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LIVELIHOOD ACTIVITIES AND DETERMINANTS OF ADOPTION OF CLIMATE CHANGE ADAPTATION STRATEGIES AMONG FARMING HOUSEHOLDS IN OYO STATE, NIGERIA

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Abstract

Study gaps still exist despite the growing number of climate change and adaptation studies. Earlier studies frequently focus on the adaptation strategies used, but they need more understanding of the institutional and socioeconomic factors affecting these choices. Furthermore, although livelihood activities diversification is acknowledged as a coping strategy against climate shocks, more is needed to know about the direct relationship between livelihood activities and adopting adaptation strategies. This study examined livelihood activities and the determinants of adopting climate change adaptation strategies among farming households in Oyo State, Nigeria. A multi-stage sampling technique was used to select 120 farming households. Data collection was done with the aid of a questionnaire designed to meet the objectives of the study. Analysis of socioeconomic characteristics and choices of adaptation strategies was done using percentages. In contrast, a binary logistic regression model was used to establish the factors influencing the likelihood of adopting adaptation strategies. The result from the study indicated that the majority (94.1%) of the household heads were between 60 years of age and below, with an average household head being 48.5 years and more than half (60%) male. Adjustment of farming operation time was adopted by the majority (84.4%) of the farmers. The binary logistic regression model highlighted that the likelihood of adopting adaptation strategies by farming households included the household heads' age (β= 0.413), sex (β= 0.210), household size (β= 0.144), farm income (β= 0.454), access to credit (β= 0.147), membership of cooperative (β= 0.344), access to weather information (β= 0.165) and crop farming as a livelihood activity (β= 0.013). This study recommends that an adequate and timely supply of weather and climate change information be provided to the farmers and regular credit access, as this is crucial for improved adoption of climate change adaptation strategies.

Key words**:** *adaptation strategies, climate change, farming households*

INTRODUCTION

Given its significant contribution to the National Gross Domestic Product, agriculture plays a crucial role in the economies of West African nations. In addition to employing almost 70% of the rural population, it generated 500 billion USD in 2023, representing 25% of the National GDP. In spite of its contribution to the economy, the sector still needs to be developed primarily due to low levels of mechanization, poor infrastructure and vulnerability to climate change [10].

Globally, agricultural systems face severe problems due to climate change [9]. The livelihoods and well-being of farming households are at risk due to its detrimental effects on food security, water availability and natural resources, especially in vulnerable areas like Nigeria, where a large percentage of the population derive their living from agriculture [13].

Alabi et al. [2] in Osun State and Ogunjimi and Ikefusi [15] in Kogi State examined the various adaptation techniques and factors that influence the selection of adaptation techniques to lessen the adverse effects of climate change on arable crop production in Nigeria.

Furthermore, different regions of the world experience the effects of climate change in different ways, with developing countries bearing the brunt of these effects due to their

lack of resources, technology, and capacity for environmental adaptation [3].

Nigeria is among the nations negatively impacted by climate change, mainly affecting its agricultural activities. Agriculture represents a major means of sustenance in the study area and the farmers are already managing with the effect of climate change as well as associated issues such as erratic rainfall patterns, temperature fluctuations, droughts and declining soil fertility [22]. Since the predicted temperatures and rainfall levels can no longer be relied upon, these erratic weather patterns can make it challenging to grow and maintain crops in areas that depend on farming as a means of livelihood [12]. Furthermore, farming households are more vulnerable due to these changes because they frequently need more institutional financial and technical assistance to appropriately respond to climate change effects.

Crop diversification, better irrigation techniques, and soil conservation are some climate change adaptation strategies advocated to lessen these difficulties [16]. Nevertheless, the adoption of these strategies and other institutional factors by farming households in Oyo State is still shallow. Socioeconomic characteristics, including age, income, education and access to financial services, influence the decision to implement adaptive measures. Additionally, farming households' means of subsistence further influence their adaptability. Many households participate in various income-generating activities as a coping strategy against climate-related shocks [17]. Nevertheless, it is unclear how much these livelihood pursuits affect adopting climate adaptation measures. Designing focused interventions that improve resilience and sustainability requires a deeper comprehension of the relationship between livelihood activities and the determinants of choices of adaptation.

Additionally, the majority of studies must concentrate on the ways in which institutional support such as credit availability and membership in cooperative societies can boost adoption choices. To fully understand the elements influencing farming households' adaptation to climate change, these gaps must be filled. This will support the development of policies and programs that would help farming households in Oyo State adopt workable strategies for adapting to climate change.

In order to better understand how agricultural households in the study area are using climate change adaptation techniques, this study looks at these objectives. Description of the socioeconomic characteristics of the farming households, identification of the various livelihood activities, examination of the different adaptation strategies employed by farming households, and analysing the factors influencing farmers' adoption of climate change adaptation strategies.

MATERIALS AND METHODS

Area of study

The study was carried out in Lagelu Local Government Area, Oyo State. Farming households in the study area were the respondents for the study. They are notably known for their extensive engagement in crop production activities such as growing of cassava, yam, cocoyam, vegetables, cocoa, kolanut, groundnut and melon. With coordinates of 8 00'N and 4 00'E, Oyo State is an inland state in the Southwest. Kwara State borders Oyo State on the North, Ogun State borders it on the South, the Republic of Benin borders it on the West and Osun State borders it on the Southeast. In 2022, its population is estimated to be 216,783,400 [20].

Sampling procedure

A multistage sampling process is used to choose farmers (heads of farming households) in the area of study. In stage 1, seven wards were randomly selected from the 14 wards in the study area. In stage 2, two (2) villages were randomly chosen from each of the seven wards to give a total of 14 villages. In stage three, 120 farming households were selected across the 14 villages based on a proportionate selection to size. This occurred due to an unequal distribution of farming households across the 14 villages. Minimum of eight (8) farming households. Primary data was collected with the aid of a well-designed

questionnaire to meet the objectives of the study.

Analytical technique

Descriptive statistics such as frequencies, percentages and means were used to describe the farming households' socioeconomic characteristics, engagement in livelihood activities and the various adaptation strategies employed to cope with climate change. Logit regression was use to examine the determinants of adoption of climate change adaptation strategies among the farming households

Factors influencing adoption of climate change adaptation strategies among the farming households

Logit Regression

The determinants of adoption of climate change adaptation strategies among farming households in the study area was examined using a logistic regression model. The dependent variable (Y) in this binary choice model is dichotomous. The model was chosen because the probability estimate lies between a range of 0 and 1 The dependent variable takes the value of 1 if the farmer adapts to climate change by adopting any of the strategy and zero if otherwise. Also, they do not exhibit linear relationship with the explanatory (independent variables) but rather depend on the cumulative logistic distribution function expressed as:

P_i = Prob {Y = 1/X} = 1/1+e-z .....(1)

For easy interpretation,

$z_i = \alpha + \beta_1 X_1 + \beta_2 X_2 \ldots \beta_n X_n$. .....(2)

Equation 2 can be stated in its odd ratio form as:

The log of odds ratio or the logit =
$\text{Ln}\ (P_i / 1-P_i) = \alpha + \beta_1 X_1 + \beta_2 X_2 \ldots . B_n X_n$...(3)

where:
P_i = Probability of adopting climate change adaptation strategies.
β_i = parameters of the independent variables,
i = indexes of the households' observations.

To get the value of z_i, the probability of observing the sample among the respondents must be formed through the introduction of a dichotomous dependent variable Y_i such that Y is equals 1 if the respondent is adopting climate change adaptation strategy and 0 if otherwise. Maximum likelihood estimation (MLE) technique was used in the estimation of the model.

The model is explicitly written as:

Y = Respondents adoption of climate change adaptation strategies (climate change adaptation strategies adoption = 1; 0 otherwise)
X_1 = Household head age in years
X_2 = Household head marital status (married = 1; 0 otherwise)
X_3 = Household head sex (male-headed household = 1; 0 otherwise)
X_4 = Household size (number)
X_5 = Household head educational status (educated = 1; 0 otherwise)
X_6 = Monthly farm income (naira)
X_7 = Farming experience (years)
X_8 = Farm size (hectares)
X_9 = Access to credit (beneficiary = 1; 0 otherwise)
X_{10} = Land ownership (owned = 1; 0 otherwise)
X_{11} = Membership of cooperative societies (member = 1; 0 otherwise)
X_{12} = Access to weather information (access = 1; 0 otherwise)
X_{13} = Crop farming is a livelihood activity (yes = 1; 0 otherwise)
X_{14} = Livestock farming is a livelihood activity (yes= 1; 0 otherwise)
X_{15} = Trading is a livelihood activity (yes= 1; 0 otherwise)

RESULTS AND DISCUSSIONS

Socio-economic characteristics of farming households

Farming households' socioeconomic characteristics are shown in Table 1. The majority (94.1%) of the household heads were between 60 and below, with an average household head being 48.5 years. This suggests that a significant portion of the farmers are still in their ideal years for

economic productivity and hence, are young. According to the results in the table, just 40% of the respondents were female, with a more significant proportion (60%) being male. This suggests that farming is a male-dominated activity, which is consistent with Oke et al.'s findings in 2022 [18].

A higher proportion (41.7%) of the household heads had primary education, a smaller percentage (15%) had tertiary education and 25% and 18.3% had secondary and non-formal education, respectively. This suggests that a larger portion of the household heads had some kind of education, which might have influenced their choice to embrace a strategy for adapting to climate change. Marital status showed that the majority (69.2%) of agricultural households in the study area were headed by married individuals. Considering that marriage is seen by society as a commitment and a responsibility, this showed that the majority of the respondents are accountable. Household size distribution showed that more than half (51.7%) of the households have 5-8 people in their households. The average household size was 5 people.

According to the study, the majority (47.5%) of the respondents had farming experience between 11 and 20 years, while a little (19.2%) had farming experience above 20 years. The average farmer had a farming experience of 14.8 years. Most (65.8%) of the farming households earned less than ₦100,000 monthly from their farming activities, with very few (3.3%) earning above ₦200,000. In addition, less than one-third earned between ₦100,000 and ₦200,000 monthly. The average monthly income among the farming households was ₦85,916.67.

Majority (94.2%) of the farmers are smallholders, as indicated by the fact that most of them owned between 1 and 5 hectares and only 5% had between 6 and 10 hectares. In terms of belonging to a cooperative society, the majority of respondents (89.2%) are cooperative society members, while very few (10.8%) are non-members. Many (84.2%) of farming households can access farm credit, while less than one-quarter (15.8%) cannot. It can also be seen from the table that there is a limited access to information on weather among the farming households going with the fact that a large number (85%) do not access weather information whereas just very few (15%) having access to information on weather.

Table 1. The socio-economic characteristics of farming households

Characteristics	Frequency	Percentage	Mean
Age (years)			
≤ 30	10	8.3	
31 – 40	45	37.5	
41 – 50	33	27.5	
51 – 60	25	20.8	
Above 60	7	5.8	48.5
Sex			
Male	72	60.0	
Female	48	40.0	
Educational level			
Non-formal	30	25.0	
Primary	50	41.7	
Secondary	22	18.3	
Tertiary	18	15.0	
Marital status			
Married	83	69.2	
Single	6	5.0	
Widow	22	18.3	
Divorced	9	7.5	
Household size (number)			
1 – 4	55	45.8	
5 – 8	62	51.7	
9 and above	3	2.5	5
Farming experience (years)			
1 – 10	40	33.3	
11 – 20	57	47.5	
21 – above	23	19.2	14.8
Monthly farm income (naira)			
< 100,000	79	65.8	
100,000 – 200,000	37	30.8	
> 200,000	4	3.3	85,916.67
Farm size (hectares)			
1 – 5	113	94.2	
6 – 10	6	5.0	
Above 10	1	0.8	2.7
Membership of cooperative society			
Yes	107	89.2	
No	13	10.8	
Access to credit			
Yes	101	84.2	
No	19	15.8	
Access to weather information			
Yes	18	15.0	
No	102	85.0	
Adoption of climate change adaptation strategies			
Yes	118	98.3	
No	2	1.7	

Source: Computed from Field Survey, 2023.

Furthermore, according to the result in Table 1, most (98.3%) of the respondents agree to be currently implementing at least one climate change adaptation strategy, while very few (1.7%) did not. This may be because most of the respondents are educated.

Livelihood activities among farming households

According to Gebru and Beyene [7], livelihood choices made by people are based on the level of their household assets or the availability of infrastructure in their community. Table 2 shows the frequency distribution of the farming households based on their primary occupation, as the majority of the farming households had numerous choices of livelihood. Crop production serves the main livelihood source as it is engaged in by the majority (77.8%). Also, very few (22.5%) were involved in livestock farming. Furthermore, a large number (65.7%) of the households engaged in trading as their source of livelihood. These findings conform to the earlier studies of [17, 1, 14], which stated that most rural households in Nigeria engage in multiple livelihood activities such as trading, small-scale business enterprises and processing of agricultural goods and arts and craft in order to supplement earning from farming.

Table 2. Distribution of farming households according to livelihood activities

Livelihood activities	Percentage*
Crop farmers	77.8
Livestock farmers	22.5
Trading	65.7

* implies multiple responses
Source: Computed from Field Survey, 2023.

Adaptation strategies for climate change

It is evident that the farmers in the area of study are informed of climate change and have taken a number of adaptation strategies to counteract the risks it poses to agricultural production. The various methods of adaptation employed by farmers in the study's location are displayed in Table 3. According to the table's results, 69.5% of respondents diversified their agricultural pursuits and 85.6% modified their operation time to favour greater output and returns. Nonetheless, 44.1% of farmers develop innovative solutions as part of their adaptation plans, while 51.7% step up irrigation operations. More so, 32.2%, 25.4% and 16.9% of the farming households adopted temporary migration to new sites, decreased the use of agricultural inputs and forests and restored damaged ecosystems, respectively. Only 1.7% of farming households do not use an adaptation strategy. The majority of farmers that adopted adaptation measures tended to combine different adaptation tactics, according to the multiple replies that were recorded. The outcome is consistent with previous reports of [4] that farmers employ a variety of adaptive measures.

Table 3. Adaptation strategies for climate change among farming households

Climate change adaptation strategies	%*	Rank
1.Farming operation time adjustment	85.6	1st
2.Agricultural activities diversification.	69.5	2nd
3.Irrigation intensification	51.7	3rd
4.Innovative solutions investigation and development	44.1	4th
5.Temporary migration to new sites	32.2	5th
6.Agricultural inputs usage decrease	25.4	6th
7.Damaged ecosystem restoration and forest replanting	16.9	7th
8.No strategy adopted at all	1.7	8th

* implies multiple responses
Source: Computed from Field Survey, 2023.

Factors influencing climate change adaptation strategies among farming households

The factors influencing farming households' decision to adopt climate change adaptation strategy was determined using a binary logistic regression. The model fits the data at ($p<0.001$) as indicated by the chi-square goodness of fit statistic (73.27). The goodness of fit demonstrated that the variables captured in this study were valid in explaining the factors determining a farmer's likelihood to adopt any adaptation strategy in tackling the climate change effect in the study's location. In addition, the pseudo R^2 value of (0.6839) shows that about 68% of the outcome (likelihood of adapting an adaptation strategy) can be determined by the selected independent variables captured in the model. Age, sex, household size, farm income, access to credit, membership of cooperatives and weather

information access had a significant effect on the decision to adopt any adaptation strategies to mitigate climate change (Table 4).

Table 4. Logistic regression result of the factors influencing climate change adaptation strategies among farming households

Variables	**Estimated B values**	**Standard error**	**z – value**	**p>|z|**
Age	0.413	0.200	2.07**	0.001
Marital status	-0.461	0.719	0.64	0.522
Sex	0.210	0.040	5.25***	0.000
Household size	0.144	0.080	1.80*	0.046
Educational level	0.982	1.170	0.84	0.404
Farm income	0.454	0.112	4.05***	0.001
Farming experience	-0.098	0.122	0.80	0.423
Farm size	-0.756	1.114	0.68	0.498
Credit access	0.147	0.038	3.87***	0.002
Land ownership status	-0.942	1.541	0.61	0.541
Cooperative membership	0.344	0.091	3.78***	0.001
Access to weather information	0.165	0.019	8.68***	0.000
Crop farming is a livelihood activity	0.013	0.005	2.60***	0.000
Livestock farming is a livelihood activity	0.318	1.589	0.20	0.917
Trading as a livelihood activity	1.498	1.654	0.91	0.876
Constant	0.769	0.196	3.92	0.000
Log likelihood function	-100.552			
Chi^2 of Likelihood Ratio test (df = 15)	73.27			
Pseudo R^2	0.6839			
Pro>chi^2	0.000			
Number of observations	120			

Source: Computed from Field Survey, 2023
***, **, * implies Significance at p<0.01, p<0.05 and p< 0.10 levels respectively

The findings showed a strong and positive relationship between the farmer's age and the strategies they choose to adapt to climate change. This indicates that household heads are more willing to implement adaptation strategies as they get older, which is consistent with previous result of [5], which found a positive correlation between age and climate change adaptation.
Adopting a strategy to adapt to climate change was positively correlated with the sex coefficient, which was significant at 1%. This means that as you move from male to female, more male-headed households are more likely to choose an adaptation strategy than female-headed households. This result is consistent with [5], who found that male-headed families are more able to take risks and learn about new technology than female-headed households. In contrast, [8] found that households headed by females are more likely to implement climate change adaptation measures.
Strategies for adapting to climate change have a positive relationship with farm income, which is significant at 1%. This suggests that the possibility of using climate change adaptation techniques increases as farm income increases.
This conclusion confirms the findings of [5], who discovered that farming households with high farm income are more likely to implement climate change adaptation strategies.
Access to credit, which was significant at 1% has a positive relationship with adopting climate change adaptation strategies.
This suggests that when farming households secure more credit, the likelihood of implementing adaptive measures increases. The outcome unequivocally demonstrates the value of financing availability in easing farmers' financial barriers to agricultural technology investment.
This is consistent with the earlier investigations of [6] and [19], who found that more credit accessibility raises the likelihood of implementing adaptation measures.
Adopting ways to adapt to climate change is

positively associated with cooperative membership, which is significant at 1%.

This suggests that embracing climate change adaptation solutions is more likely when one is a part of a cooperative society.

This finding is consistent with that of [5] and [11], who claimed that association membership raises farmers' awareness of coping mechanisms for the consequences of climate change.

When deciding whether to put climate change adaptation techniques into practice, access to weather information has a positive coefficient and was significant at the 1% level. This is consistent with the previous findings of [7] and [21], who also observed comparable outcomes.

Cultivation of crops as a source of livelihood was likewise important and had a positive effect at 1% significance level on the choice to adopt climate change adaptation measures.

This suggests that households involved in crop farming are more likely to use strategies for adapting to climate change than households involved in raising livestock or buying and selling activities.

This implies that crop cultivation is more affected by climate change than other sources of livelihood.

The table also showed that the likelihood of farming households implementing climate change adaptation measures is not significantly impacted by other factors, including marital status, educational attainment, experience in farming, size of the farmland and land ownership status.

CONCLUSIONS

While just 22.5% of farming households are engaged in the production of livestock, a sizable number (77.8%) are engaged in raising crops. Furthermore, only 1.7% of agricultural households did not adopt any climate change adaptation strategy, whereas the majority (98.3%) did. According to the study's findings on climate change adaptation strategies, 69.5% of the farming households varied their agricultural pursuits and 85.6% of them modified their operating hours to favour greater output and returns. Nonetheless, as part of their adaptation plans, 44.1% of the farmers create creative solutions, while 51.7% of the farmers step up irrigation operations. Furthermore, 32.2%, 25.4%, and 16.9% of the farming households, respectively, migrated temporarily to new locations, reduced their use of forests and agricultural inputs and repaired damaged ecosystems. According to the results of the logistic model, age, sex, household size, farm income, access to credit, cooperative membership and access to information on weather all have a significant impact on the likelihood that farming households in the study area will implement any climate change adaptation strategies.

Female farmers should be adequately equipped and trained to adopt adaptation strategies. Older farmers should be trained and encouraged to implement adaptation strategies. Farmers should try to join cooperative societies. Government policies should be restructured to properly address the needs of farming households to safeguard them from the effects of climate change by helping them with timely access to weather information. Government and private lending institutions should make credit readily available to farmers for better farming practices.

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