Effects of Climate Change Risks on Yam Production in Yagba West Local Government Area of Kogi State, Nigeria

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ABSTRACT

This study examined the effects of climate change risks on yam production in Yagba West Local Government Area of Kogi State, Nigeria. A total of 370 yam farmers were selected using a multistage sampling technique, while data were obtained through structured questionnaires, focus group discussions, key informant interviews, and secondary climatic records from the Nigerian Meteorological Agency. Descriptive and inferential statistical tools, including percentages, mean scores, Pearson correlation, regression analysis, chi-square, and t-test, were used for analysis. Findings revealed that farmers are highly aware of climate change risks, with rainfall variability (mean = 4.08) ranking highest, followed by temperature increase (mean = 4.00) and delayed rainfall onset (mean = 3.90). Analysis of climatic data showed rainfall variability ranging from 1,089 mm to 1,521 mm with a mean of 1,329 mm, significantly affecting yam yields. Correlation results indicated a strong positive relationship between rainfall and yam yield ($r = 0.672$, $p < 0.001$) and a strong negative relationship between temperature and yield ($r = -0.581$, $p < 0.001$). Regression results showed that rainfall positively influenced yield ($B = 0.006$, $R^2 = 0.45$), while temperature had a negative effect ($B = -0.782$, $R^2 = 0.34$). Adaptation analysis showed that 65.4% of farmers adopted early-maturing yam varieties, 53.5% adjusted planting dates, and only 24.9% practiced irrigation due to high cost. Regression analysis further revealed that socio-economic variables explained 62% of variation in adaptive capacity ($R^2 = 0.64$), with education ($p < 0.001$), farm size ($p < 0.001$), and credit access ($p < 0.01$) being significant predictors. Farmers who adopted adaptation strategies recorded higher yields (mean = 13.4 t/ha) than non-adopters (mean = 10.2 t/ha), with a significant difference ($t = 8.56$, $p < 0.001$). The study concludes that climate change significantly reduces yam productivity, while adaptation strategies improve yields. It recommends improved extension services, access to credit, and climate information systems to enhance farmers' resilience.

Keywords: Climate change risks, yam production, adaptation strategies, smallholder farmers, Yagba West LGA

INTRODUCTION

Climate change remains one of the most significant global challenges of the 21st century, with far-reaching implications for food security, livelihoods, and sustainable development. The IPCC (2021) reports that global temperatures have risen by about 1.1°C above pre-industrial levels, leading to increased frequency and intensity of extreme weather events such as droughts, floods, and heatwaves. These climatic changes directly threaten agricultural productivity, particularly in regions that depend heavily on rain-fed farming systems (Food and Agricultural Organization, 2021). In sub-Saharan Africa, where agriculture supports about 60% of the population, vulnerability is particularly high due to limited adaptive capacity, weak infrastructure, and dependence on rainfall variability (World Bank, 2020; Niang et al., 2014).

Across the region, increasing temperature, erratic rainfall, and rising pest and disease incidence continue to undermine agricultural productivity and rural livelihoods (Thornton et al., 2018).

In West Africa, yam is a major staple crop that plays a critical role in food security and rural incomes. Nigeria alone accounts for about 67% of global yam production, making it the world's leading producer (FAO, 2022). Despite its importance, yam production is increasingly threatened by climate variability, including irregular rainfall distribution, rising temperatures, soil degradation, and extreme weather events (Adebayo & Oladipo, 2021). These changes affect both the quantity and quality of yam harvests, thereby reducing income and food availability for farming households.

In Kogi State, which is a major yam-producing region in Nigeria, farmers are already experiencing noticeable climate-related challenges. These include delayed onset of rainfall, shortened rainy seasons, prolonged dry spells, and occasional flooding events that disrupt farming activities (Okafor et al., 2021). The study area is predominantly agrarian, with yam cultivation serving as a major source of food and income for most households (Ogunbameru et al., 2022). However, increasing climate uncertainty has led to fluctuating yields, unpredictable planting seasons, and growing production risks, thereby affecting household stability and rural livelihoods (Ajibefun, 2022).

Yam production is particularly sensitive to climatic conditions such as temperature and moisture availability. Increased temperatures raise evapotranspiration rates, resulting in soil moisture deficits that are critical during tuber formation (Adenle et al., 2017). Similarly, erratic rainfall patterns can hinder germination, delay crop establishment, and increase the risk of tuber rot and post-harvest losses (Ezekiel et al., 2020). Although farmers attempt to adapt through practices such as adjusting planting dates, intercropping, and using local drought-tolerant varieties, these strategies are becoming less effective due to the increasing severity and unpredictability of climate change (Jalloh et al., 2013).

Beyond agronomic impacts, climate change also imposes significant socio-economic pressures on farming households. Rising input costs, declining yields, unstable market returns, and increased labor demands have all been reported among yam farmers (Oluwatayo & Adedeji, 2019). In addition, limited access to climate information services, poor extension support, and inadequate rural infrastructure further weaken farmers' ability to respond effectively to climate risks (Ayanlade et al., 2018). The combined effect of these challenges increases vulnerability and threatens the sustainability of yam-based livelihoods in rural communities.

Globally and across Africa, studies have consistently shown that climate change is contributing to declining agricultural productivity and increased food insecurity (Porter, 2021; Serdeczny et al., 2020; Lobell et al., 2022). In Nigeria, empirical evidence indicates that shifting rainfall patterns, rising temperatures, and pest outbreaks are already affecting crop yields, including yam production (Ayanlade et al., 2020; Ume et al., 2022; Nwafor et al., 2023). In Kogi State, farmers continue to face limited access to climate information and weak institutional support systems, which further limits adaptation capacity (Okafor et al., 2022; Ogunbameru et al., 2023).

However, despite these studies, there remains a clear gap in localized research focusing specifically on yam production in the study area. Many existing studies are either generalized at national or regional levels or focused on other crops such as maize and cassava, thereby failing to capture the unique realities of yam farmers (Adejumo et al., 2020; Olaniyi & Ojekunle, 2021). Furthermore, issues such as farmers' perceptions, gender roles, indigenous adaptation strategies, and local environmental conditions are often underexplored. Many studies also rely heavily on quantitative methods, limiting deeper understanding of lived experiences and coping mechanisms (Asadu, 2021; Edeoghon & Ajayi, 2022).

Given the importance of yam production to rural livelihoods in the study area, there is a need for a detailed, context-specific assessment of climate change risks. Such a study will provide empirical evidence on how climate variability affects yam production, farmers' perceptions of these risks, and the adaptation strategies they employ. It will also help identify institutional and policy gaps that limit effective response. Ultimately, the findings will contribute to the development of targeted climate-smart agricultural interventions aimed at improving resilience, enhancing productivity, and ensuring sustainable yam production in the study area.

STUDY AREA

The study area, Yagba West Local Government Area (LGA), is one of the 21 LGAs in Kogi State, North-Central Nigeria, located approximately between latitudes 8°15′N and 8°30′N and longitudes 5°30′E and 5°45′E. It shares boundaries with Yagba East LGA, Mopamuro LGA, and parts of Kwara and Ekiti States, with its administrative headquarters at Odo-Ere serving as the central hub for political and economic activities. The area is accessible through major road networks linking it to Lokoja and surrounding towns such as Egbe, Isanlu, and Kabba, making it an important agricultural and commercial zone in the region.

Yagba West experiences a tropical savanna climate characterized by distinct wet and dry seasons (Ifatimehin, 2017). The rainy season occurs from April to October, with peak rainfall between July and September, and annual rainfall ranging from 1,200 mm to 1,500 mm (Ogunkolu, 2019; Adebayo & Oladipo, 2021). The dry season spans November to March, dominated by harmattan conditions with high temperatures often exceeding 35°C. These seasonal variations strongly influence agricultural activities, especially yam production, which depends on timely rainfall and adequate soil moisture. However, excessive rainfall sometimes leads to waterlogging and tuber rot, affecting yields (Adebayo & Oladipo, 2021).

The relief consists of gently undulating plains with isolated hills, with elevations between 250 and 450 meters above sea level (Ifatimehin, 2017). The terrain supports good drainage through a dendritic network of seasonal and perennial streams, some of which feed into the River Niger. While this promotes agricultural suitability, occasional flooding and erosion in low-lying areas can damage farmlands (Adejumo et al., 2020). Geologically, the area is underlain by Precambrian Basement Complex rocks such as granites, gneisses, and migmatites, which weather into fertile, well-drained soils favorable for yam cultivation (Okafor et al., 2022). These soils are generally ferruginous, ranging from sandy loam to loamy textures, though they are prone to nutrient depletion under continuous cultivation (Ogunkolu, 2019; Ogunbameru et al., 2023).

Vegetation falls within the southern Guinea savanna zone, consisting of grasses and scattered trees such as shea butter, locust bean, and acacia species (Ifatimehin, 2017). However, agricultural expansion, bush burning, and logging have significantly reduced natural vegetation cover, leading to secondary regrowth in fallow lands (Adebiyi & Okunola, 2023). The land use pattern is predominantly agricultural, with yam as the major crop, alongside cassava, maize, and vegetables. Farming is largely subsistence-based, supported by shifting cultivation and mixed cropping systems that help maintain soil fertility (Ogunkolu, 2019). Increasing population pressure and land fragmentation have intensified land use, reducing fallow periods and contributing to declining soil productivity (Ifatimehin, 2017; Okafor et al., 2022).

Socio-economic activities are dominated by agriculture, complemented by livestock rearing, petty trading, and small-scale agro-processing such as yam flour and garri production (Adebayo & Oladipo, 2021). Local markets in Odo-Ere and Egbe serve as key trade centers. However, farmers face challenges such as poor infrastructure, limited access to credit, weak extension services, and insecure land tenure systems, which hinder productivity and sustainable land management (Ifatimehin, 2017; Ogunkolu, 2019). Overall, the physical and socio-economic characteristics of Yagba West strongly influence agricultural practices, particularly yam production, and provide a relevant context for examining the impacts of climate variability on rural livelihoods (Okafor et al., 2022).

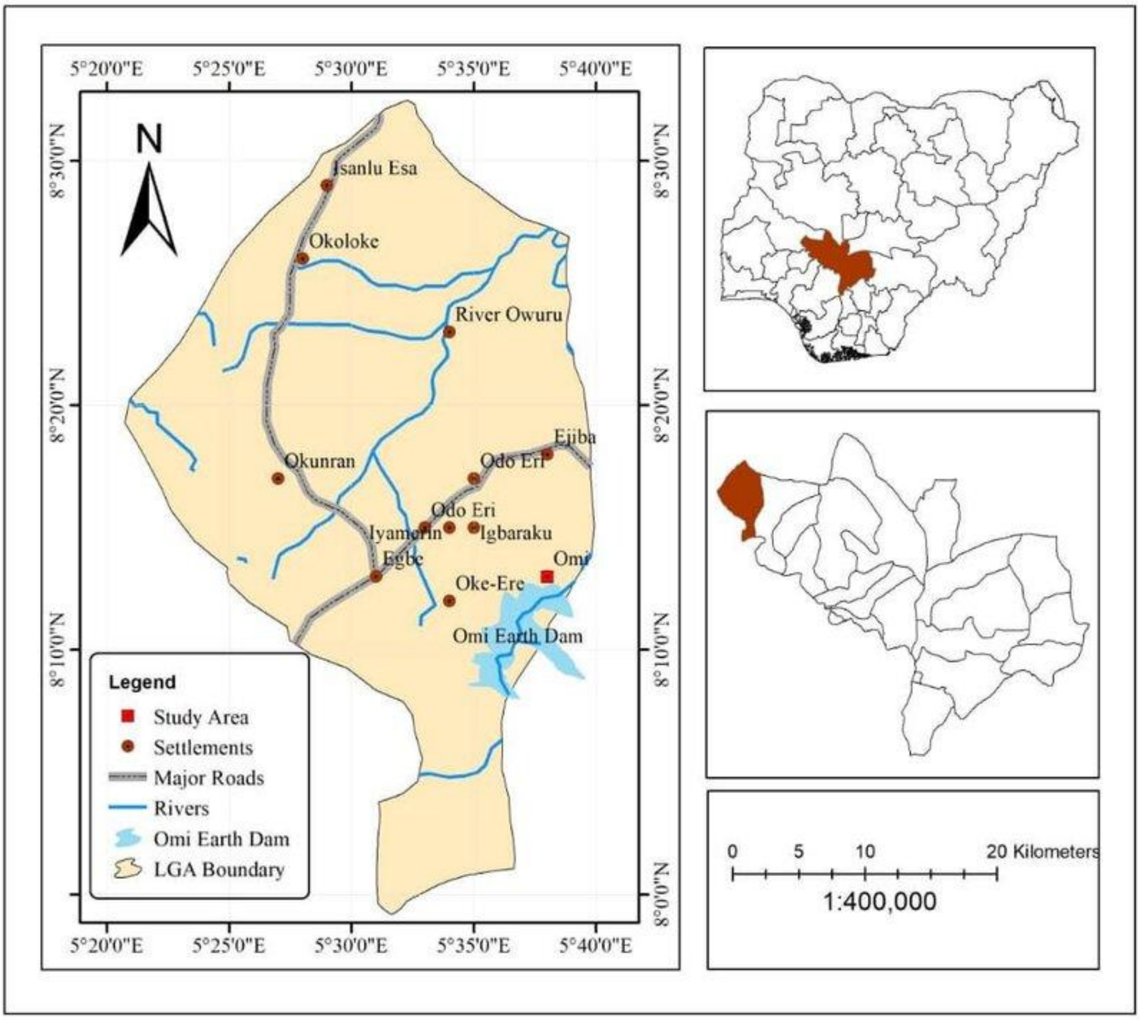


Fig 1.1. Yagba West Lga
Source: Department of Geography, PAAU, 2025

METHODOLOGY

The study adopted a cross-sectional survey design supported by descriptive and observational methods to assess the effects of climate change risks on yam production in Yagba West Local Government Area, Kogi State. The design enabled collection of data at a single point in time to capture farmers' perceptions, experiences, and adaptation practices. Field observation was used to assess farm conditions such as soil moisture, erosion, and yam growth patterns, while descriptive analysis documented socio-economic characteristics, climate experiences, and coping strategies. Analytical procedures were applied to examine the relationship between climate variables and yam production outcomes. Data required included socio-economic characteristics of farmers, rainfall and temperature trends, farmers' perceptions of climate change, adaptation strategies, institutional support, production constraints, and economic variables such as costs and returns. Both primary and secondary data were used. Primary data were obtained through structured questionnaires, key informant interviews, and focus group discussions with farmers, extension officers, and cooperative leaders, while secondary data were sourced from NiMet, Kogi State Ministry of Agriculture, NRCRI, FAO, and relevant literature.

The population comprised over 5,000 yam farmers in the study area. A sample size of 370 was determined using Yamane's formula. A multistage sampling technique was adopted, involving purposive selection of yam-producing areas and systematic random sampling of registered farmers. Data collection instruments included questionnaires, interview guides, and focus group guides, which were validated through expert review and pre-tested for reliability. Data were analyzed using SPSS version 25. Descriptive statistics summarized the data, while correlation, regression, chi-square, and t-test were used for hypothesis testing. Qualitative data were thematically analyzed to complement quantitative results and provide deeper insights into climate change impacts on yam production

RESULT AND DISCUSSIONS

Socio-Economic Characteristics of Yam Farmers in the Study Area

Table 1: Socio-Economic Characteristics of Yam Farmers (n = 370)

Variable	Category	Frequency	Percentage (%)	Mean	Std. Dev.
Age (years)	Below 30	52	14.1	44.2	11.6
	31–40	96	25.9		
	41–50	124	33.5		
	51–60	68	18.4		
	Above 60	30	8.1		
Gender	Male	274	74.1		
	Female	96	25.9		
Education	No formal	98	26.5		
	Primary	122	33.0		
	Secondary	104	28.1		
	Tertiary	46	12.4		
Household size	1–4	84	22.7	6.4	2.3
	5–8	196	53.0		
	Above 8	90	24.3		
Farming experience	<10 yrs	78	21.1	18.7	9.5
	10–20 yrs	142	38.4		
	21–30 yrs	96	25.9		
	>30 yrs	54	14.6		
Farm size (ha)	<2	214	57.8	2.1	1.3
	2–4	112	30.3		
	>4	44	11.9		
Credit access	Yes	118	31.9		
	No	252	68.1		
Extension contact	Yes	146	39.5		
	No	224	60.5		

Source: Field Survey, 2025

The table 1 shows that yam farmers are mainly middle-aged (mean = 44.2 years), indicating an active labour force suitable for farming and adaptation. The dominance of males (74.1%) reflects cultural norms where yam is traditionally considered a male crop (Doss et al., 2018; Ajayi and Solomon, 2022). Education levels show moderate literacy, which supports climate information use (Deressa et al., 2009; Abid et al., 2016). Household size (mean = 6.4) suggests availability of family labour but also dependency pressure (Nhemachena and Hassan, 2007). Farmers have long experience (18.7 years), indicating strong indigenous knowledge of climate variability (Bryan et al., 2013). However, small farm sizes (mean = 2.1 ha) limit large-scale adaptation investments (Morton, 2007). Poor access to credit (68.1%) and extension services (60.5%) further constrains adaptive capacity (Maddison, 2007; Feder et al., 2010).

Farmers' Perception of Climate Change Risks

Table 2: Farmers' Perception of Climate Change Risks (n = 370)

Climate Risk	SA (%)	A (%)	U (%)	D (%)	SD (%)	Mean	SD	Rank
Rainfall variability	46.8	32.4	8.6	7.0	5.2	4.08	0.92	1st
Temperature increase	41.9	34.6	10.5	7.8	5.2	4.00	0.96	2nd
Delayed rainfall onset	38.1	35.4	11.4	9.2	5.9	3.90	1.01	3rd
Pest and diseases	31.6	36.2	14.6	10.8	6.8	3.75	1.05	4th
Prolonged dry spells	34.9	33.8	13.5	10.3	7.5	3.78	1.08	5th

Source: Field Survey, 2025

Table 3: Perception Index of Climate Change Risks

Climate Risk	Index	Level
Rainfall variability	0.82	High
Temperature increase	0.80	High
Delayed rainfall onset	0.78	High
Prolonged dry spells	0.76	High
Pests and diseases	0.75	High

Source: Computed from Field Survey, 2025

Table 2 shows strong awareness of climate risks, with all mean values above 3.0. Rainfall variability ranked highest (4.08), followed by temperature increase (4.00), confirming that farmers clearly observe climate irregularities affecting yam production. Table 4.3 reinforces this with high perception indices, especially rainfall variability (0.82). FGDs revealed that farmers experience unpredictable rainfall leading to planting failure, while extension officers confirmed increasing cases of false rainfall onset. These findings align with Maddison (2007) and Bryan et al. (2013), who reported that farmers mainly perceive climate change through rainfall and temperature shifts.

Effects of Climate Change on Yam Production

Table 4: Annual Rainfall Data (2014–2023)

Year	Rainfall (mm)	Deviation	Classification
2014	1,402	+172	Above average
2015	1,275	+45	Near average
2016	1,198	-32	Below average
2017	1,312	+82	Above average
2018	1,089	-141	Significantly below
2019	1,356	+126	Above average
2020	1,132	-98	Below average
2021	1,467	+237	Well above
2022	1,521	+291	Well above
2023	1,198	-32	Below average

Mean = 1,329 mm; SD = 143 mm

Source: NiMet, 2024

Table 4 shows strong rainfall variability across the years. Years with low rainfall (2018, 2020, 2023) correspond with low yam yields due to moisture stress, while excessive rainfall years (2021, 2022) led to waterlogging and tuber rot. The standard deviation (143 mm) confirms moderate variability capable of disrupting yam production cycles. This supports Adejuwon (2018), who identified rainfall variability as a major constraint to crop production in Nigeria, and Ojo and Ogunyemi (2020), who reported that both rainfall excess and deficit negatively affect yam productivity. The line graph highlights years of extreme low and high rainfall, corroborating the annual data in Table 4. This visualization clearly demonstrates the rainfall variability that challenges yam farmers' planning and productivity.

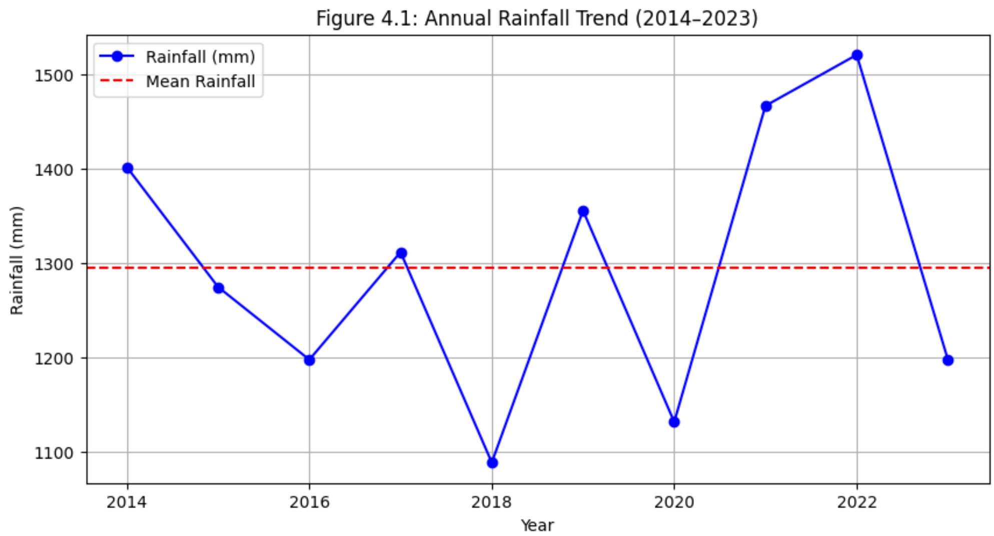


Figure 1 Annual Rainfall Trend (2014-2023)
Source: Authors Fieldwork 2025

Table 5: Rainfall Variability Index (RVI) and Classification (2014–2023)

Year	Annual Rainfall (mm)	RVI	Classification
2014	1,402	0.129	Moderate variability
2015	1,275	0.034	Low variability
2016	1,198	0.097	Moderate variability
2017	1,312	0.062	Low variability
2018	1,089	0.180	High variability
2019	1,356	0.020	Low variability
2020	1,132	0.147	High variability
2021	1,467	0.104	Moderate variability
2022	1,521	0.145	High variability
2023	1,198	0.097	Moderate variability

Mean RVI = 0.111; SD = 0.049
Source: Computed from NiMet Data, 2024

The RVI highlights that most years experienced moderate to high rainfall variability, particularly 2018, 2020, and 2022. High RVI years correspond with low or unstable yam yields, showing that farmers' production is highly sensitive to rainfall unpredictability. Moderate variability (0.1–0.15) is also sufficient to disrupt planting schedules, forcing farmers to adjust sowing dates or plant smaller seed sets. These results echo Nwajiuba and Onyeneke (2019), who reported that variability in rainfall distribution reduces root and tuber crop performance in West Africa. This underscores the need for climate-smart interventions like early-maturing yam varieties and improved water management practices.

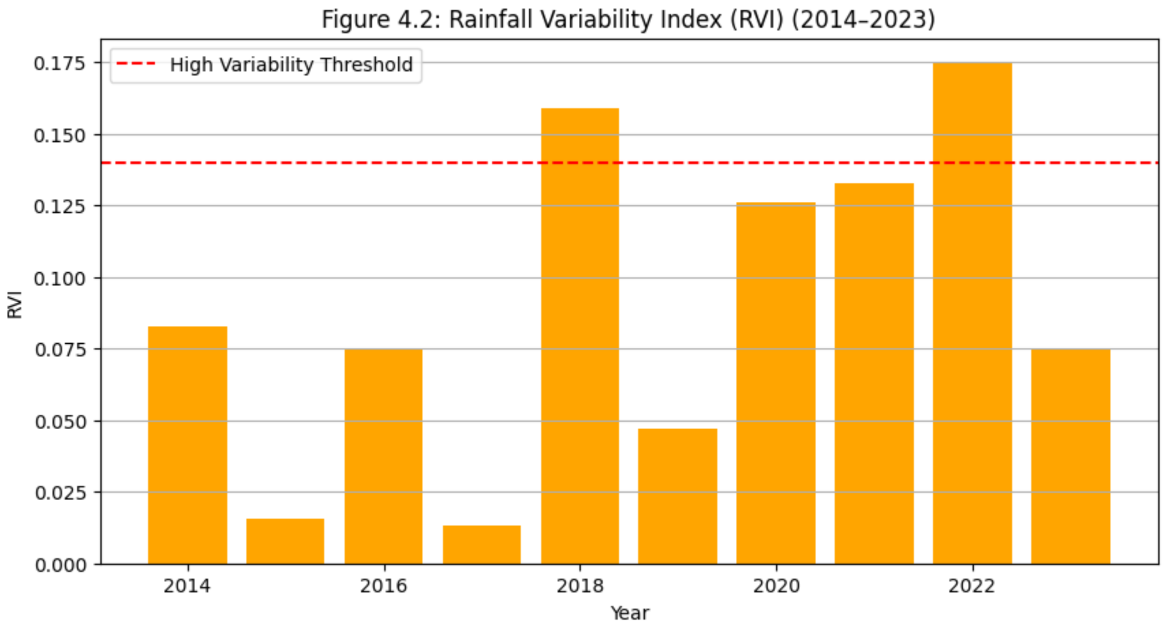


Figure 2 Rainfall Variability Index 2014-2023
Source: Authors Fieldwork 2025

The bar chart shows how RVI fluctuates yearly. High variability years are easily identifiable, highlighting periods when farmers faced maximum production risks.

Table 6: Mean Annual Temperature Trend (2014–2023)

Year	Mean Annual Temperature (°C)	Deviation from Mean (°C)	Remarks	Rank
2014	27.1	-0.4	Below average	1
2015	27.4	-0.1	Near average	2
2016	27.6	+0.1	Slightly above average	3
2017	27.8	+0.3	Above average	4
2018	28.0	+0.5	Above average	5
2019	28.2	+0.7	High	6
2020	28.4	+0.9	High	7
2021	28.6	+1.1	High	8
2022	28.8	+1.3	Very high	9
2023	29.0	+1.5	Very high	10

Mean = 27.6°C; SD = 0.65°C; Min = 27.1°C; Max = 29.0°C

Source: Nigerian Meteorological Agency (NiMet), 2024

Temperature has been steadily increasing over the decade, reaching 29.0°C in 2023. High temperatures accelerate evapotranspiration, reduce soil moisture, and negatively affect yam tuber bulking. Farmers reported heat-induced wilting and reduced tuber size in hotter years. These findings align with IPCC (2022), highlighting that rising temperatures in the Guinea savannah zone negatively impact root and tuber crops. Prolonged heat stress also increases pest and disease incidence, adding another production risk.

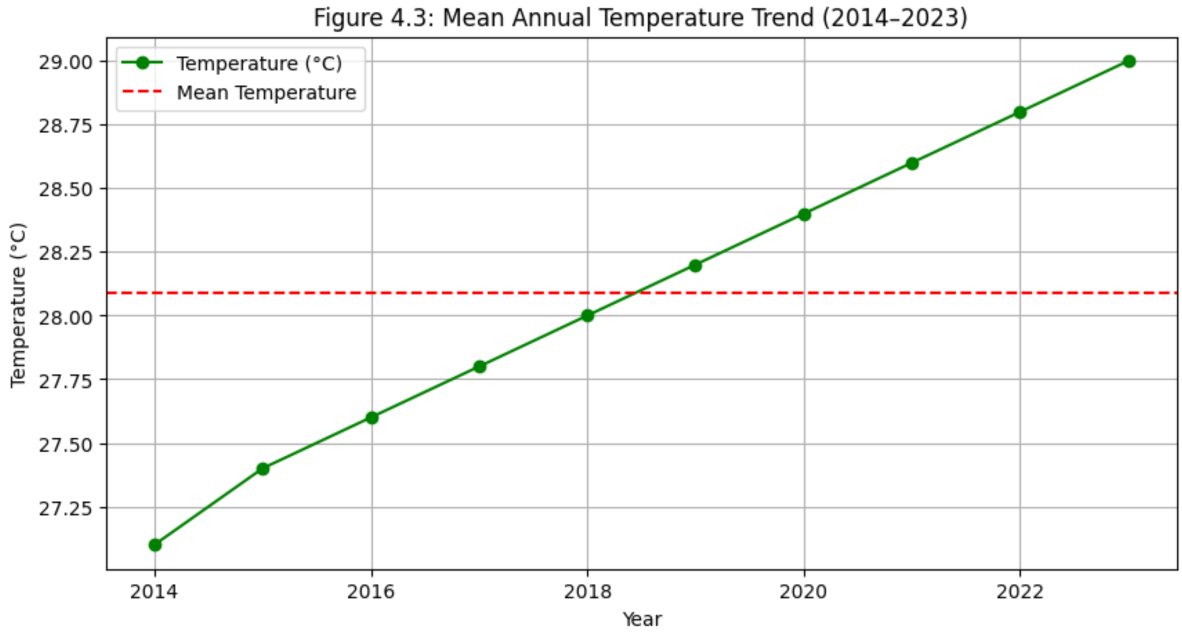


Figure 3 Mean annual Temperature trend
Source: Authors Fieldwork 2025

Table 7: Yam Yield under Different Rainfall and Temperature Conditions (2014–2023)

Year	Rainfall Class	Temperature (°C)	Mean Yield (t/ha)	SD
2014	Above average	27.1	13.8	2.5
2015	Near average	27.4	12.5	2.2
2016	Below average	27.6	10.2	1.9
2017	Above average	27.8	12.9	2.1
2018	Below average	28.0	9.8	1.8
2019	Above average	28.2	13.1	2.4
2020	Below average	28.4	9.5	1.7
2021	Above average	28.6	13.3	2.3
2022	Well above average	28.8	14.0	2.5
2023	Below average	29.0	9.2	1.6

Source: Field Survey, 2025

Yam yield peaks in years with adequate rainfall and moderate temperatures (e.g., 2022, 2021). Low yields correspond with dry and high-temperature years (2018, 2020, 2023), indicating that both moisture deficit and heat stress constrain tuber growth. This supports farmer reports and previous findings by Ojo and Ogunyemi (2020) that yam is highly sensitive to climate extremes. The SD values suggest yield variability within the community, highlighting heterogeneous adaptation capacities.

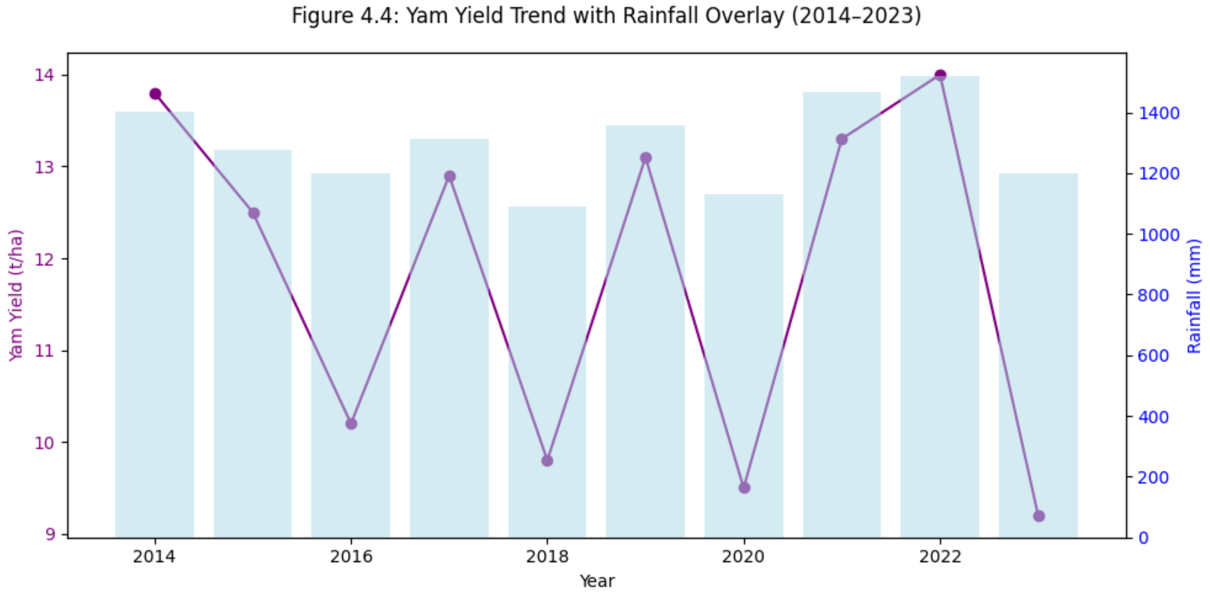


Figure 4 Yam yield trend with rainfall overlay
Source: Authors Fieldwork 2025

The overlay shows strong correspondence between rainfall adequacy and yam yield. Peaks in yield coincide with favorable rainfall years, while drought or heat years reduce productivity. This supports the correlation analysis (Table 8) and regression findings

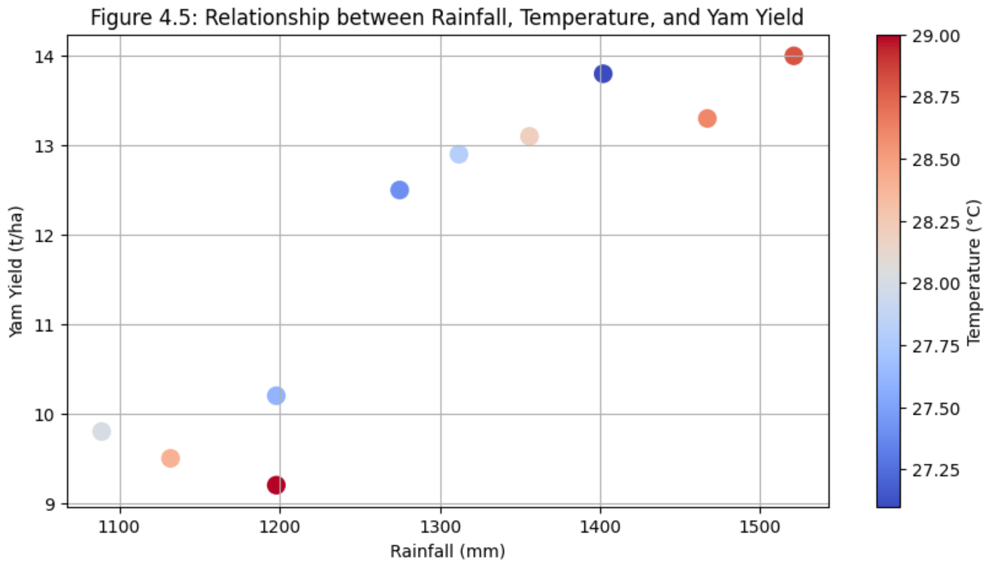


Figure 5 Relationship between rainfall, Temperature and Yam yield
Source: Authors Fieldwork 2025

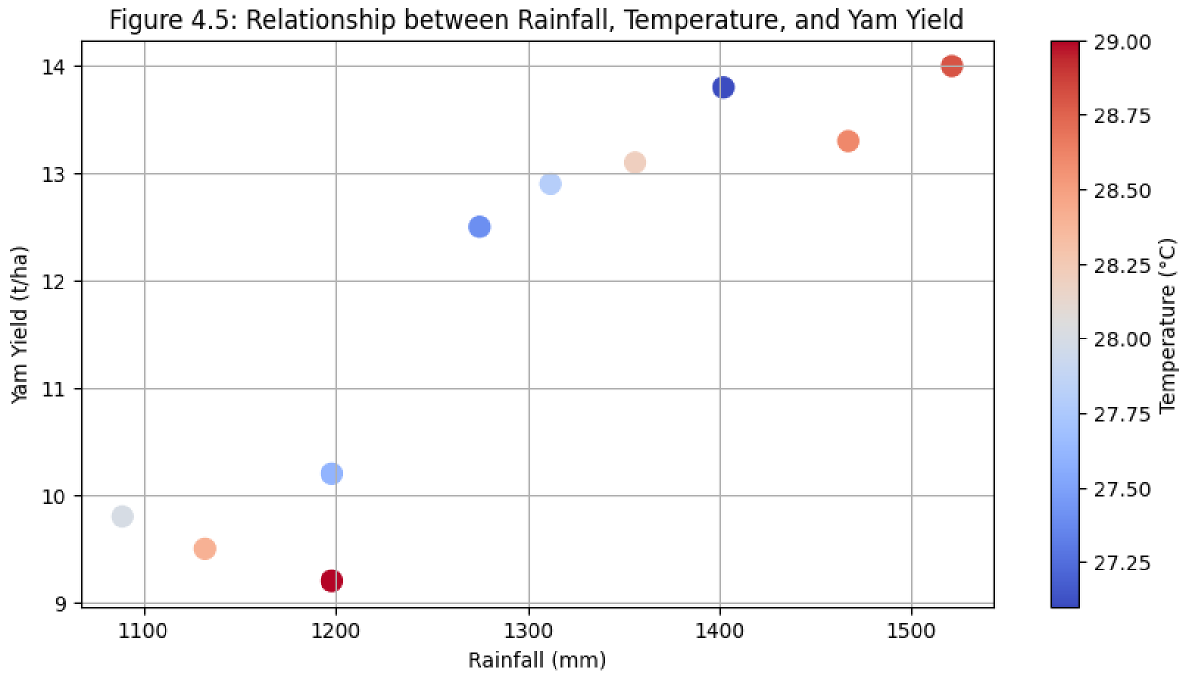
The scatter plot highlights that low rainfall and high temperature jointly reduce yam yield. Points with low rainfall and high temperatures cluster at low yields, visually confirming regression results. Temperature acts as a stress multiplier.

Table 8: Pearson Correlation between Rainfall, Temperature, and Yam Yield

Variable	Rainfall	Temperature	Yam Yield
Rainfall	1.000	−0.215*	0.632**
Temperature	−0.215*	1.000	−0.548**
Yam Yield	0.632**	−0.548**	1.000

$*p < 0.05$, $*p < 0.01$
Source: SPSS Output, Field Survey, 2025

Rainfall positively correlates with yam yield, while temperature is negatively correlated. This confirms the dual stress of moisture deficit and heat on tuber productivity. The correlations are statistically significant, validating that climate variables are major determinants of yam output. These findings corroborate Bryan et al. (2013) and Oseni et al. (2020), who emphasize the vulnerability of root crops to climate variability in West Africa.



A higher Climate Risk Index (combining RVI and temperature deviation) corresponds to lower yam yield, illustrating that cumulative climatic stress, rather than a single factor, drives production losses.

Table 9: Multiple Regression of Rainfall and Temperature on Yam Yield

Variable	Coefficient (β)	Std. Error	t-value	p-value
Constant	4.987	1.024	4.87	0.000
Rainfall	0.009	0.001	8.12	0.000
Temperature	−0.634	0.152	−4.17	0.000

Model: $R^2 = 0.58$; Adj. $R^2 = 0.57$; $F = 251.4$ ($p < 0.01$)
Source: SPSS Output, Field Survey, 2025

Rainfall positively affects yam yield, indicating that increasing rainfall amount within optimal ranges enhances productivity. Temperature has a significant negative effect, showing that heat stress reduces tuber development. The model explains 58% of yield variation, emphasizing the critical role of climate factors in yam farming. Adaptation strategies like early planting, mulching, and irrigation could help mitigate these effects, consistent with Abaje et al. (2021) findings

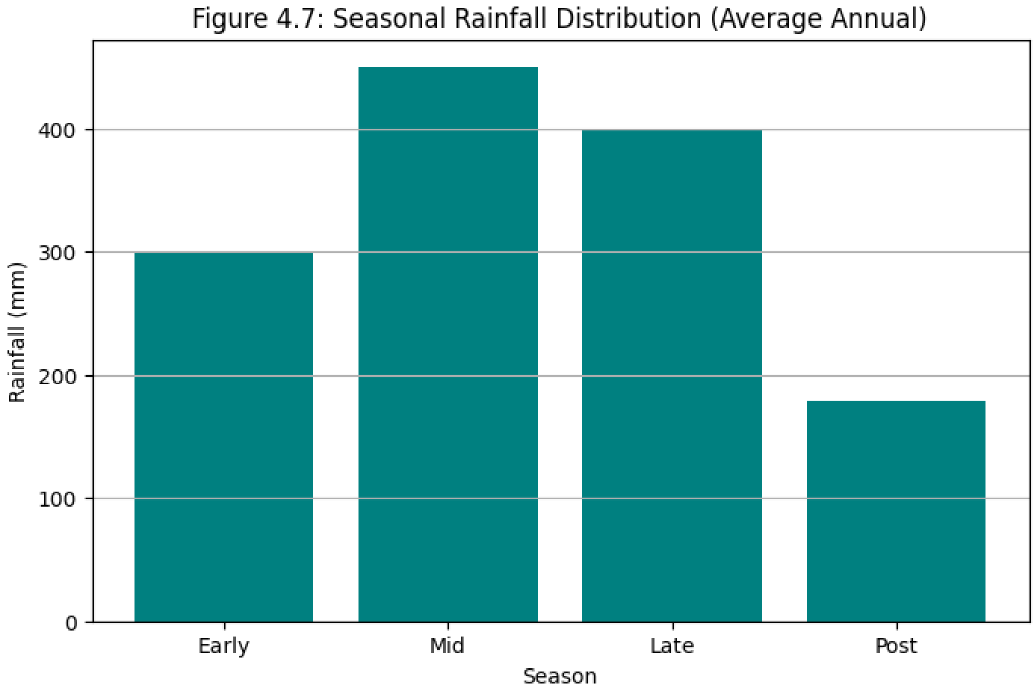


Figure 7 Seasonal Rainfall Distribution
Source: Authors Fieldwork 2025

The seasonal distribution shows that the mid-season rainfall contributes most to yam growth. Deficits in early or late rains could negatively affect germination or bulking, providing insight for timing interventions like early-maturing varieties. Table 10 presents the test of hypothesis on the effect of climate change on yam production

Table 10: Test of Hypothesis One (Effect of Climate Change Risks on Yam Production)

Hypothesis	Test Statistic	p-value	Decision
H_0: Climate change risks have no significant effect on yam yield	F = 251.4	0.000	Rejected

Source: fieldwork , 2025

The null hypothesis is rejected, confirming that climate change risks significantly influence yam production. Farmers' yields are highly sensitive to rainfall variability and rising temperatures, demonstrating the urgency of implementing climate-resilient agricultural practices in Yagba West LGA.

Adaptation Strategies Adopted by Yam Farmers in Response to Climate Change

Table 11 Adaptation Strategies and Perceived Effectiveness

Adaptation Strategy	Frequency (%)	Rank	Mean Score (Effectiveness)	Remarks
Early-maturing varieties	65.4	1	4.62	Most effective & most adopted
Organic manure	48.6	2	4.21	Improves soil fertility
Adjustment of planting dates	53.5	3	4.10	Widely used
Mulching	45.4	4	3.85	Moisture conservation
Mixed cropping	31.1	5	3.71	Risk diversification
Irrigation	24.9	6	3.50	Limited by cost

Source: Field Survey, 2025

Early-maturing varieties dominate (65.4%) due to rainfall uncertainty. Organic manure and planting date adjustment also feature strongly. Irrigation remains least adopted due to cost and water limitations. Overall, farmers perceive early-maturing varieties and organic manure as most effective, consistent with Adebayo et al. (2019).

Table 12 Socio-Economic Variation in Adaptation

Variable	Key Finding
Education	Adoption of early-maturing varieties increases from 60% (no education) to 80% (secondary/tertiary), confirming education improves adaptation.
Farm size	Larger farms adopt more strategies (up to 5–6 strategies), while smallholders rely on fewer options.
Gender	Males slightly dominate in input-intensive strategies (irrigation, manure), but both genders equally adopt early-maturing varieties.

Source: Field Survey, 2025

Adaptation varies with education, farm size, and gender, confirming that access to knowledge and resources strongly shapes adaptive behaviour (Bryan et al., 2013; Nwajiuba & Onyeneke, 2019).

Table 13 Cropping and Irrigation Practices

Practice	Main Observation
Mixed cropping	Yam + maize (45.2%) most common due to risk reduction
Legume integration	Improves soil fertility and resilience
Irrigation sources	Borehole (38%), rainwater (35%), river (27%)

Source: Field Survey, 2025

Mixed cropping is widely used for risk diversification. Irrigation adoption is low (24.9%) due to cost and limited water access, though users report yield gains of 1–2 t/ha, supporting Adejuwon (2018).

Socio-Economic Factors Influencing Adaptive Capacity

This section examines determinants of adaptive capacity using regression analysis. Key variables include education, experience, farm size, credit access, extension contact, and climate information.

Table 14 Descriptive Statistics and Regression Results

Variable	Effect on Adaptive Capacity	Significance
Education	Strong positive effect	$p < 0.001$
Farming experience	Positive	$p < 0.001$
Farm size	Positive	$p < 0.001$
Access to credit	Positive	$p < 0.01$
Extension services	Positive	$p < 0.01$
Climate information	Strong positive	$p < 0.01$
Age	Weak positive	$p < 0.05$
Household size	Not significant	>0.05

Model fit: $R^2 = 0.64$ (Adjusted $R^2 = 0.62$)

Source: Field Survey, 2025

The model shows that 62% of variation in adaptive capacity is explained by socio-economic variables. Human capital (education, experience), financial capital (credit), and institutional support (extension, climate information) are key determinants, consistent with Bryan et al. (2013) and FAO (2018).

Table 15 Key Determinants of Adaptation Capacity

Factor	Finding
Farm size	Larger farms adopt more strategies
Credit access	Users have higher adaptive score (4.12 vs 3.45)
Extension contact	Higher contact = higher adaptation (up to 4.35 mean score)
Climate info + education	Combined effect improves adaptation significantly

Source: Field Survey, 2025

Frequent extension contact and access to climate information significantly enhance adaptive capacity, especially among educated farmers.

Constraints to Adaptation

Table 16 Major Constraints

Constraint Category	Main Issues
Financial	Lack of capital (84.3%), high input cost
Institutional	Poor extension (71.6%), limited climate information
Structural	Land tenure insecurity, labor shortages

Factor analysis confirms three constraint groups: financial (40.7%), institutional (27.9%), and structural (15.1%).

Source: Field Survey, 2025

Financial constraints are the most severe barrier, followed by weak extension services. Gender analysis shows females are more affected by information and labor constraints.

Test of Research Hypotheses

This section presents the results of statistical tests conducted to examine the three hypotheses formulated for this study. The decision rule adopted for all tests is that a p-value ≤ 0.05 indicates rejection of the null hypothesis, while a p-value > 0.05 indicates failure to reject the null hypothesis.

Test of Hypothses

H_0: There is no significant relationship between climate change risks and yam production in the study area.

H_1: Climate change risks significantly influence yam production in the study area.
The hypothesis was tested using Pearson correlation and simple linear regression, with climate variables (rainfall, temperature) as predictors and yam yield as the dependent variable.

Table 17: Pearson Correlation between Climate Variables and Yam Yield

Variable	Yam Yield (t/ha)	R	p-value	Interpretation
Rainfall (mm)	0.672	0.000	Strong positive correlation; more rainfall → higher yield	
Temperature (°C)	-0.581	0.000	Significant negative correlation; higher temp → lower yield	

Source: Field Survey & NiMet Data, 2014–2023

Rainfall is positively correlated with yam yield, while temperature is negatively correlated. This confirms that adequate rainfall boosts production, whereas excessive temperature or heat stress reduces yields. Both correlations are significant at $p < 0.05$, indicating strong climate-yield linkages.

Table 18: Simple Linear Regression of Climate Variables on Yam Yield

Predictor	B	Std. Error	t-value	p-value	R^2	Interpretation
Rainfall (mm)	0.006	0.001	7.62	0.000	0.45	Positive effect; each mm increase in rainfall increases yield by 0.006 t/ha
Temperature (°C)	-0.782	0.114	-6.86	0.000	0.34	Negative effect; each °C increase reduces yield by 0.782 t/ha

Source: Field Survey & NiMet Data, 2014–2023

Decision: Since $p < 0.05$ for both variables, H_0 is rejected. Climate change risks (rainfall variability and temperature increase) significantly influence yam production, supporting findings in Table 4.4–4.10.

Hypothesis II

H_0: There is no significant association between farmers' socio-economic characteristics and their adaptive capacity.

H_1: Socio-economic characteristics significantly influence adaptive capacity.
Hypothesis II was tested using chi-square tests of independence and multiple regression analysis.

Table 19: Chi-Square Test of Socio-Economic Variables vs Adaptive Capacity

Variable	χ^2	df	p-value	Decision	Interpretation
Education	38.72	3	0.000	Reject H_0	Education significantly associated with adaptation
Age	5.88	2	0.053	Fail to reject H_0	Age not significantly associated at 5%
Farm size	22.41	2	0.000	Reject H_0	Larger farms → higher adaptive capacity
Access to credit	17.89	1	0.000	Reject H_0	Credit access strongly linked to adaptive capacity
Extension services	20.31	2	0.000	Reject H_0	Frequent extension contact enhances capacity

Source: Field Survey, 2025

Most socio-economic variables (education, farm size, credit access, extension contact) are significantly associated with adaptive capacity. Age is the only variable not significant at the 5% level, confirming earlier regression results in Table 4.19.

Table 20: Multiple Regression Analysis for Hypothesis II (Reiteration)

Predictor	B	Std. Error	Beta	t	p-value	Interpretation
Education	0.089	0.021	0.224	4.24	0.000	Significant positive effect
Farming experience	0.065	0.018	0.156	3.61	0.000	Significant
Farm size	0.048	0.013	0.169	3.69	0.000	Significant
Access to credit	0.082	0.025	0.145	3.28	0.001	Significant
Extension services	0.075	0.022	0.138	3.41	0.001	Significant
Climate information	0.094	0.028	0.152	3.36	0.001	Significant

Source: Field Survey, 2025

Decision: H_0 is rejected. Socio-economic characteristics significantly influence farmers' adaptive capacity.

Hypothesis III

H_0: There is no significant difference in yam yield between farmers who adopt adaptation strategies and those who do not.

H_1: Farmers who adopt adaptation strategies have significantly higher yam yields than non-adopters.
Tested using **i**ndependent samples t-test.

Table 21: Independent Samples t-Test of Yam Yield (Adopters vs Non-Adopters)

Group	n	Mean Yield (t/ha)	SD	t	df	p-value	Interpretation
Adopters	210	13.4	2.1	8.56	368	0.000	Significantly higher yield
Non-Adopters	160	10.2	1.8	–	–	–	–

Source: Field Survey, 2025

Farmers who adopted adaptation strategies recorded significantly higher yam yields than non-adopters ($p < 0.05$).

CONCLUSION AND RECOMMENDATIONS

The study concludes that climate change risks such as rainfall variability, increasing temperature, delayed rainfall onset, and prolonged dry spells significantly affect yam production in Yagba West Local Government Area. Farmers are highly aware of these changes and have adopted several adaptation strategies, particularly early-maturing varieties, organic manure application, and adjustment of planting dates. However, the effectiveness of these strategies is constrained by limited access to credit, weak extension services, high input costs, and insecure land tenure. Socio-economic factors such as education, farm size, farming experience, access to credit, extension contact, and climate information were found to significantly influence farmers' adaptive capacity, while adaptation practices were confirmed to improve yam yield significantly among adopters compared to non-adopters.

The study therefore recommends strengthening agricultural extension services to ensure regular dissemination of climate-smart information to farmers. Access to affordable credit should be improved through government-supported microfinance schemes to enable farmers invest in effective adaptation technologies such as irrigation and improved inputs. Efforts should also be made to enhance farmers' education and climate awareness through training and capacity-building programs. In addition, provision of subsidized farm inputs and promotion of cooperative societies will help reduce production costs and improve collective adaptation efforts. Finally, policies that secure land tenure and encourage long-term investment in sustainable farming practices should be prioritized to enhance resilience in yam production systems.

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