Climate Change Adaptation Strategies Adopted by Cocoa Farmers in Ovia North East and Ovia South West Local Government Area, Edo State, Nigeria

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Abstract
Adaptation strategies are described as patterns of varied efforts organized by people to fulfill basic necessities and address challenges. This study assesses cocoa farmers' adoption of climate change adaptation strategies in Ovia North East and Ovia South West Local Government Areas, Edo State, Nigeria. Specifically, the study described the socio-economic characteristics, identified the climate change adaptation strategies adopted, and examined the constraints faced by cocoa farmers in adopting various adaptation strategies in the study area. A two-stage sampling procedure was employed to select 100 cocoa farmers for the study. Data was collected using both interview schedule and questionnaire. Data was analyzed using descriptive and inferential statistics such as Pearson Correlation at 1%, 5%, and 10% levels of significance. The study revealed a mean age of 41 years, 90% males, and 74% married population with a mean household size of 8 members. Farming was their main livelihood with a mean cocoa farming experience of 12 years and an average yearly income of approximately ₦555,140.35. The most adopted climate change adaptation strategy was the use of cocoa hybrid ($\bar{x}$ = 2.84). Inadequate government support ($\bar{x}$ = 3.69) was the most prevalent constraint faced by the respondents. The study also revealed a significant correlation between sex (r=0.186), age (r=-0.248), farming experience (r = -0.253), and estimated yearly income from cocoa activities (r = -0.230) and adaptation strategies adopted. This study concludes that sex, age, farming experience, and estimated yearly income from cocoa activities significantly affect the adoption of adaptation strategies by cocoa farmers in the study area.

Keywords: climate change, adaptation, strategies, cocoa, farmers

Introduction

Climate change is increasingly jeopardizing sustainable agricultural development. Sustainable agricultural development in Africa is seriously affected due to its effects and challenges in combating these adverse effects.

Shifting climatic conditions lead to rising temperatures, irregular rainfall patterns, flooding, desertification, extreme drought, and ozone layer depletion caused by greenhouse gases. These events reduce agricultural production, affecting farmers' livelihoods (Nkeme et al., 2017). Farmers rely on weather patterns to determine when to apply inputs such as fertilizers and pesticides, which help enrich soil nutrients and protect crops from pests and diseases. However, changes in rainfall and temperature patterns frequently disrupt the normal growth cycle of cocoa trees, affecting production (Ehiakpor et al., 2016).

Nigerian farmers indicate changing climates have delayed flowering, delayed or reduced pod development, and diminished seedling establishment (Agbongiarhuoyi et al., 2013). The production of major export crops such as cocoa in Nigeria has declined since the drought of 1972/73, which was the first evidence of climate change in the region (Nwachukwu et al., 2012). Climate change in agriculture is a significant problem, as agriculture makes up 60-70% of the workforce in Nigeria and 30-40% of the gross domestic product (GDP) (Sofoluwe et al., 2011).

Many Nigerian households rely on cultivating and selling crops such as cocoa for their livelihoods. Climate change directly threatens cocoa production in Nigeria (McIvor et al., 2017). Variations in humidity, temperature, and rainfall, all essential for plant growth, significantly affect agricultural output (Oyekale and Oladele, 2012). Changes in these climatic factors challenge cocoa farming, reduce yields, and endanger farmers' livelihoods. These effects highlight the urgent need for innovative adaptation strategies to sustain cocoa production.

Reduced rainfall and prolonged droughts have led to water stress, hindering cocoa plant growth and reducing yields. Sofoluwe et al. (2011) highlighted the direct relationship between decreased rainfall and lower cocoa output. Furthermore, unstable weather patterns exacerbate these challenges, causing plant die-offs (Mase et al., 2016).

Rising temperatures, projected to persist throughout the 21st century, stress cocoa plants already nearing their thermal tolerance limits, resulting in stunted growth and yield reductions (Sofoluwe et al., 2011; IPCC, 2012). Higher temperatures also reduce rainfall and increase humidity, creating an environment conducive to disease proliferation, notably Black Pod disease, which thrives in moist conditions (Lawal et al., 2007; Akrofi et al., 2015).

Farmers' adaptation involves recognizing climate change and implementing suitable strategies (Li et al., 2021; Morton, 2007). Effective adaptation requires institutional support and policy frameworks to enhance adoption (Belay et al., 2022). Early planting, for instance, minimizes water and heat stress during critical growth stages, allowing plants to maximize soil moisture and reduce drought vulnerability (Paul et al., 2016; Anning et al., 2022).

Mulching, a vital soil conservation technique, reduces evaporation, regulates soil temperature, and enhances nutrient retention, addressing water and nutrient limitations in cocoa farming (Steinmetz et al., 2016; Acheampong et al., 2019). Intercropping, by introducing additional crops alongside cocoa, provides shade, wind protection, and an improved microclimate for seedlings, reducing their exposure to extreme weather (Brooker et al., 2015; Kaba et al., 2019).

Crop diversification enables farmers to manage risks from climate and market fluctuations. Cultivating multiple crops increases productivity, strengthens economic resilience, and supports food security for households and communities (Hufnagel et al., 2020; McCord et al., 2015). Hybrid cocoa varieties, which are resistant to drought, pests, and diseases, provide stable yields and greater resilience to climate-related stresses (Wiredu et al., 2011). Additional strategies include income diversification, climate forecasting, soil erosion control, fertilizer use, and agroforestry (Kosoe et al., 2022; Agbongiarhuoyi, 2013).

However, the adoption of these strategies is influenced by factors like access to land, credit, farming experience, and extension services (Yirimodah et al., 2022). Barriers include high costs, inadequate institutional support, and limited awareness (Oluwatusin, 2014).

Although climate change adaptation has been widely studied in various regions, there is a lack of research specifically addressing cocoa farmers in Ovia North East and Ovia South West Local Government Areas of Edo State. These regions are vital to Nigeria's cocoa production and experience distinct climatic vulnerabilities that may necessitate tailored adaptation strategies. Additionally, the socio-economic determinants influencing adaptation decisions among cocoa farmers in these areas are not well documented, resulting in a research gap that this study seeks to fill.

The choice of Ovia North East and Ovia South West LGAs is strategic, as these areas represent major cocoa-producing zones in Edo State with favourable soil conditions and traditional farming systems that are increasingly threatened by climate variability. Understanding adaptation strategies in these specific locations will provide valuable insights for developing targeted interventions and policies to support cocoa farmers' resilience to climate change.

This study seeks to inform policy development that promotes sustainable practices and reduces climate risks. Climate change significantly challenges cocoa farming by lowering yields and threatening livelihoods. Effective adaptation strategies, supported by institutional frameworks and financial incentives, are essential for resilience and sustainability in cocoa production. Policymakers and stakeholders should collaborate to ensure farmers have access to necessary resources and technologies.

The results of this study will help improve cocoa farmers' awareness and adoption of adaptation strategies for climate change. It will also help Edo State Agricultural Development Programme (ADP) and Cocoa Research Institute of Nigeria (CRIN) reach out to cocoa farmers in communicating information on climate change and its adaptation strategies, thereby improving cocoa production.

Test of Hypothesis

Based on the above objectives, the following hypothesis stated in null form was tested:

H_0: There is no significant relationship between the socioeconomic characteristics of respondents (sex, age, marital status, household size, educational qualification, farm size, farming experience, membership to associations, and estimated yearly income) and the climate change adaptation strategies adopted.

Methodology

Edo State, located in Nigeria's South-South geopolitical zone between latitudes 5°00'N and 7°30'N and longitudes 5°00'E and 6°30'E, shares borders with Kogi State to the northeast, Anambra State to the east, Delta State to the southeast and south, and Ondo State to the west. Established in 1991 from the former Bendel State, Edo is often referred to as the Heartbeat of the Nation. Major crops cultivated in the state include rubber, oil palm, cashew, cassava, rice, maize, and cocoa.

This research was carried out in Ovia North East and Ovia South West Local Government Areas, Edo State, where fertile soil and abundant water supply create favourable conditions for cocoa production. These LGAs were specifically chosen due to their significance as major cocoa-producing areas in Edo State, their vulnerability to climate change impacts, and their representativeness of typical smallholder cocoa farming systems in the region. Small farmers, marginal farmers, and agriculture laborers all benefit from arable crop production as a source of income and employment.

Primary data through the administration of a structured questionnaire complemented with a scheduled interview.

Two stage sampling procedure was used in the selection of respondents. The first stage involved the use of simple random sampling technique to select five communities from each of Ovia North East (Utese, Okada, Egbeta, Ogbese, Uhen) and Ovia South West Local Government Areas (Iguobazuwa, Udo, Usen, Ugbogue, Umaza), giving a total of 10 communities.

The second stage involved the use of simple random sampling technique to select 10 cocoa farmers from each of the ten communities. The sample size of 100 respondents was determined using Yamane's (1967) formula for finite populations:

$n = N / (1 + N(e)^2)$ ………………………………………… eqtn 1

Where:
n = sample size
N = population size (estimated at 2,500 cocoa farmers in both LGAs based on ADP records) e = margin of error (0.05 for 95% confidence level)
$n = 2,500 / (1 + 2,500 (0.05)^2)$
$n = 2,500 / (1 + 2,500(0.0025))$
$n = 2,500 / (1 + 6.25)$ $n = 2,500 / 7.25$
$n = 345$

However, due to resource constraints, accessibility challenges in rural areas, and the intensive nature of data collection, a sample size of 100 respondents was considered adequate for study, representing approximately 4% of the estimated population.

Method of Data Analysis

The data collected were analyzed using descriptive statistics such as frequency counts, percentages, and means. Respondents' socioeconomic characteristics were analyzed using frequency and percentage.

Pearson correlation was used to examine the relationship between socio-economic characteristics of respondents and their adoption of climate change adaptation strategies. This statistical method was appropriate for this study because it measures the linear relationship between continuous and ordinal variables, which suited the nature of the data collected.

The degree of adoption for each adaptation strategy was measured on a 3-point scale where: 0 = Not adopted, 1 = Sometimes adopted, and 2 = Always adopted. These scores were summed to give an assumed interval scale, and socioeconomic characteristics measured at the appropriate level were correlated with it using Pearson Correlation.

This is stated mathematically below:

$$r = \Sigma(x_i - \bar{x})(y_i - \bar{y}) / \sqrt{[\Sigma(x_i - \bar{x})^2\Sigma(y_i - \bar{y})^2]} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \text{eqtn 2}$$

Where:

r = Correlation coefficient between X and Y
n = Number of observations
xi = Individual values of variable X (socioeconomic characteristics)
yi = Individual values of variable Y (climate change adaptation strategy adopted)
$\bar{x}$ = Mean of variable X
$\bar{y}$ = Mean of variable Y

Results and Discussion

Socioeconomic Characteristics of Cocoa Farmers

Table 1: Distribution according to socioeconomic characteristics of the cocoa farmers in the study area

Variable	**Freq. (%)**	**Mean**	**Variable**	**Freq. (%)**	**Mean**
Sex			**Main occupation**		
Male	90		Farming only	78	
Female	10		Farming and Business	4	
			Farming and Trading	2	
			Teacher	1	
			Other business	13	
Age in years			**Average farm size (ha)**		
20 – 29	17		1 – 5	26	
30 – 39	27	41	6 – 10	41	
40 – 49	31	years	11 – 15	26	8.665
>50	25		>15	7	**S.D. = 4.2**
Marital status			**Cocoa production experience (in years)**		
Single	18				
Married	74		1 – 5	12	
Divorced	2		6 – 10	36	11.75
Widowed	6		11 – 15	27	
			16 – 20	15	
			>20	10	

Household size			**Membership to Association**		
Below 6	32		Cocoa farmers' association	88	
6 – 10	51		Cooperative society	12	
11 – 15	14	8			
>15	3				
Educational qualification	3		**Estimated yearly income in naira**		
No formal education	12		Below 100,000	2	
Primary education	36		101,000 – 200,000	5	
Secondary school	26		201,000 – 300,000	3	₦555,140.35
NCE/OND	23		301,000 – 400,000	5	
HND/BSc.			401,000 – 500,000	15	
			>500,0000	70	
Total					

Source: Field Survey, 2023; ha = Hectares; S.D. = Standard Deviation

The analysis shows that respondents are predominantly male (90%), indicating that males are more involved in cocoa production while women's roles are often related to post-harvest activities such as fermentation, drying, sorting, and packaging. This finding aligns with traditional gender roles in agricultural production in Nigeria, where men typically handle field operations while women focus on processing and marketing activities.

The results show that respondents are in their middle-ages (mean = 41 years), implying that most farmers are still in their economically active age, which would result in positive effects on production. Farmers within the middle age and younger categories are typically more open to new ideas and easily adopt new technologies (Osarenren et al., 2016). This age distribution suggests good potential for technology adoption and adaptation strategy implementation.

The analysis shows that the majority of respondents are married (74%), indicating that married persons are more involved in cocoa farming, which they use to meet their financial needs. This finding suggests that family responsibilities drive participation in cocoa farming as a primary income source.

The analysis shows that the majority of respondents have large household sizes (mean = 8 members), which can translate into free labour force for farmers. Large household size is assumed to represent labour available for farming activities. Additionally, large household sizes can translate to high tendency to have members involved with off-farm activities compared to households with fewer family members, helping to diversify family income.

The results show that farmers have some form of education (only 3% have no formal education), which will facilitate adoption of new farming technologies and promote better production practices. Research by Fagariba et al. (2018) stated that educated farmers have high tendency to adapt to technology-inclined strategies to tackle climate change compared to uneducated farmers who may rely solely on traditional experience. The analysis reveals a high percentage of respondents (78%) engage in farming as their main occupation. Due to the demanding nature of cocoa farming, most respondents cannot venture into other occupations and base their livelihoods solely on cocoa farming, buying and selling.

The average farm size ($\bar{x}$ = 8.665 ± 4.2 hectares) shows that respondents engage in medium-scale production. The table shows that more of the respondents (41%) operate farms in the 6-10 hectares category, confirming the medium-scale nature of cocoa production in the study area.

The analysis shows cocoa farmers in the study area have adequate experience and knowledge (mean = 11.75 years) about the impact of changing climatic conditions on production and other agricultural activities. This experience level suggests farmers have witnessed climate variations over time and developed coping mechanisms.

The results show that the majority of farmers (88%) in the study area are members of platforms where information is disseminated among farmers. According to Wainaina et al. (2016), farmers who have many contacts with local traders are more likely to have information about agricultural input costs and production prices on local markets and thus adopt agricultural technologies.

The results show that 70% of respondents earn above ₦500,000 annually, revealing that farming has become a lucrative business for those who engage in it. This implies that cocoa farming generates an appreciable amount of income for farmers and serves as an important source of livelihood. The income level can be attributed to the price of a bag of dried cocoa beans (₦137,500) at the time of this research.

The relatively high educational levels (97% have some formal education) and substantial farming experience (mean = 11.75 years) provide farmers with the cognitive capacity to understand climate risks and evaluate adaptation options. However, the income level (70% earn above ₦500,000 annually) creates a financial threshold that influences which strategies farmers can afford to implement. For instance, high-cost strategies like irrigation system will show lower adoption despite their effectiveness, while relatively affordable strategies like using improved seeds will show high adoption rates.

The large household sizes (mean = 8 members) provide labour availability for labour-intensive adaptation practices like mulching and intercropping, explaining their moderate-to-high adoption rates. Conversely, strategies requiring specialized knowledge or external inputs (like climate forecasting) show poor adoption, reflecting limited access to technical extension services despite high association membership.

An average farm size of 8.665 hectares enables the implementation of diversification strategies. Larger farms support the cultivation of multiple crops and facilitate risk mitigation, whereas smaller farms are typically restricted to monoculture systems with limited adaptation options.

Climate Change Adaptation Strategies Adopted by Cocoa Farmers

Table 2: Climate change adaptation strategies adopted by respondents

Climate change adaptation strategies	**Always (%)**	**Sometimes (%)**	**Not at all (%)**	**Mean**	**Rank**
Change in planting date to suit changing climate	25	53	22	2.03	13
Covering of the topsoil (Mulching)	63	28	9	2.54	8
Intercropping, planting more trees to protect cocoa from wind	50	27	23	2.27	11
Crop diversification, growing different crops aside from cocoa	73	27	0	2.73	2
Use of cocoa hybrid that produces higher yield	85	14	1	2.84	1
Planting shade trees to provide shade for cocoa tree	62	13	25	2.37	9
Praying for rain	64	34	2	2.62	7
Planting improved varieties that are resistant to disease	80	10	10	2.70	3
Climate forecasting to know climate conditions	26	25	49	1.77	14
Changes in cropping pattern	27	21	52	1.75	15
Irrigation of cocoa seedlings to avoid dying out	54	28	18	2.36	10
Application of fertilizer to increase soil fertility	71	21	8	2.63	6
Application of insecticide to reduce insect attack	67	31	2	2.65	5
Application of herbicide to reduce weed competition	68	31	1	2.67	4
Application of fungicide to reduce fungus attack	46	29	25	2.21	12

Source: Field Survey, 2023

The study reveals that farmers employ diverse approaches to address climate change impacts, which aligns with findings by Agbongiarhuoyi et al. (2013), who established that appropriate responses and measures are needed to curb climate change impacts and prevent further deterioration.

The most widely adopted strategy is the use of cocoa hybrid varieties ($\bar{x}$ = 2.84). Farmers select these varieties due to their higher yields and increased resistance to climate-induced stresses. This adoption demonstrates a practical approach to sustaining productivity amid environmental changes. The prevalence of hybrids is attributable to their accessibility through agricultural development initiatives and their demonstrated effectiveness in local contexts.

Crop diversification is the second most common strategy ($\bar{x}$ = 2.73), indicating an application of risk management principles. Cultivating multiple crops alongside cocoa enables farmers to mitigate risks from climate variability and market changes. This approach supports both food security and income stability, and constitutes a long-term adaptation strategy rather than a short-term coping response.

The widespread adoption of improved disease-resistant varieties ($\bar{x}$ = 2.70) reflects farmers' response to increased disease pressure under changing climatic conditions. Higher temperatures and humidity create favourable environments for diseases like Black Pod, making resistant varieties essential for sustainable production.

Low adoption of climate forecasting ($\bar{x}$ = 1.77) and changes in cropping patterns ($\bar{x}$ = 1.75) indicates barriers such as limited access to weather information services and reluctance to modify traditional farming practices. The cost and technical complexity of these strategies may limit their adoption among smallholder farmers.

The moderate adoption of irrigation ($\bar{x}$ = 2.36) reflects the high cost of installation and maintenance of irrigation facilities, which many smallholder farmers cannot afford. However, shortage of rainfall makes cocoa vulnerable to climate change impacts, making the low adoption of irrigation a serious concern that requires policy attention.

Interestingly, praying for rain ($\bar{x}$ = 2.62) remains a common strategy, reflecting the cultural and religious context of farming communities in Nigeria. This finding aligns with Agbongiarhuoyi et al. (2013), who noted that farmers often call on God for solutions during difficult times.

Short-term Coping Strategies (immediate responses to climate stress)

i. Praying for rain ($\bar{x}$ = 2.62, rank 7) - represents immediate response to drought stress
ii. Application of fertilizers ($\bar{x}$ = 2.63, rank 6), insecticides ($\bar{x}$ = 2.65, rank 5), and herbicides ($\bar{x}$ = 2.67, rank 4) - reactive measures to address immediate production challenges
iii. Change in planting dates ($\bar{x}$ = 2.03, rank 13) - short-term adjustment to seasonal variations
iv. Mulching ($\bar{x}$ = 2.54, rank 8) - immediate soil and water conservation response

Long-term Adaptation Strategies (proactive, transformational changes):

I. Use of cocoa hybrids ($\bar{x}$ = 2.84, rank 1) - represents genetic resource improvement with lasting impact
II. Crop diversification ($\bar{x}$ = 2.73, rank 2) - fundamental farming system transformation for risk reduction
III. Planting improved disease-resistant varieties ($\bar{x}$ = 2.70, rank 3) - long-term genetic adaptation
IV. Intercropping and shade tree planting ($\bar{x}$ = 2.27, rank 11; $\bar{x}$ = 2.37, rank 9) - agroecological system modifications
V. Climate forecasting ($\bar{x}$ = 1.77, rank 14) and cropping pattern changes ($\bar{x}$ = 1.75, rank 15) - information-based planning adaptations

The high adoption of long-term strategies (hybrids, diversification, resistant varieties) indicates that farmers with higher education levels and substantial farming experience recognize the persistent nature of climate change and invest in transformational changes. However, the continued reliance on short-term coping strategies suggests that immediate survival needs often override long-term planning, particularly among farmers with limited income and credit access.

The lower adoption of information-based adaptations (climate forecasting, cropping pattern changes) reflects limited access to climate services and technical support, despite high association membership. This pattern suggests that while farmers possess indigenous knowledge for immediate coping, they require institutional support for implementing science-based adaptation strategies. Understanding the link between farmers' socioeconomic characteristics and their choice of adaptation strategies is vital. Farmers with better education and higher incomes often channel resources into long-term adjustments, while those struggling with daily survival tend to rely on short-term coping mechanisms.

Constraints Faced by Respondents in Adopting Adaptation Strategies

Table 3: Constraints faced by respondents in adopting adaptation strategies

Constraints	Very Serious (%)	Serious (%)	Not Serious (%)	Not a Problem (%)	Mean	Rank
Poor access to agricultural extension services	58	31	7	4	3.43	3
Inadequate government support	76	17	7	0	3.69	1
Lack of information about climate change	33	37	26	4	2.99	6
High cost of farm input	77	10	8	5	3.59	2
Lack of access to modern climate change adaptation technologies	34	36	23	7	2.97	7
Lack of assistance from other support groups	44	18	32	6	3.00	5
Lack of credit facilities/loan	45	28	19	8	3.10	4
Limited access to input markets	9	18	13	60	1.76	11
Low level of education	9	11	36	44	1.85	10
Poor health status	9	21	28	42	1.97	9
Household size	20	23	21	36	2.27	8

Source: Field Survey, 2023

Adaptation decisions are shaped by both personal and external conditions. Elements such as education, farming experience, family size, landholdings, institutional support, social connections, and access to markets influence how farmers respond to climate challenges (Below et al., 2015). These factors can either enable or limit participation in meaningful adaptation practices. Among the constraints identified, weak government support ($\bar{x}$ = 3.69) stood out as the most critical. The lack of strong policy backing, subsidies, and institutional assistance leaves farmers with limited capacity to adapt effectively. This underscores the importance of government involvement in promoting climate resilience among smallholder farmers.

The high price of agricultural inputs ($\bar{x}$ = 3.59) was another significant challenge. This aligns with the observations of Kosoe and Ahmed (2022), who emphasized that rising costs of improved seeds, fertilizers, pesticides, and equipment often discourage farmers from adopting new practices.

A third key issue was limited access to extension services ($\bar{x}$ = 3.43). Extension agents are instrumental in introducing climate-smart techniques and innovations. While the global benchmark recommends a farmer–extension officer ratio of 1:200–500 (World Bank, 2012), the ratio in the study area is far less favourable, restricting farmers' access to timely technical advice.

The lack of credit facilities ($\bar{x}$ = 3.10) also presented a notable barrier. Without financial support, farmers struggle to cover the upfront costs of new technologies or farm adjustments.

Interestingly, low education levels ($\bar{x}$ = 1.85) did not appear to be a major limitation, indicating that most farmers had sufficient knowledge to pursue adaptation. Likewise, restricted access to input markets ($\bar{x}$ = 1.76) was the least pressing concern, suggesting that farm inputs were relatively available in the study location.

Hypothesis Testing: Relationship between Socioeconomic Characteristics and Adaptation Strategies

Table 4: Hypothesis Testing Results

Socioeconomic Variable	Correlation Coefficient	p-value	Decision
Sex	0.186	0.065*	S
Age	-0.248	0.013**	S
Marital status	-0.094	0.356	NS
Household size	0.101	0.297	NS
Educational qualification	-0.128	0.206	NS
Farm size	-0.020	0.843	NS
Farming experience	-0.253	0.011**	S
Membership to associations	-0.010	0.922	NS
Estimated yearly income	-0.230	0.022**	S

Source: Field Survey, 2023; S = Significant; NS = Non-significant

*Significant at 0.10 level (2-tailed) ** Significant at 0.05 level (2-tailed); *** Significant at 0.01 level (2-tailed)

The Pearson correlation test revealed a significant positive relationship between sex and adaptation strategies adopted ($r = 0.186$, $p = 0.065$). Since $p = 0.065 < 0.10$, this relationship is statistically significant at the 10% level. This result supports findings by Denkyirah et al. (2017), who stated that male farmers are more likely to have access to information about new technologies and undertake risky ventures because they are better endowed with resources such as land and typically serve as household decision-makers controlling productive resources like land, labour, and capital.

This finding has important policy implications, suggesting that extension programs should specifically target women farmers to bridge the gender gap in adaptation strategy adoption, while ensuring equitable access to resources and decision-making opportunities.

The results indicated a significant negative correlation between age and the adoption of adaptation strategies ($r = -0.248$, $p = 0.013 < 0.05$). This suggests that younger farmers are more open to experimenting with new technologies, while older farmers tend to rely on established methods and show less interest in recently introduced practices. In other words, the willingness to embrace climate adaptation measures appears to decline with increasing age. This outcome differs from the findings of Denkyirah et al. (2017), who reported a positive relationship.

No meaningful association was observed between marital status and adaptation decisions ($r = -0.094$, $p = 0.356 > 0.05$). In this study, whether a farmer was married or single had little influence on the strategies adopted. This contrasts with Oluwatusin (2014), who found that married farmers demonstrated stronger adaptation capacities compared to their single counterparts.

The correlation analysis showed that household size did not significantly shape farmers' adaptation choices ($r = 0.101$, $p = 0.297 > 0.05$). This finding runs counter to Oluwatusin (2014), who argued that larger households adapt more readily because they are more aware of livelihood risks.

Education level also showed no significant relationship with adaptation practices ($r = -0.124$, $p = 0.206 > 0.05$). This differs from the observations of Owoeye and Sekumade (2016), who emphasized the importance of education in enabling cocoa farmers in Ondo State to adopt coping strategies more effectively.

Farm size did not emerge as a significant factor in adaptation behaviour ($r = -0.020$, $p = 0.843 > 0.05$). This contrasts with Tesso et al. (2012), who linked larger farm holdings with greater wealth and an enhanced ability to cope with climate risks.

Interestingly, farming experience showed a significant negative relationship with adaptation strategies ($r = -0.253$, $p = 0.011 < 0.05$). More experienced farmers tended to rely on familiar, traditional approaches rather than adopting new methods, indicating a reluctance to deviate from long-established practices. This result is at odds with the findings of Oluwatusin (2014), who suggested that farming experience supports adaptation.

Finally, belonging to farmer associations did not significantly affect the adoption of adaptation measures ($r = -0.010$, $p = 0.922 > 0.05$). In the study area, membership status alone did not play a major role in shaping farmers' responses to climate change.

The analysis revealed a significant negative relationship between estimated yearly income and adaptation strategies adopted ($r = -0.230$, $p = 0.022 < 0.05$). This finding aligns with Denkyirah et al. (2017), who found that higher cocoa income was negatively associated with climate change adaptation. This counterintuitive result suggests that farmers with higher incomes may perceive climate change as having minimal impact on their farming activities or may divert income to non-farm activities rather than climate adaptation investments.

This disagree with the findings of Mamkwe (2016) who after conducted his test with Chi-square and binary logistic model of 113 small farming households in Tanzania found that there is a statistically associated relationship between socio economic variables like farm size, age, education level of the household head, with the climate adaptation strategies adopted such as probability to use improved seed, probability to use fertilizer, probability to use inter-cropping among others. Mamkwe (2016) concluded that adoption of different climate change adaptation strategies is influenced by age, household size and farm size.

Conclusion

Farmers in the study area adopt various adaptation strategies to minimize climate change effects on cocoa production. The most serious constraints faced by cocoa farmers in adopting climate change adaptation strategies were inadequate government support ($\bar{x} = 3.69$), high cost of farm inputs ($\bar{x} = 3.59$), and poor access to agricultural extension services ($\bar{x} = 3.43$). The study revealed that sex, age, farming experience, and estimated annual income were all significantly associated with the adoption of adaptation strategies. Younger male farmers, particularly those with fewer years of farming experience and lower incomes, showed a greater tendency to adopt new practices. This suggests that adaptation programs should place greater emphasis on engaging older and more experienced farmers, who may be less receptive to change, while also ensuring that female farmers are not disadvantaged in terms of access to information and resources.

Interestingly, neither education nor farm size played a significant role in shaping adaptation decisions. This implies that in the study area, lack of knowledge or land resources may not be the key barriers to adoption. Rather, institutional support, affordability of farm inputs, and the effectiveness of extension services emerged as the more critical determinants of adaptation behaviour.

Recommendations

Based on these findings,

1.Policy measures should prioritize strengthening government support systems for smallholder farmers, lowering input costs possibly through subsidies or collective purchasing schemes and enhancing the quality and reach of extension services.

2. Adaptation initiatives should be designed with gender inclusivity in mind, ensuring that both men and women benefit equally from climate-smart agricultural programs.

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