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SOCIO-ECONOMIC DETERMINANTS OF CLIMATE VARIABILITY ADAPTATION STRATEGIES AMONG FARMERS IN AKOKO SOUTHWEST LOCAL GOVERNMENT OF ONDO STATE, NIGERIA

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Abstract

This study looked at socio-economic factors that affect how farmers of arable crops adapt to climate variability. Using a multistage sample strategy, a structured interview was conducted to gather information from 150 farmers in rural communities across the local governments in the study area. Descriptive and inferential statistics, including chi-square and Pearson Product Moment Correlation, were utilized to analyse the study's data. The research showed that farmers' socio-economic characteristics influence adaptation strategies. Household size ($\chi 2=179.3$), and farm size ($\chi 2=136.4$) positively influence adaptation strategies to be adopted by farmers at $p<0.05$. Additionally, there was a strong correlation between farmers' perceptions of climate variability and adaptation strategies ($r=0.591$, $p<0.05$). According to the study's findings, farmers' perceptions of climate unpredictability and socio-economic characteristics have a significant impact on their adaptation strategies. The study recommended that climate variability awareness and sensitization should be put in place at the Local, State, and Federal government level to have a community whereby the farmers are adeptly aware of the causes and effects of climate variability in the area.

Key words**:** *adaptation, climate variability, farmers, socio-economic*

INTRODUCTION

Agriculture is a key activity of human beings since it provides humanity with food, raw materials, shelter, clothing, fibre, and other by-products [26]. Hence, the importance of its interaction with the environment cannot be over-emphasized as the climate is the primary source of agricultural productivity. Because of this, the potential outcomes of variation in climate on agricultural production have generated a lot of reaction from different stakeholders in agricultural sector most especially the government and the farmers in particular [42]. Smallholders experience anxiety in different ways due to climate variability-related issue in the areas of longer and shorter period of rainfall, average temperature, and exposure to extreme climate variability which had significantly resulted to soil erosion during growing season and changes in sea level [38]. Given that agricultural production remains the majority of rural communities' primary source of food and income, climate variability conditions such as rising temperatures, decreased rainfall, and increased rainfall variability pose a serious threat to food security, crop yield, and the fight against poverty [19]. To maintain and enhance farmers' livelihoods and assure food security, it is crucial to adapt the agricultural industry to the negative consequences of climatic variability [11].

Beyond specific weather events, climate variability is the variance in the average condition and perhaps other data of the climate on all spatial and temporal scales [43]. The term "climate variability" is often used to denote deviations in climatic statistics over a given period (e.g. month, season, or year) when compared to long-term statistics for the same calendar period and these deviations, which are commonly referred to as anomalies, can be measured. They may be caused by the climate system's natural internal processes (internal variability or changes in natural or manmade external influences) (external variability) [37, 39].

Climate variability has become a global concern since it can adversely affect elements

of various systems and sectors that threaten human wellbeing [41]. The Intergovernmental Panel on Climate Change's fifth assessment report provided clear evidence of variations in climate due to human activities [22]. Recently, climate variability has had obvious impacts on agriculture in many areas of Nigeria, particularly in Ondo State including Akoko Southwest. In order to create adaptation methods to deal with the challenges and risks of climate variability in the agricultural sector, farmers' understanding of climate variability is essential [7]. Such knowledge is essential in Nigeria since the key predictor of how effectively agriculture can be carried out is climate, and changes in climate have significant effects not only on the agricultural sector but also on other sectors [28]. Studies have revealed that the agricultural industry, food security, community health, natural resources, biodiversity, and water supply are all greatly threatened by climate variability and extreme weather events [14, 31]. The implications of climate variability would be stronger on socio-economic development and agriculture, which play considerably more significant roles in food production in Africa, according to projections from the intergovernmental panels on climate change [22].

Long-term adaptive actions have been outlined in Nigeria's national statements to the United Nations Framework Convention on Climate Change, along with several other African nations. In their National Adaptation Programme of Actions (NAPAs), which emphasize agriculture, food security, and water resource management, several of these nations have specified emergency adaptation measures [11]. Several of the strategies are yet to be effectively integrated, keeping many farmers in the dark about the difficulties that climatic unpredictability presents for agricultural productivity [44]. This indicates that because of their abilities to adapt to climate change or fluctuation, African nations are more likely to be more seriously affected. However, it is clear from the literature that farmers' awareness of socio-economic factors and adaptability to climate action are crucial to ensuring food security and safeguarding the lives of the poor [3].

Culture, traditions, market, water supply, climate, soil condition, plot size, and distance from home all influence what and how much is produced in agriculture [4]. Given the aforementioned, it is clear that one of the key elements affecting crop yield and production is the climate. Realizing that agricultural yield and production are crucial to the economics and way of life of Nigerian farmers, the fluctuation of rainfall, temperature, and humidity levels has been a pressing concern in a sustainable environment [36]. For example, a substantial portion of the rural dwellers relied on rain for agricultural activities, therefore farmers keep deeper relationships with nature and their natural resources serve as the foundation from which their fundamental needs are obtained [5].

Since the current climate change is anticipated to present increased risk, new combinations of risks, and potentially serious consequences, climate variability adaptation methods are those strategies that enable the individual or the community to cope with or adjust to the ongoing series of adaptations in response to climate variability [6]. As a result, policy options for reducing the negative impact of climatic variability on farm productivity have been identified, including adaptation [21]. When it comes to agriculture, adaptation enables farmers to meet their goals for securing their food, income, and livelihood despite deteriorating socio-economic and climatic situations like floods and droughts [32]. According to farm-level study, when adaptation is completely adopted, there might be a significant decrease in the negative effects of climatic variability [27]. Farmers may modify their agricultural output by using effective environmental resource management techniques include planting early-maturing crops, mulching, small-scale irrigation, choosing hardy types of crops, planting trees, and staking to prevent heat burns [20]. Additionally, [30] noted that knowledge gaps on suitable adaptation were among the impediments to adaptation options such as poor deployment of socio-economic attributes, poor access to the market and the

labour crunch in agriculture. Therefore, it can be claimed that a lack of these variables as well as the ability to choose effective adaptive methods presents a significant barrier to agricultural output. The main factors of adaptation are information, awareness, labour, and capital.

However, climate variability uncertainty has been found to be a deterrent to investment in agricultural technology and market prospects [9]. Climate variability is a developing issue that poses a danger to peasant farmers, sustainable economic growth, and the entirety of human life [1].

In light of this, a research was conducted in the Akoko southwest local government area of Ondo State, Nigeria, to look at farmers' socio-economic drivers of climatic variability adaptation techniques. The study objectives are to:

(i) describe the socio-economic characteristics of arable crop farmers in the study area.

(ii) ascertain farmers' perception of climate variability on crop production.

(iii) determine socio-economic factors that influence farmers' adaptation strategies.

Hypotheses

(i)There is no significant relationship between socio-economic characteristics and farmers' adaptation strategies

(ii)There is no significant relationship between farmers' perception of climate variability and the adaptation strategies adopted by the farmers.

MATERIALS AND METHODS

Area of study

The study was carried out in Akoko South West Local Government Area of Ondo State, Nigeria. Akoko Southwest was created in 1996 (Ondo State Bureau of Statistics) with nine (9) communities and its headquarters area in the town of Oka Akoko. With a total population of 228,383 people and a land area of 340.1 (km) square, it is located in the deciduous rainforest of South Western Nigeria [33]. The local government is bounded to the north by Akoko north-east local government area, to the south by Ose and Owo local government area, and to the west by Ekiti state. The climate of the study area is equatorial with two peaks of rainfall. The first peak comes up between April and July while the second peak falls between late August and October. These two peaks are marked by heavy rainfall with a mean annual rainfall of 1,500mm-2,000mm. It has a relative humidity of 75-95% which results in severe cold conditions with a mean annual temperature of 23˚C-26˚C [35]. The study area lies between the latitude 7.23' 51.6˚ North and longitude 5˚41'40.7˚ East. This shows that the state lies in the rainforest and guinea savannah vegetation which is characterised by different plants and trees with a height of 5m and even more. The major form of occupation in the study area is agriculture, which is mainly of smallholder with the production of crops such as maize, yam, cassava, cocoa, cashew, rice, oil palm, timber, citrus, plantain, soya beans, cowpea, kola nut, and vegetables. More than 75% of the State's population benefits from it in the form of jobs and money. Additionally, it accounts for more than 70% of the state's GDP [40].

Study population

Farmers of arable crops in Akoko Southwest local government area of Ondo State make up the study's population.

Sampling procedure and sample size

The entire number of respondents for the survey was chosen using multi-stage sampling approaches. Five (5) communities from Akoko Southwest, namely Oke-Oka Akoko, Akungba-Akoko, Supare Akoko, Ikun Akoko, and Oba Akoko, were purposefully chosen for the initial stage. A simple random selection of two (2) wards from each community was used in the second stage. In the last phase, 15 farmers were randomly chosen from each of the chosen wards who are into arable crop farming, giving a total of one hundred and fifty (150) respondents.

Data collection and analysis

Data collection was carried out using primary and secondary sources. The primary data was collected using a questionnaire with well constructed open-ended and closed-ended questions, supported by the interview schedule while the secondary data were gathered from the literature that was available.

15 selected arable crop farmers from each of the wards chosen based on the list compiled by the Extension Agents of the Agricultural Development Programme (ADP) in the study region received the questionnaire. The data were examined using descriptive and inferential statistics including Chi-Square, Correlation analysis, and Ordinary least square regression to evaluate the proposed hypotheses. Frequency counts, percentages, and means were used to describe the respondents' socio-economic characteristics. Information on the respondents' methods for adapting to climatic fluctuation was gathered using a five-point Likert scale. The regression function postulated to isolate factors influencing adaptation strategies in the study was implicitly represented by the equation:

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, e)$ .....(1)

where:
Y = Adaptation Strategies
X_1 = Sex
X_2 = Age
X_3 = Farm Size
X_4 = Level of education
X_5 = Extension agent visit
X_6 = Experience in farming
X_7 = Perception
X_8 = Income of farmers
X_9 = Other sources of income
X_{10} =Lack of credit
The functional forms are as follows:

$Y_1 = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + \mu_i$ .....(2)

where:
a's and b's were parameters estimated while e represents the error term associated with data collected from the arable crop farmers. The error term was assumed to be normally distributed with zero mean value and constant variance. This regression analysis's main goal is to identify the variables that affect adaptation strategies.
Using inferential statistics like the Chi-square test and Pearson product-moment correlation analysis, the study hypothesis was put to the test.

RESULTS AND DISCUSSIONS

Socio-economic characteristics of respondents

According to Table 1, the average age of respondents in the study area is 48 years, with nearly half (42.0%) falling between the ages of 46 and 65 and 39.3% falling between the ages of 25 and 45. Only 16.0% and 2.7% respectively, of them were 66 to 95 years old. This means that adaptation to climatic fluctuation declines with age. That is, younger agricultural households are more likely to adapt to climate variability more than the elderly farming household. This is in line with the findings of [29], which observed that elderly people's physical strength, stamina, and mobility are reduced owing to their age, which then leads to them being unable to adapt to climate variability. More than half (62.7%) of the farmers were male while only 37.3% of them were female. This result indicates a higher percentage of males compared to females, reflecting the fact that the study area has a more male-dominated labour force in terms of crop production than the female. Although, the higher percentage of male to female farmers is insignificant to climate variability as the gender-based perceptions of climate variability will have weight on both male and female farmers' but women's capacity to adapt to climate variability risk is also lower than men due to lack of access to financial services, limited economic opportunities, and limited voice in decision making–especially in rural areas – where only 18 percent of adult women earn an income thereby affecting their decisions to implement adaptation practices to the threat of variations in climate [24]. A good number of the respondents as shown in Table 1 have large families of 4-7 (62.0%) with a mean household size of 5.1. This may be an advantage if they are used as farm labour. This is in line with [1, 10] who said that using households with larger sizes provides cheap labour to the households, increases their farm size, increases agricultural production, and

enables the adoption of some practices which can mitigate the impacts of climate variability compared to households with smaller family size.

Table 1 further shows the average income of farmers, within a farming season was ₦101,000 ($242.9) with half (50.0%) of them earning above ₦81,000 ($194.8) per farming season. This suggests that farmers' use of adaptation methods, interest in alternative adaptation strategies, and willingness to pay for access to such adaptation strategies are all strongly influenced by their income levels. In addition, the study found that the average year of farmers' experience was 25.5 years. More than half (60.0%) of them had from 1-10 years and 21-30 years of farming experience respectively. This indicates that the likelihood of diversifying portfolios (that is, adopting new crops or crop varieties, or using mixed farming systems), changing planting dates, and changing the amount of land under production increases with farm experience. This finding is in line with that of [11], who found that farmer attitudes, amount of farming experience, and income all influence how well farmers adjust to climatic unpredictability. Additionally, 14.7% of farmers have no formal education, compared to 22.0% of farmers with a primary education and 38.7% of farmers with a secondary education. While only 24.6% of respondents had a bachelor's degree or less, this indicates a respectable level of literacy in western education, as seen in Table 1. Because educated individuals are better able to access information, they play a crucial role in raising awareness in rural areas. [15] found that education in whatever form brings about the inculcation of the right type of awareness, knowledge, attitude, and the capacity to change the perception of the farmers to engage in different activities which can prevent or mitigate climate variability in extreme conditions or situations.

The mean farm size cultivated by the respondents was 2.2 acres, and this indicates that more than half (68%) of the farmers cultivated below the mean farm size which was still small and can make them more susceptible and less equipped to handle the adverse effect of climate variability. This result upholds the findings of [2, 13], who found that households with larger lands dedicated to cultivation are more likely to employ a variety of adaptation strategies.

Table 1. Distribution of respondents based on socio-economic characteristics

Socio-economic Variable	**Frequency (n= 150)**	**Percentage**	**Mean**
Gender			
Male	94	62.7	
Female	56	37.3	
Age			
25-45	59	39.3	
46-65	63	42.0	
66-85	24	16.0	
86-95	4	2.7	48.0
Household Size			
1-3	39	26.0	
4-7	93	62.0	
8-11	14	9.3	
12-14	4	2.7	5.1
Income on Farming			
10,000-40,000	26	17.3	
41,000-80,000	49	32.6	
Above 81,000	75	50.0	101,000
Other source of income			
No other sources	59	39.3	
10,000-40,000	40	26.6	
41,000-80,000	32	21.4	
Above 81,000	19	12.6	35,015
Level of education			
No formal education	22	14.7	
Primary education	33	22.0	
Secondary Education	58	38.7	
NCE/OND	20	13.3	
HND/B.Sc.	17	11.3	3.83
Arable crop planted			
Maize	100	31.3	
Groundnut	19	5.9	
Vegetable crop	63	19.7	
Tuber	105	32.8	
Rice	10	3.1	
Millet	12	3.8	
Beans	11	3.4	
Farm size			
Less than 1 Acre	34	22.7	
1-2.5	68	45.3	
2.5-4.0	32	21.3	
4.1-6.0	16	10.7	2.2
Access to extension services			
Yes	45	30.0	
No	105	70.0	1.7
Farm experience			
1-10	45	30.0	
11-20	31	20.7	
21-30	45	30.0	
Above 31	29	19.4	25.5

Source: Source: Field Survey, 2021.

Table 1 further demonstrates that the majority of farmers (70.0%) have access to extension agents, whereas 30.0% do not. This suggests that extension contacts determine the knowledge farmers will acquire about production activities and the deployment of

innovations through counseling and demonstrations by extension agents, which may affect the farmers' ability to adapt to climatic unpredictability. This result is consistent with [16, 25] who discovered that information received through extension service delivery is helpful to farmers in that it can enable them to develop coping strategies for adverse weather conditions on plants, livestock and the farmers themselves.

Farmers' perceptions of climate variability on crop production

The distribution of responses regarding farmers' perceptions of climatic variability is shown in Table 2. Farmers believed that the impact of climatic variability has resulted in a drop in crop output (mean=4.3), they also revealed that rainfall doesn't start and end at the normal period of the year due to variations in climates and this has resulted to crop failure overtime (mean=4.1). Farmers expressed that an increase in temperature and drought has led to decreased in soil fertility and thereby affected crop production (mean=4.0). The Table further shows that more than half (52.0%) of the farmers strongly agreed that excess rainfall hardly supports crop production (mean=39) and 50.0% indicated abnormal temperature in recent time and this has affected crop yield (mean=3.8).

The conclusion is that most survey respondents have positive assessments of the impact of climatic variability on agricultural output in the study area, which may be due to their high experience in farming. Their perceptions of climate variability are important to adaptation as they determine decisions in agricultural planning and management. The result is consistent with [17], indicating that farming experience and educational level positively influence adaptation decisions in planning and management of their agricultural activities.

Table 2. Farmers' perceptions of climate variability on crop production

Farmers' perception of climate variability	SA	A	UD	D	SD	M
	F (%)	F (%)	F (%)	F (%)	F (%)	
Temperature is not normal in recent time	75 (50.0)	27 (18.0)	14 (9.3)	23 (15.3)	11 (7.3)	3.8
Rainfall does not start and end at the normal period	84 (56.0)	28 (18.7)	17 (11.3)	11 (7.3)	10 (6.7)	4.1
There is an increase in temperature and drought	80 (53.3)	30 (20.0)	18 (12.0)	12 (8.0)	10 (6.7)	4.0
There has been an increase in the intensity and frequency of weather events	59 (39.3)	43 (28.7)	29 (19.3)	6 (4.0)	13 (8.7)	3.8
There has been noticeable drying of streams and river	72 (48.0)	33 (22.0)	23 (15.3)	9 (6.0)	13 (8.7)	3.9
All your crops have been failing due to the variations in climates	81 (54.0)	39 (26.0)	17 (11.3)	4 (2.7)	9 (6.0)	4.1
Vegetation has been dried	71 (47.3)	40 (26.7)	20 (13.3)	10 (6.7)	9 (6.0)	4.0
There has been decrease in crop yields	96 (64.0)	30 (20.0)	8 (5.3)	6 (4.0)	10 (6.7)	4.3
There has been noticeable land degradation in the community	44 (29.3)	64 (42.7)	27 (18.0)	8 (5.3)	7 (4.7)	3.8
There has been reduced soil fertility	77 (51.3)	33 (22.0)	15 (10.0)	14 (9.3)	11 (7.3)	4.0
Excessive rain hardly supports crops production	78 (52.0)	38 (25.3)	7 (4.7)	8 (5.3)	19 (12.7)	3.9

SA=Strongly Agreed, A=Agreed, UD=Undecided, D=Disagree, SD=Strongly Disagree, M=Mean
Source: Field survey, 2021.

Hypotheses testing

The findings in Table 3 made it abundantly evident that there was no significant relationship between gender ($\chi2=46.5$, $p>0.05$), age ($\chi2=199.5$, $p>0.05$) religion ($\chi2=79.4$, $p>0.05$), education ($\chi2=247.6$, $p>0.05$) and experience ($\chi2=299.4$, $p>0.05$), and farmers adaptation strategies. However, there was a significant correlation between household size ($\chi2=179.3$, $p<0.05$), farm size

(χ2=136.4, p<0.05) and farmers' adaptation techniques. The implication is that the rural farmers with larger households have a potentially higher labour force and are more likely to implement adaptation strategies. This is consistent with the findings of [23] who submit that larger household size is a positive determinant of household farm income that may enhance their adaptive capacities to combat variations in climatic conditions. The anticipated association between farm size and adaptability indicated that a large farm sizes provides farmers with room to implement more adaption techniques [12]. In a related study, [34] reiterated the role of farm size in influencing farmers' adaptation strategies.

Table 3. Chi-Square analysis of the relationship between selected socio-economic characteristics of respondents and the adaptation strategies

Socio-economic characteristics	χ^2	P-value	Decision
Gender	46.5	0.161	Not Significant
Age	199.5	0.913	Not Significant
Household size	179.3	0.034*	Significant
Farm size	136.4	0.020*	Significant
Religion	79.4	.372	Not Significant
Level of education	247.6	.117	Not Significant
Years of experience	299.4	.563	Not Significant

**significant: p<0.05; χ^2: Chi-square value; p-value: asymptotic significance value*
Source: Own results.

Table 4. Pearson Product Moment Correlation showing the relationship between perception of climate variability and adaptation strategies by the respondents

Variable	r-value	p-value	Decision	Remark
Perception of climate variability	0.591	0.000*	Significant	Ho rejected

**Significant: p < 0.05*

The results obtained in Table 4 found that a significant relationship existed between the farmers' perception of climate variability (r=0.591, p<0.05) and their methods for adjusting to climate variability. The research demonstrates that farmers' perceptions are crucial to the effective use of adaptation methods to lessen the effects of climate variability on agricultural activities [18]. The result corroborated the findings of [8] as they pinpointed that any farmers who lack perception will experience a major setback by facing critical challenges for not responding to climate variability through adaptation.

CONCLUSIONS

It could be inferred that farmers' perception of climate variability greatly influences adaptation strategies. Based on the findings of the study, we could have deduced that an increase in perception of climate variability will improve farmers' adaptation strategies thereby improving the value of their products, preventing the destruction of crops and farmland, and generally bring about improvement in the livelihoods of farmers, empower the farmers as well as having positive impact on the productivity, and reduce poverty level in the rural areas. Moreover, the result has shown that the household size and farm size have a big impact on farmers' adaption techniques.

Based on the study's findings, the following recommendations are made:

-There should be increased knowledge of and sensitivity to climate variability at the Local, State, and Federal government levels to have a community whereby the farmers are adeptly aware of the causes and effects of climate variability. Such awareness when put in place should modify the already existing perception of climate variability and at the same time create favourable adaptation measures appropriate and suitable for arable crops peculiar to the study area.

-Farmers should be exposed to more training and visitation from extension agent and all other relevant organizations and personnel to increase their awareness, knowledge, and insight on appropriate and affordable adaptation strategies that are suitable and relevant to their situation and circumstances.

-The farmers in the locality should also be exposed to new and emerging adaptation measures from research institutes scientifically proven to be effective for arable crops.

-Additionally, in order to effectively communicate knowledge to farmers, extension agents need to be given the necessary knowledge and skills in adaptation

and coping mechanisms through frequent training programmes.

-All the three tiers of government in Nigeria (Federal, State, and Local) should try as much as possible to lessen the constraints experienced by the farmers by providing credits, irrigation facilities, and more extension officers on the field.

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