



## FACTORS INFLUENCING CHOICE OF COPING STRATEGIES AMONG RURAL FARMERS IN OKUNLAND: KOGI STATE: NIGERIA

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### ABSTRACT

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This study examined the factors that influenced the choice of coping strategies to climate change among rural farmers in Okun Area of Kogi State, Nigeria. A total of one hundred and fifty copies of questionnaire were randomly administered on the respondents through a multi-stage random sampling technique. But only one hundred and forty-six (146) copies were retrieved and used for the analysis. Both descriptive and inferential statistics were used for the analyses. The descriptive statistics used were frequency tables, percentages and mean, while the inferential statistic used was Multinomial Logistic regression. The results indicate that 72.60% of the respondents were male while 27.40% were female. It was discovered that 30.82% of the farmers chose fertilizer application as a measure to cope with the impact of climate change while 11.64% engaged in the planting of cover crops as a measure to cope with the changing climate. The result of the multinomial logistic regression model showed educational status, farming experience, access to credit, access to extension services, farm size, farm and non-farm incomes as well as access to climate information were among the factors that influenced farmers' choice of coping strategies to climate change at 95% confidence interval.

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### INTRODUCTION

The United Nations Framework Convention on Climate Change (UNFCCC, 2007) defined climate change as “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.” The Intergovernmental Panel on Climate Change (IPCC) on the other hand defines climate change as a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (IPCC Working Group I, 2001).

Climate change is one of the most serious environmental threats facing mankind worldwide. Its variables influence biophysical factors, such as plant and animal, water cycles, biodiversity and nutrient cycling and the ways in which these are managed through agricultural practices and land use for food production (Archer & Tan dross, 2009). Climate change, which is attributable to the natural climate cycle and human activities, has adversely affected agricultural productivity in Africa (Ziervogel et al,

2006). As the planet warms, rainfall patterns shift, and extreme events such as droughts, floods, and forest fires become more frequent (Zoellick, 2009), which results in poor and unpredictable yields, thereby making farmers more vulnerable, particularly in Africa (UNFCCC, 2007). Farmers, who constitute the bulk of the poor in Africa, face prospects of tragic crop failures, reduced agricultural productivity, increased hunger, malnutrition and diseases (Zoellick, 2009). Therefore, today's farmers need to be able to respond quickly to climate change and be able to manage risk. In view of this, agricultural extension workers should be able to provide farmers with necessary information about climate change. The extension agents can introduce locally appropriate technologies and management techniques that enable farmers to adapt to climate change by, for example, disseminating local cultivars of drought-resistant crop varieties with information about the crops. Also, extension staff can share with farmers their knowledge of cropping and management systems that are resilient to changing climate conditions such as intercropping, sequential cropping, and no-till agriculture (Davis, 2009). It is a common knowledge that rural farmers in Nigeria are highly dependent on farming and collection of Non-Timber Forest Products (NTFPs) for survival. Nonetheless, their contribution in ensuring food security for the people is significantly declining. This is mainly due to the fact that a large proportion of the farmers and forest-based households operate at the subsistence level, and that a large amount of the farm output is in the hands of these smallholder rural and forest-based farmers who are the most vulnerable groups to the effects of climate change (Petrie, 2010).

There are several factors or events that influence rural households' choice of coping strategies to climate change. However, there is dearth of empirical analysis carried out with respect to the specific factors that influence rural households' decision to cope with the impact of climate change, particularly in the rural and forest-based areas of Okun land in Kogi State, Nigeria. Despite the fact that several studies have been carried out on climate change adaptation, most of these studies have only focused on policy responses to climate change, either internationally, nationally or at community level and often leaving out adaptation or coping strategies at the individual or household level and specifically, the participation of rural farmers in adaptation efforts. Some of these previous studies include Smit *et al* (2009); Rasmus *et al.* (2009); Bryan *et al.* (2011) as well as Smit and Skinner (2002) that mainly focused on policy responses to climate change. This study however considered factors that influenced the choice of coping strategies among rural farmers in Okun area of Kogi State. In addition, since there are usually multiple coping strategies available to rural farmers, this study considered Multinomial Logistic Regression as appropriate model to determine the factors that influence rural households' choice of coping strategies to adapt to climate change in rural and forest-based communities of Okun area of Kogi Specific Objectives.

- 1- To examine the perception of rural dwellers towards climate change.
- 2- To identify the climate change coping strategies adopted by rural dwellers.
- 3- To determine factors influencing the choice of coping strategies to climate change among rural dwellers.

## METHODOLOGY

### Study Area

The study was carried out in Okun Area of Kogi State. The area comprises Ijumu, Kabba-Bunu, Yagba West, Yagba East, and Mopa-Muro Local Government Areas of the state. Kogi State is situated within the North-Central zone of Nigeria. It is the most centrally located of all the States of the Federation, with a population of 3,595,789 (NPC, 2006). It comprises Igala, Ebira, Kabba, Yoruba and Kogi divisions of former Kabba Province with Yoruba, Nupe and Bassa as the main ethnic groups and Yoruba, Nupe and Ebira as the major languages spoken. The State has two distinct seasons (the wet and dry seasons) and a humid tropical climate prevails over the State. The study was carried out in selected sawmills and timber markets in West Senatorial District of the State, which forms the Yoruba speaking part of Kogi State. Sampling Technique and Method of Data Collection A multistage sampling procedure was adopted in this study. The first stage involved the random selection of three LGAs out of the six LGAs in the region. The second stage involved the random selection of two communities each from the LGAs selected, making a total of six (6) communities selected. The third stage involved the random selection of twenty-five (25) respondents from each of the selected communities. In all, one hundred and fifty (150) respondents were selected for the study. However, only one hundred and forty-six (146) copies of the questionnaire were retrieved and were used for the analyses.

Data were collected through the use of questionnaire; focus group discussion, key informant interview and observation methods. Focus Group Discussion (FGD) and Key Informant Interview Techniques were an important approach to get opinions from groups of people and were also critical in terms of capturing information not captured through the use of questionnaire.

### Method of Data Analysis

Data were analyzed through the use of both descriptive and inferential statistics. Multinomial Logistic Regression Model was used to identify factors influencing farmers' choice of coping strategies to climate change in the study area. Qualitative data that was obtained from interview and discussion was analyzed through content analysis.

#### Specification for Multinomial Logit Model

Whenever there is a dependent variable that has more than two alternatives from which decision maker has to choose, the requisite econometric model would be either Multinomial Logit or Multinomial Probit Regression Model. Both estimate the effect of predictor variables on dependent variable involving multiple choices with unordered response categories (Greene, 2000). Therefore, since the response variable for this study has more than two categories, Multinomial Logistic Regression Model was considered appropriate. Multinomial Probit is, however, rarely used in empirical studies due to estimation difficulty imposed by the need to solve multiple integration related to multivariate normal distribution (Yirga, 2007). Moreover, Multinomial Logit Model is selected not only because of the computational ease but also Multinomial Logit analysis exhibits a superior ability to predict adaptation strategy choices and picking up the differences between the adaptation strategies of rural households (Keane 1992; Chan 2005). It is a simple extension of the binary choice model and is the most frequently used model for nominal outcomes that are often used when a dependent variable has more than two choices.

Therefore, for this study, five mutually exclusive adaptation strategies were identified. These are planting of cover crops, fertilizer application, and diversification to non-farm activities, cultivation of improved varieties and delayed planting. According to Greene (2000), suppose for the  $i^{\text{th}}$  respondent faced with  $j$  choices, the utility choice  $j$  can be specified as:

$$U_{ij} = Z_{ij} \beta + \varepsilon_{ij} \quad (1)$$

If the respondent makes choice  $j$  in particular, then  $U_{ij}$  is the maximum among the  $j$  utilities. So, the statistical model is derived by the probability that choice  $j$  is made, which is:

$$\text{Prob}(U_{ij} > U_{ik}) \text{ for all others } K \neq j \quad (2)$$

Where;  $U_{ij}$  is the utility to the  $i^{\text{th}}$  respondent from coping strategy  $j$ ; and  $U_{ik}$  is the utility to the  $i^{\text{th}}$  respondent from coping strategy  $k$ . Thus, the  $i^{\text{th}}$  household's decision can be modelled as maximizing the expected utility by choosing the  $j^{\text{th}}$  coping strategy among  $J$  discrete coping strategies, that is:

$$\text{Max}_j = E(U_{ij}) = f_j(x_i) + \varepsilon_{ij}, \quad j=0 \dots J \quad (3)$$

In general, for an outcome variable with  $J$  categories let the  $j^{\text{th}}$  coping strategy that the  $i^{\text{th}}$  household chooses to maximize its utility take the value 1 if the  $i^{\text{th}}$  household chooses  $j^{\text{th}}$  coping strategy and 0 if otherwise. The probability that a household with characteristics  $x$  chooses coping strategy  $j$ ,  $P_{ij}$  is modelled as:

$$P_{ij} = \frac{\exp(x_i' \beta_j)}{\sum_{j=0}^J \exp(x_i' \beta_j)} \quad j=0 \quad (4)$$

With the requirement that  $\sum_{j=0}^J P_{ij} = 1$  for any  $i$

Where;  $P_{ij}$  = probability representing the  $i^{\text{th}}$  respondent's chance of falling into category  $j$ ;  $X_i$  = predictors of response probabilities; and  $\beta_j$  = covariate effects specific to  $j^{\text{th}}$  response category with the first category as the reference. A convenient normalization that removes indeterminacy in the model is to assume that  $\beta_1 = 0$  (Greene, 2000).

The Multinomial Model can be expressed explicitly as follows:

$$Y_i = b_0 + b_1 X_1 + b_2 X_2 + \dots + b_n X_n \quad (5)$$

Where  $Y_i$  can be expressed as follows:  $Y_1$ = Planting of cover crops

$Y_2$ = Planting of improved crop varieties  $Y_3$ = Diversification to non-farm activities  $Y_4$ = Fertilizer application

$Y_5$  = Delayed planting

Planting of cover crops was used as the reference category in the model. It was also assumed that each farmer only used one of the available coping strategies to adapt to climate change. Therefore, farmers were required to choose one adaptation strategy they considered as the best coping strategy adopted by them to cope with the changing climate.

The independent variables are expressed as follows:

$X_1$ = Gender of respondent; 1 if male and 0, if female

$X_2$  = educational status; 1 if educated and 0, if no education  $X_3$ = Age of respondent

$X_4$ = Access to credit; 1 if has access to credit and 0, if otherwise

$X_5$ = Access to information on climate change; 1 if has access to information and 0 if otherwise

$X_6$ = Farming Experience  $X_7$  = farm size

$X_8$ = Household size

$X_9$ = Access to extension services; 1 if access to services and 0 if otherwise  $X_{10}$ = Farm income

$X_{11}$  = Non-farm Income

## RESULTS AND DISCUSSION

Findings from the study showed that the average age of the respondents was 43.4 years, as shown in Table1. This is an indication that the respondents were still in their active age, and could therefore easily adopt coping strategies to adapt to climate change. This may not be unconnected to the fact that old age makes it difficult for people to adapt to climate change, because agricultural activities require intensive labour as well as strong and healthy individuals to perform. It was further discovered from the study that 55.47% of the respondents engaged in farming as their major occupation. In addition, about 82% of the respondents had at least secondary education. This supports the fact that education is essential for the farmers to understand and interpret information as they relate to climate change. This will also enhance their capacity to utilize such information. Furthermore, the average farming experience of the respondents in the study area was 18.4 years. This implies that farmers in the study area had experience in farming, as farmers with high farming experience were more likely to understand the effects of climate change and embark on measures to adapt to climate change than farmers with less farming experience.

**Table1: Socio-economic Characteristics of Respondents**

Variable	Frequency	Percentage	Mean
Gender	106	72.60	
Male			
Female	40	27.40	
Total	146	100	43.4
Age (Years)			
<30	10	6.85	
30-40	21	14.38	
41-50	51	34.93	
51-60	42	28.77	
>60	22	15.07	
Total	146	100	
Marital Status			
Single	7	4.79	
Married	133	91.10	
Widowed	6	4.11	
Total	146	100	
Household Size			6
1-5	55	37.67	
6-10	63	43.15	
11-15	18	12.33	

Above 15	10	6.85	
Total	146	100	
Educational Status			
No formal	12	8.22	
Primary	15	10.27	
Secondary	70	47.95	
Tertiary	49	33.56	
Total	146	100	
Primary Occupation			
Farming	81	55.47	
Artisanship	21	14.38	
Trading	17	11.64	
Civil Service	27	18.49	
Total	146	100	
Farming Experience			18.4
1-10	23	15.75	
11-20	56	38.36	
21-30	42	28.77	
Above 30	25	17.12	
Total	146	100	
Source: Field Survey, 2021			

From Table2, .it was observed that 48.63% of the respondents were of the view that rainfall pattern had been erratic in the study area and that there had been delay in the arrival of rainfall in the study area, while 55.48% claimed there had been considerable rise in temperature in the study area over the past ten years. They agreed that all these variabilities were as a result of climate change. This is in agreement with studies by Oyekale and Oladele (2012) where farmers affirmed that there was climate change, as they had noticed rise in temperature in their localities and the resultant negative impact on their farming activities and livelihood.

Table2: Perception of Rural Farmers about Climate Change

Variable	*Frequency	Percentage
Delayed/Erratic Rainfall	71	48.63
Decreased Rainfall	39	26.71
Higher Temperature	81	55.48
Increased Rainfall	12	8.22
Lower Temperature	46	31.51
Source: Field Survey, 2021 *Multiple Responses		

Table3 depicts the most commonly adopted coping strategies among the rural households in the study area. The table reveals that 30.82% of the households used fertilizer on their farm as a coping strategy to improve soil nutrient, leading to improved farm yields. Just about 12% of the respondents embarked on delayed planting as a measure to cope with the effect of climate change. Furthermore, 26.03% of the respondents planted improved crop varieties as a strategy to cope with climate change, while 11.64% of them planted cover crops as a way to reduce the impact of climate change on their livelihood.

Table3: Climate Change Coping Strategies Adopted by Rural Dwellers

Strategies	Frequency	Percentage
Planting of cover crops	17	11.64
Fertilizer application	45	30.82
Diversification to non-farm activities	28	19.18
Planting of improved varieties	38	26.03
Delayed planting	18	12.33
Total	146	100
Source: Field Survey, 2021		

Table 4 shows the result for the Multinomial Regression of the factors influencing the choice of coping strategies by farmers in the study area. It was discovered from the results that farmer with advanced years of experience were more disposed to the use of fertilizer, cultivation of improved crop varieties as well as delayed planting than the planting of cover crops a coping strategy to climate change. This implies that the number of years a farmer had engaged in farming had significant influence on their use of fertilizer, cultivation of improved crop varieties as well as changing their planting dates as coping strategies to climate change. This implies that farmers with better farming experience know when to apply fertilizer on their farms and the type of fertilizer to apply as well as the best time to plant their crops to be able to cope with the changing climate. Findings further revealed that household size also significantly influenced the decision of respondents to diversify to non- farm activities as a way of coping with climate change at 0.05 significance level. This may be due to the fact that large household size has larger number of people to cater for when compared to households with smaller number of people. This therefore necessitated the need for such households to find additional and alternative means of providing for the large household in the event that output from their farms could no longer cater for the entire household's needs. This finding corroborates the work by Mano and Nhemachena (2006) that large household size is mostly inclined to divert part of its labour force into non-farm activities in order to increase their chances of adapting to climate change. It was further discovered that access to climate information has significant relationship with farmers' decision to change their planting time as well as apply fertilizer on their farms. That is, farmers who have access to climate information have better awareness on when best to plant their crops and when is the right time to apply fertilizer on their farms. In addition, farmers with education are better informed on

climate change and the need to cultivate improved crop varieties as well as apply fertilizer to improve the soil nutrients in order to increase their farm productivity, as they were both significant at 0.05 level. Findings also revealed that farmers who have access to credit facilities were more likely to cultivate improved crop varieties, diversify to non-farm activities as well as apply fertilizer to their farms as means of coping with climate change. In addition, farmers with large farm size had greater chance of engaging in planting of cover crops as a measure to cope with climate change, rather than to diversify to non-farm activities. This may be due to the fact that there is enough land available to such farmers to embark on the planting of cover crops like shrubs and leguminous trees to prevent the soil from direct sunlight. This will help to retain and improve the soil nutrients for improved yield. Study further showed that farmers who had access to extension services were also likely to adopt the cultivation of improved crop varieties as well as change their planting dates as a coping strategy. This may be due to the role played by extension agents in providing useful advice and information to farmers on how to cope with climate change and how to use different improved technologies to boost their production as well as when it is best to plant their crops. Farmers with higher farm incomes are also more likely to embrace the application of fertilizer on their farms as well as the cultivation of improved crop varieties than embark on the planting of cover crops. This could be due to the fact that farmers with better farm incomes could afford to purchase fertilizer and the price of improved crop varieties when compared to farmers with low farm income. Likewise, farmers with improved non-farm incomes are also more likely to diversify to non-farm activities as a coping strategy to climate change, when compared to their willingness to plant cover crops as a coping strategy. This implies that farmers with better farm and non-farm incomes have greater capacity to adapt to climate change than farmers with low farm and non-farm incomes. Therefore, with increased farm and non-farm incomes, farmers are more likely to adopt the use of fertilizer as well as improved crop varieties as coping strategies to climate change. This is therefore in line with the work by Deressa *et al* (2011) that the higher the income to the farmers, the less the risk of farmers to climate change.

## CONCLUSION

The study revealed that most of the respondents in the study area expressed strong perception about climate variability as 48.63% of them perceived that there had been delayed and erratic rainfall pattern in recent times while 55.48% claimed that there had been rise in temperature. It was also discovered that the choice of coping strategies adopted by farmers was influenced by some socioeconomic variables. The result of the multinomial logistic regression shows that such variables include educational status, access to credit, access to information on climate, farming experience, farm size, household size, access to extension services, farm and non-farm incomes which were all significant, at 5% level, in determining rural farmers' choice of coping strategies to climate change. The coping strategies adopted by the farmers in the study area are a, fertilizer application, planting of cover crops, diversification to non-farm activities, among others.



Table 4: Determinants of Rural farmers' Choice of Coping Strategies to Climate Change.

Diversification Strategies adopted by Rural Farmers									
Variable	Planting of improved crop varieties Y <sub>2</sub>		Diversification to non-farm activities Y <sub>3</sub>		Fertilizer application Y <sub>4</sub>		Delayed planting time Y <sub>5</sub>		
	Odd Ratio	P-Value	Odd Ratio	P-Value	Odd Ratio	P-Value	Odd Ratio	P-Value	
Gender (X <sub>1</sub> )	1.411	0.611	1.213	0.097	1.657	0.734	1.4102	0.099	
Educational status (X <sub>2</sub> )	1.215	0.034*	1.011	0.614	1.331	0.005*	0.667	0.321	
Age (X <sub>3</sub> )	1.112	0.543	1.232	0.078	2.141	0.104	1.440	0.085	
Access to Credit (X <sub>4</sub> )	3.321	0.000*	1.451	0.041*	2.534	0.034*	1.024	0.503	
Access to climate information (X <sub>5</sub> )	2.200	0.615	0.677	0.452	0.799	0.041*	1.451	0.000*	
Farming Experience (X <sub>6</sub> )	3.244	0.020*	4.244	0.213	1.524	0.010*	2.011	0.033*	
Farm Size X <sub>(7)</sub>	1.022	0.231	0.670	0.007*	0.076	0.242	0.834	0.074	
Household Size( X <sub>8</sub> )	1.321	0.755	5.255	0.022*	0.788	0.662	1.355	0.744	
Access to Extension Services (X <sub>9</sub> )	1.450	0.004*	1.234	0.244	4.238	0.644	0.755	0.001*	
Farm Income (X <sub>10</sub> )	5.164	0.011*	1.511	0.728	4.178	0.000*	4.110	0.345	
Non-farm Income (X <sub>11</sub> )	1.803	0.442	3.000	0.030*	4.127	0.446	1.210	0.338	

\*Significant at 5% level

### الخلاصة

فحصت هذه الدراسة العوامل التي أثرت في اختيار استراتيجيات التكيف مع تغير المناخ بين المزارعين الريفيين في منطقة أوكون بولاية كوجي ، نيجيريا. تم إعطاء ما مجموعه مائة وخمسين نسخة من الاستبيان بشكل عشوائي على المستجيبين من خلال تقنية أخذ العينات العشوائية متعددة المراحل. ولكن تم استرداد مائة وستة وأربعين (146) نسخة فقط واستخدامها للتحليل تم استخدام كل من الإحصائيات الوصفية والاستنتاجية للتحليلات. الإحصاء الوصفي المستخدم هو الجداول التكرارية والنسب المئوية والمتوسط ، بينما الإحصاء الاستدلالي المستخدم كان الانحدار اللوجستي متعدد الحدود. بينت النتائج أن 72.60% من المستجيبين ذكور مقابل 27.40% إناث. تم اكتشاف أن 30.82% من المزارعين اختاروا استخدام الأسمدة كإجراء للتعامل مع تأثير تغير المناخ بينما شارك 11.64% في زراعة محاصيل الغطاء كإجراء للتعامل مع تغير المناخ. أظهرت نتيجة نموذج الانحدار اللوجستي متعدد الحدود أن الحالة التعليمية والخبرة الزراعية والوصول إلى الائتمان والوصول إلى خدمات الإرشاد وحجم المزرعة والدخل من المزرعة وغير الزراعية وكذلك الوصول إلى المعلومات المناخية كانت من بين العوامل التي أثرت في اختيار المزارعين للمزارعين. استراتيجيات التكيف مع تغير المناخ عند فاصل ثقة 95%.

الكلمات الدالة: تغير المناخ، هطول الأمطار ، درجة الحرارة ، الطقس

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