3)	16(13.3)	2.68	7th
Construction of proper drainage channels	4(3.3)	4(3.3)	26(21.7)	59(49.2)	27(22.5)	2.15	8th
Drought tolerant crop varieties	2(1.7)	8(6.7)	12(10.0)	56(46.7)	42(35.0)	1.93	9th
Shifting cultivation	3(2.5)	5(4.2)	20(16.7)	42(35.0)	50(41.7)	1.90	10th
Irrigation of farmland	5(4.2)	4(3.3)	1(0.8)	54(45.0)	56(46.7)	1.73	11th
Cultivation on floodplains and valleys	4(3.3)	2(1.7)	6(5.0)	48(40.0)	60(50.0)	1.68	12th
Alley farming	2(1.7)	2(1.7)	1(0.8)	25(20.8)	90(75.0)	1.34	13th

Source: Field survey, 2021.

Constraints to the use of adaptation strategies

Table 4 presents the distribution of the respondents according to constraints limiting the use of adaptation strategies among the farmers. Ranking first is inadequate access/capital unavailability with WMS score of 2.80, following this, the second and third-ranking are unavailability of subsidies on planting materials, and unavailability of required production inputs with WMS scores of 2.79 and 2.56 respectively. These results are in line with that of [14] who reported that. inadequate access/unavailability of capital and unavailability of the required production inputs are the major factors limiting adaptation strategies among farmers in the study area. The least severe constraints to adaptation strategies in the study area are a low level of awareness of climate change variability, irregularities of extension services, gross time consumption, and poor access to climate change information with a WMS score of 1.98, 1.70, 1.68, and 1.55 respectively.

Low awareness level of climate change variability (WMS = 1.98), irregularity of extension services (WMS = 1.70), gross time consumption (WMS = 1.68) and poor access to information on climate change (WMS = 1.55) were the least severe constraints to the use of adaptation strategies.

Table 4. Distribution of arable crop farmers according to constraints to the use of adaptation strategies

Constraints	Very severe	Severe	Mild	WMS	Rank
Capital unavailability	103(85.8)	10(8.3)	7(5.8)	2.80	1st
No subsidies of planting materials	102(85.0)	11(9.2)	7(5.8)	2.79	2nd
Inadequate required production input	75(62.5)	38(31.7)	7(5.8)	2.56	3rd
Low awareness level of climate change variability	28(23.3)	62(51.7)	30(25.0)	1.98	4th
Irregularity of extension services	30(25.0)	25(20.8)	65(54.2)	1.70	5th
Gross time consumption	11(9.2)	60(50.0)	49(40.8)	1.68	6th
Poor access to information on climate change	3(2.5)	60(50.0)	57(47.5)	1.55	7th

Source: Field survey, 2021.

Results of simple linear regression analysis: The results of regression analysis used to determine the significant factors influencing adaptation strategies utilised in the study area are shown in Table 5.

Table 5. Simple linear regression analysis showing selected socio-economic factors influencing adaptation strategies employed

Variables	Coefficient(β)	Std. Error	t value	Significance
(Constant)	38.757	3.462	11.195	0.000
Age	-0.087	0.061	-1.420	0.170
Farming experience	-0.023	0.058	-0.393	0.698
Farm size	0.227	0.084	2.707	0.013**
IGA	0.001	0.000	3.501	0.002***
Years of education	0.157	0.080	1.962	0.062*

N.B: *** Significant at 1% and ** Significant at 5% *Significant at 10%

R^2=0.689, Adjusted R^2=0.519, F value=9.765

Source: Data Analysis, 2021.

Table 5 shows that the adjusted R-squared is 0.52 and the F-value (9.765) is statistically significant at a 10% level, implying that the model fitted the data for the study and that the independent variables explain about 52.00% variation in the dependent variable.

The farm size coefficient has a negative value and is statistically significant at a 5% level, indicating that the variable is negatively related to the adaptation strategies utilised by the sampled farmers in the study area.

The coefficients of years of formal education and income-generating activities (IGAs) are positive and significant at 1% and 10% levels of significance respectively, showing that these variables are positive determinants of adaptation strategies utilized by the sampled farmers in the study area.

Test of hypothesis

Table 6 shows the summary of the Pearson product correlation matrix establishing the association between arable crop farmers selected socio-economic characteristics and strategies adopted by the farmers to cope with the effects of climate change.

Results in the Table show that age (r=-0.397, p=0.000) and farm size (r=0.395, p=0.000) ae negatively related to farmers' adaptation strategies. These implies that aged farmers and farmers with large farm size may not be able to cope with effects of climate change, while farmers with moderate farm size may cope effectively with the effects of climate change.

However, farmers with large household size, higher years of formal education, and farming experience may cope effectively with climate change effects.

Table 6. Pearson product correlation matrix showing the relationship between selected socio- economic characteristics of the arable crop farmers and climate adaptation strategies

Variable	Coefficient	Sig	Decision
Age	-0.397	0.000**	S
Household size	0.257	0.005**	S
Years of education	0.215	0.018*	S
Farming experience	0.299	0.000**	S
Farm size	-0.395	0.000**	S

Source: Data analysis, 2021.
**Significant at 1%, *Significant at 5%

CONCLUSIONS

It was concluded that farmers were aware of the manifestations of climate change. They never planted their crops sequentially rather; they always planted most of their crops at the onset of raining season. Adaptation measures such as planting of crops more adaptable to new climate situation; application of irrigation; planting early maturing varieties; planting drought resistant varieties; planting pests and diseases resistance varieties were commonly in practice among the sampled farmers. Capital unavailability and no subsidy of planting materials constrained the use of adaptation strategies, alternating seasons for cropping and farm insurance were least adopted byarable crop farmers in the study area. Adaptation strategies were influenced by socio-economic characteristics of the farmers.

From the study findings, the following recommendations were made:

(i)Intensification of extension services especially campaigns on adoption of improved agronomic practices; planting of early maturing and drought resistance varieties that would help farmers to mitigate the effects of climate change.

(ii)Extension education to encourage farmers to insure their farms against crop failures due to climate change should be intensified among the farmers.

(iii) Farmers should have access to credit facilities and other farm inputs that will cushion them against climate change effects in the study area and

(iv) Subsidy on planting materials and required production inputs should be provided by government and agricultural stakeholders, to encourage proper and increase use of adaptation strategies.

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