

Climate Adaptation Decisions and Economic Returns Among Smallholder Cassava Farmers in Ekiti State, Nigeria

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ABSTRACT

Climate variability poses substantial risks to smallholder agriculture in Nigeria, making adaptation decisions and their economic implications increasingly important. This study examined climate adaptation decisions and farm profitability among smallholder cassava farmers in Ekiti State, Nigeria. A multistage sampling procedure was used to select 120 cassava farmers, and primary data were collected using a structured questionnaire. Descriptive statistics, farm budgeting, binary logistic regression, and Cobb-Douglas multiple regression were employed for analysis. Results showed that all respondents perceived changes in climatic conditions, with 77.5% reporting increased temperatures. Soil conservation was the most frequently reported adaptation practice (36.7%), followed by chemical and pesticide use (21.7%) and mulching (18.3%). Major adaptation constraints included inadequate information (81.7%), inadequate funding (79.2%), inadequate technological know-how (78.3%), and poor irrigation potential (61.7%). Logistic regression results indicated that age, income, farm size, access to credit, inadequate funding, and perceived temperature were significantly associated with adaptation decisions. Cassava production was profitable, generating total revenue of ₦683,958.33/ha and net farm revenue of ₦504,058.34/ha, with a gross return-cost ratio of 3.802. Farming experience, household income, farm size, planting materials, and agrochemical use were positively associated with profitability, while family labour showed a negative association. The findings highlight the importance of strengthening farmers' access to climate information, technical knowledge, appropriate financial services, and production resources. Such support could enhance farmers' capacity to implement suitable climate responses while sustaining economically viable cassava production under changing climatic conditions.

Keywords: Climate adaptation; Cassava production; Farm profitability; Smallholder farmers; Climate change; Ekiti State.

1. Introduction

Climate variability and long-term climate change increasingly affect agricultural production and rural livelihoods in Africa, particularly in rainfed farming systems. Shifts in rainfall timing and distribution, rising temperatures, drought and flooding can disrupt farm operations, crop performance and household income. The vulnerability of African agriculture is intensified by socioeconomic and institutional constraints that limit farmers' capacity to respond to climate-related risks [1].

Evidence also shows that the livelihood effects of climate shocks are uneven because adaptive capacity depends on household assets, access to information, finance and other forms of support [2]. These conditions make farm-level adaptation an economic as well as an agronomic decision.

Cassava is an important crop for examining these relationships in Nigeria because it contributes to food security, household income and rural employment. Although cassava is often described as relatively tolerant of climatic stress, its performance can still be affected by rainfall variability, temperature, pests, diseases and access to production inputs. Continental modelling suggests that cassava may retain comparatively high climatic suitability in many African locations, while also facing location-specific biotic and abiotic risks that require adaptive management [3]. Nigerian studies report responses such as improved or alternative varieties, crop diversification, modified planting arrangements, soil-management practices and changes in input use [4,5]. Evidence from Abia State similarly links adaptation practices with cassava productivity and farmers' socioeconomic characteristics [6]. The ability to adopt such practices is shaped by farmers' socioeconomic characteristics, resource endowments and institutional access. Evidence from southwestern Nigeria indicates that education, income, farming experience, farm size, land tenure, cooperative membership, extension contact, credit access and climatic conditions can influence adaptation choices [4].

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Studies from other parts of Nigeria likewise identify limited finance, weak extension contact and inadequate climate information as important constraints [5,7]. Regional evidence from West Africa further shows that access to credit, extension services and farmer organisations can influence the adoption of climate-smart agricultural technologies and associated welfare outcomes [8]. These findings indicate that a technically suitable option may remain beyond a farmer's reach when its financial, labour or information requirements exceed available resources. A further issue is the definition of adaptation itself. A change in farm practice should be treated as climate adaptation only when it is undertaken in response to experienced or anticipated climate-related conditions and is consistent with the study's measurement framework. For example, fertiliser or agrochemical use may be a routine production decision rather than a climate response unless farmers identify a climate-related reason for using it. Maintaining this distinction reduces the risk of overstating adaptation by classifying ordinary agronomic practices as climate responses [4,7].

Adaptation may also alter production costs and farm returns. Farmers can incur additional expenditure on labour, planting materials, soil or water management, fertiliser, agrochemicals and other inputs when responding to climate risks. The decision to adopt therefore involves a balance between immediate costs and the expected benefit of reducing production risk or protecting output. Evidence from cassava farmers in Southwest Nigeria shows that funding and labour constraints can limit adaptation and that adaptation choices, rainfall and climate-information access are associated with net revenue alongside socioeconomic and production characteristics [7].

Profitability analysis provides a complementary way to assess the economic context in which adaptation occurs. Net farm revenue measures the difference between the value of output and the production costs included in the farm budget, and therefore provides an indication of the returns generated by cassava production under the specified accounting assumptions. Recent evidence from Ekiti State reports positive returns from cassava production while also showing that production costs, market conditions and resource-use efficiency influence farm performance [9]. Profitability estimates nevertheless remain context-specific because they depend on the production season, farm size, input and output prices, labour valuation and treatment of fixed and variable costs.

The relationship between adaptation and profitability must therefore be interpreted carefully. Better-resourced farmers may be both more capable of adopting climate responses and more likely to earn higher returns, so a statistical association between adaptation and profit does not by itself establish that adaptation caused the observed economic outcome. Similarly, frequently reported constraints identify important problems but do not establish independent causal effects. Multivariate models can help identify characteristics associated with adaptation decisions and profitability after controlling for other observed factors, but cross-sectional estimates should still be interpreted as associations rather than causal effects.

Existing studies provide useful evidence but leave room for an integrated farm-level assessment in Ekiti State. Research in Osun State has examined determinants of adaptation choices and cassava productivity [4], while studies across Southwest Nigeria have linked climate adaptation, constraints and net revenue [7].

Other work has investigated climate impacts and adaptation among cassava farmers in Ebonyi and Abia States [5,6], and recent research has assessed the profitability and efficiency of cassava production in Ekiti State [9]. These studies establish the relevance of adaptation, resource constraints, productivity and profitability, but their findings differ by location, sample and analytical approach. Examining these dimensions together in Ekiti State can therefore provide locally specific evidence on reported adaptation practices, constraints, economic returns and associated farm characteristics.

Against this background, this study examined climate adaptation decisions and farm profitability among smallholder cassava farmers in Ekiti State, Nigeria. Specifically, it aimed to: (i) describe the climate adaptation practices reported by cassava farmers; (ii) examine socioeconomic, farm and institutional characteristics associated with adaptation decisions; (iii) estimate the profitability of cassava production; and (iv) examine socioeconomic, production and adaptation-related characteristics associated with farm profitability.

2. Materials and methods

2.1 Study area

The study was conducted in selected cassava-producing communities in Ekiti State, southwestern Nigeria. Ekiti State lies in Nigeria's tropical zone and is bordered by Kwara and Kogi States to the north, Osun State to the west, and Ondo State to the east and south. The State covers approximately 5,888 km² and has a predominantly agrarian economy. Agriculture is an important source of employment and household income, and cassava is widely cultivated across the State.

Ekiti State has a tropical climate characterised by distinct wet and dry seasons. The rainy season generally extends from April to October, while the dry season occurs from November to March. Mean temperatures are commonly within the range of about 21°C-28°C, with relatively high humidity. The southern part of the State is mainly tropical forest, while the northern margins contain elements of derived savanna. These ecological conditions support the cultivation of cassava, maize, yam, rice, plantain, cocoa and oil palm.

Cassava was selected because it is widely cultivated for both household consumption and commercial purposes and supplies raw material for products such as gari, starch, chips and livestock feed. Its importance to farm households and agro-processing activities makes it suitable for analysing climate-response decisions and farm-level economic performance. Recent evidence from Ekiti State also confirms continuing interest in the profitability and efficiency of cassava production [9].

2.2 Sampling and data collection

A multistage procedure selected 120 cassava farmers. Stage one involved four purposively selected LGAs because they have a high concentration of cassava-farming households. The second stage involved randomly selecting three communities within each LGA and ten farmers in each community, yielding 12 communities and 10 cassava farmers per community, for a total of 120 respondents. A structured questionnaire collected socioeconomic and farm characteristics, climate perceptions, adaptation practices, and barriers. Production expenditure and revenue provided farm budget information. Climate variables represented farmers' perceptions.

2.3 Analytical framework

2.3.1 Descriptive Statistics

Descriptive statistics, including means, standard deviations, frequencies and percentages, were used to summarise respondents' socioeconomic characteristics, climate perceptions, reported adaptation practices and barriers to adaptation.

2.3.2 Profitability measurement

Cassava profitability was assessed using gross revenue, total variable cost, gross margin, total production cost and net farm revenue. Gross revenue was calculated as output quantity multiplied by the prevailing farm-gate price received by each farmer. Variable costs included planting materials, labour, fertiliser, agrochemicals, harvesting, transportation and other variable production expenses. Gross margin was calculated as gross revenue minus total variable cost, while total production cost was the sum of variable and fixed costs. Net farm revenue, used as the principal measure of profit, was calculated as gross revenue minus total production cost. The gross return-cost ratio was computed as gross revenue divided by total production cost.

The measures were specified as follows:

$$GR_i = P_{yi}Q_{yi}$$

$$TVC_i = \sum_{k=1}^n C_{ki}$$

$$GM_i = GR_i - TVC_i$$

$$TC_i = TVC_i + TFC_i$$

$$NFI_i = GR_i - TC_i$$

where GR_i is gross revenue, P_{yi} is the unit price of cassava output, Q_{yi} is the quantity of cassava produced, TVC_i is the total variable cost, TFC_i is total fixed cost, TC_i is total production cost, GM_i is gross margin and NFI_i is net farm income for the i -th farm. In addition, the benefit-cost ratio was calculated as $BCR_i = GR_i/TC_i$ to indicate the revenue generated per naira of total production cost.

2.3.3 Logistic Regression

Binary logistic regression was used to examine factors associated with farmers' climate-adaptation decisions. The method is appropriate when the dependent variable is binary and models the probability of an outcome as a function of explanatory variables [15]. In this study, $Y = 1$ if a cassava farmer reported adapting to climate change and $Y = 0$ otherwise.

The logit probability function is expressed as:

$$P(y = 1) = P = \frac{e^{(\beta_0 + \beta_1 x_1 + \dots + \beta_n x_n)}}{e^{(\beta_0 + \beta_1 x_1 + \dots + \beta_n x_n)} + 1}$$

$$P(y = 0) = 1 - P = \frac{1 - \{e^{(\beta_0 + \beta_1 x_1 + \dots + \beta_n x_n)}\}}{e^{(\beta_0 + \beta_1 x_1 + \dots + \beta_n x_n)} + 1}$$

From the equations above,

$y = 1$ represents the probability of adopting strategies, and equals P

$y = 0$ represents the probability of not adopting strategies, and equals $1 - P$

β = Coefficient

X = Explanatory variables

$$\left[\frac{p}{1-p} \right] \text{ can be written as : } \left[\frac{Y}{1-Y_i} \right]$$

$$= \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \dots + \beta_n X_n + \varepsilon$$

Where,

Y = Probability of adopting strategies

$1-Y$ = probability of not adopting strategies

i = i^{th} observation in the sample

β_0 = the intercept

$\beta_1 - \beta_n$ = the coefficients

$X_1 - X_{11}$ = independent variables

ε = the error term.

The independent variables were specified as follows:

X_1 = Age (Continuous- years)

X_2 = Gender (Dummy: 1 = Male and 0 = Female)

X_3 = Farmer income (Continuous- Naira)

X_4 = Household size (Discrete – number)

X_5 = Access to extension services (Dummy: 1= access and 0, otherwise)

X_6 = Farm size (Continuous- ha)

X_7 = Access to credit (Dummy: 1= access and 0, otherwise)

X_8 = Access to climate information (Dummy: 1= access and 0, otherwise)

X_9 = Level of temperature (Dummy: 1= moderate and 0, otherwise)

X_{10} = Inadequate funding (Dummy: 1= Yes and 0, otherwise)

X_{11} = Inadequate technology (Dummy: 1= Yes and 0, otherwise)

e_i = Disturbance error

2.3.4 Multiple Regression Analysis

A Cobb-Douglas multiple regression model was used to examine factors associated with cassava farm profitability. Net farm revenue was the dependent variable, and the explanatory variables represented socioeconomic characteristics, production inputs, labour use and perceived temperature conditions.

The regression model is specified as follows:

$$\ln Y = \ln(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \dots + \beta_{15} X_{15})$$

Where, Y = Net Revenue (TR – TC)

$\ln$ = natural logarithm

β_0 = Constant (Intercept)

X_1 = Age (Continuous – years)

X_2 = Gender (Dummy 1=Male and 0=Female)

X_3 = Marital status (Dummy 1= Married, and 0 otherwise)

X_4 = Educational level (Discrete – number of years)

X_5 = Farming experience (Continuous – number of years)

X_6 = Farmer income (Continuous- Naira)

X_7 = Farm size (Continuous – ha)

X_8 = Planting materials (stems) (Continuous – number)

X_9 = Perceived temperature (Dummy 1=Moderate and 0, otherwise)

X_{10} = Family labour application (Dummy: 1= Yes and 0, otherwise)

X_{11} = Hired labour application (Dummy: 1= Yes and 0, otherwise)

X_{12} = Agrochemical application (Dummy: 1= Yes and 0, otherwise)

$\beta_1 \dots \beta_{12}$ = coefficients of the independent variables.

3 Results and Discussion

3.1 Socioeconomic and farm characteristics

Table 1 presents the respondents' socioeconomic and farm characteristics. The sample was predominantly male (85.0%), while the mean age of the respondents was 43.45 years. More than half of the farmers (52.5%) were within the 41–50-year age group, indicating that cassava production in the study area was largely undertaken by farmers within the economically active age range. The mean farming experience was 25.69 years, suggesting considerable accumulated experience in cassava production.

Farm holdings were generally small: mean farm size was 1.12 ha and 68.3% of respondents cultivated one hectare or less. This pattern is consistent with the smallholder structure of cassava production in southwestern Nigeria. The mean farm size was lower than the 2.02 ha reported for cassava farmers in Osun State [4], which may reflect differences in land access, sampling locations and household resource endowments.

Institutional support was limited in the sample. Only 24.2% of respondents had access to extension services and 30.0% reported access to credit. These proportions are lower than those reported for cassava farmers in Osun State, where extension and credit access were more widespread [4]. Limited advisory and financial access may restrict farmers' ability to obtain technical information, purchase inputs or finance climate responses. This interpretation is consistent with evidence that inadequate funding and labour requirements constrain adaptation among cassava farmers in Southwest Nigeria [7].

The educational profile was mixed: 21.7% had no formal education, 30.8% had primary education, 27.5% had secondary education and 20.0% had tertiary education. Thus, most respondents had some formal schooling, although only one-fifth had tertiary education. Education can support the interpretation of agricultural information, but its usefulness also depends on whether farmers can access relevant extension and climate services. Previous evidence identifies education among the characteristics associated with cassava farmers' adaptation choices [4].

Table 1: Selected characteristics of respondents

Characteristic	Summary Statistics
Male respondents	85.0%
Age 41–50 years	52.5%
Age in years	43.45 ± 5.82
Farming experience in years	25.69 ± 7.52
Farm size in hectares	1.12 ± 0.75
Farm size at most 1 hectare	68.3%
Access to extension services	24.2%
Access to credit	30.0%
No formal education	21.7%
Primary education	30.8%
Secondary education	27.5%
Tertiary education	20.0%

3.2 Climate perceptions and adaptation practices

All respondents agreed or strongly agreed that local climatic conditions were changing. Increased temperature was reported by 77.5%, declining rainfall by 45.0%, and increased sunshine by 64.1%. The predominance of perceived temperature increases is comparable with evidence from Southwest Nigeria, where rising temperature was widely reported by cassava farmers [7]. A study in Ondo State also identified high temperature and fewer rainfall days among commonly perceived climatic changes [14].

Table 2 presents the reported adaptation practices. Soil conservation was the most frequently reported practice,

adopted by 36.7% of respondents, followed by the use of chemical fertilisers and pesticides (21.7%) and mulching (18.3%). Smaller proportions reported planting different cassava varieties (10.8%), moving production to a different site (8.3%), and changing the area cultivated (4.2%). The results indicate that farmers relied more on within-farm management adjustments than on major changes in farm location or cultivated area.

fertiliser fertiliser The prominence of soil-management practices is consistent with evidence that cassava farmers use both soil and input-management responses to cope with climatic variability. Previous Nigerian research has documented organic and inorganic fertiliser use, crop diversification and multiple crop varieties among reported adaptation practices, with socioeconomic and institutional characteristics influencing the choices made [4].

Only 10.8% of respondents reported planting different cassava varieties, a lower proportion than has been observed in some other Nigerian studies. Evidence from Southwest Nigeria and Ebonyi State indicates more frequent use of alternative or improved varieties among cassava farmers [5,7]. Differences across studies may reflect variation in access to planting materials, extension services, climate information, finance and local production conditions.

A notable result is the gap between high awareness of climate change and the limited uptake of any single adaptation practice. Although all respondents perceived climatic change, no individual practice was reported by a majority. This suggests that awareness alone may be insufficient to produce widespread adoption. Farmers must also be able to finance, understand and implement a practice and perceive it as worthwhile under local conditions [7,8].

Table 2: Adaptation practices among the cassava farmers

Practice	Farmers reporting yes	Percentage
Soil conservation	44	36.7
Chemical fertiliser and pesticide use	26	21.7
Mulching	22	18.3
Planting different varieties	13	10.8
Moving to a different site	10	8.3
Changing cultivated land area	5	4.2

3.3 Factors associated with adaptation decisions

Table 3 presents the logit estimates of the factors associated with farmers' adaptation decisions. Age, income, farm size, access to credit, inadequate funding, and perceived temperature changes were statistically significant, whereas gender, household size, extension contact, inadequate technology, and inadequate information were not significant.

$\beta = 1.325, p < 0.01$ $\beta = 0.291, p < 0.05$ $\beta = 0.181, p < 0.01$ $\beta = 0.110, p < 0.01$. Age had a positive and statistically significant coefficient ($\beta = 1.325; p < 0.001$), indicating that older farmers in the sample had higher odds of reporting adaptation. Income was also positively associated with adaptation ($\beta = 0.291; p = 0.039$), while farm size ($\beta = 0.181; p < 0.001$) and access to credit ($\beta = 0.110; p < 0.001$) were positive and significant. These associations are broadly consistent with evidence that farmers' resources and socioeconomic characteristics influence cassava adaptation choices [4].

The positive association between credit access and adaptation is consistent with wider Nigerian evidence showing that financial access and farm resources can influence climate-response choices [11]. Credit can relax short-term liquidity constraints when adaptation requires expenditure on labour, inputs or other farm investments.

$\beta = 0.023$, $p < 0.01$ Inadequate funding was significant but had a positive coefficient ($\beta = 0.023$; $p = 0.001$). Because this variable represents a reported constraint rather than financial access, the result should not be interpreted as evidence that funding shortages promote adaptation. A more plausible interpretation is that farmers who are actively making adaptation decisions may also be more likely to recognise financing as a binding constraint. Independent evidence identifies insufficient funding as an important barrier to climate adaptation among cassava farmers [7].

$\beta = 0.849$, $p < 0.01$ Perceived temperature change was positively associated with adaptation ($\beta = 0.849$; $p = 0.002$), indicating that farmers who perceived temperature change were more likely to report an adaptation response. This is consistent with evidence that farmers' perceptions of climatic conditions are related to the adaptation choices they make [4,5].

Gender, household size and extension access were not statistically significant in the present model. The result for extension differs from studies in which extension contact significantly influenced adaptation [4,5]. Differences may arise from the relatively low extension coverage in this sample, the way adaptation was measured, or differences in model specification and location. Likewise, the non-significance of inadequate information in the regression should not be read as evidence that information is unimportant; climate-information access has been associated with adaptation and economic outcomes in other studies [7,10].

R^2 The model has a pseudo- R^2 of 0.7404, indicating substantial model fit relative to the null specification. Overall, the results suggest that adaptation decisions among the sampled cassava farmers were associated more strongly with farmers' age, income, farm size, credit access, reported funding constraints, and perceptions of temperature change than with gender, household size, extension access, or the other reported constraints.

Table 3: Logit regression model for adaptation decisions

Variable	Estimate	Standard error	P-value
Age	1.325***	0.173	0.000
Gender	2.12	4.160	0.987
Income	0.291**	0.111	0.039
Household size	2.441	2.071	0.293
Access to extension services	0.136	0.332	0.414
Farm size	0.181***	0.037	0.000
Access to credit	0.110***	0.026	0.000
Inadequate technology	0.128	0.247	0.287
Inadequate funding	0.023***	0.007	0.001
Inadequate information	1.071	2.101	0.988
Temperature	0.849	0.334	0.002
Constant	1.342	0.219	0.000
pseudo $R^2 = 0.7404$			

3.4 Constraints to adaptation

Table 4 presents the major constraints reported by cassava farmers. Inadequate information was the most frequently reported constraint, affecting 81.7% of respondents, followed by inadequate funding (79.2%) and inadequate technological know-how (78.3%). A substantial proportion of farmers also reported poor irrigation potential (61.7%). The results therefore indicate that adaptation constraints were predominantly related to information, financial resources, technical capacity, and water-management infrastructure. Information, finance and technical capacity emerged as prominent reported barriers. The high frequency of inadequate information is consistent with evidence that cassava farmers demand locally relevant agro-climatic guidance, including information on climate-adaptive varieties and planting periods [10].

Financial constraints were also widespread, which aligns with findings that adaptation can require additional expenditure and that limited funding restricts farmers' response capacity [7,12]. Inadequate technological know-how was reported by 78.3% of respondents. This result indicates that recognising climatic risk does not necessarily mean that farmers know which response to select or how to implement it effectively. Previous studies have linked education and extension contact with adaptation choices, underscoring the importance of technical support and practical knowledge [4,5].

Poor irrigation potential was reported by 61.7% of respondents. Although cassava can tolerate short periods of moisture stress, reliable water availability remains important for establishment and yield when rainfall becomes irregular. Water management is therefore an important component of agricultural adaptation in Africa [1]. The result should nevertheless be interpreted as a perceived infrastructural constraint rather than proof that irrigation investment would automatically increase adaptation or profitability.

Table 4: Barriers to adaptation

Barrier	Farmers reporting yes	Percentage
Inadequate information	98	81.7
Inadequate funding	95	79.2
Inadequate technological know-how	94	78.3
Poor irrigation potential	74	61.7

3.5 Costs, Returns and Profitability

Table 5 presents the estimated costs, returns and profitability of cassava production per hectare. Total production cost was ₦179,899.99/ha, comprising land expenditure (₦112,708.33/ha), planting materials (₦22,733.33/ha), agrochemicals (₦8,533.33/ha), and labour (₦35,925.00/ha). Land expenditure constituted the largest component of the reported production cost, followed by labour and planting materials. Total revenue was estimated at ₦683,958.33/ha, resulting in a net farm return of ₦504,058.34/ha.

The gross return-to-cost ratio was 3.802, indicating that approximately ₦3.80 in gross revenue was generated for every ₦1.00 of reported production cost. The reported net return on investment (NROI) of 280.2% further indicates a positive financial return relative to the production cost. Overall, the estimates suggest that cassava production generated positive returns for the sampled farmers during the study period.

The profitability estimate is comparable with recent evidence from Ekiti State, where positive gross margins and net profits were reported for cassava production [9]. Differences in prices, cost structures, farm characteristics and survey periods limit direct numerical comparison. Evidence from Southwest Nigeria further suggests that climate-response measures can add production costs while also being associated with higher net revenue, reinforcing the need to consider both costs and returns when assessing adaptation [7].

Table 5: Farm budget and estimated ratios

Item	Amount or ratio
Land expenditure	₦112,708.33/ha
Planting materials	₦22,733.33/ha
Agrochemicals	₦8,533.33/ha
Labour	₦35,925.00/ha
Total cost	₦179,899.99/ha
Total revenue	₦683,958.33/ha
Net farm revenue	₦504,058.34/ha
Gross return-cost ratio	3.802
Net return on investment	280.2%

3.6 Factors associated with farm profitability

Table 6 presents the regression estimates of the factors associated with cassava farm profitability. The model was statistically significant overall ($F = 67.981$; $p < 0.001$), indicating that the explanatory variables jointly explained variation in farm profit. The results showed that farming experience, household income, farm size, planting materials and agrochemical use were positively and significantly associated with farm profit, whereas gender and family labour had negative significant associations. Marital status and hired labour were also positively associated with profitability at the 10% significance level. Farming experience had a positive and significant coefficient ($\beta = 0.132$; $p < 0.001$), suggesting that more experienced farmers tended to report higher profitability, potentially reflecting accumulated production knowledge and improved farm management. This finding is consistent with recent evidence from Osun State, where farming experience was identified as an important determinant of net farm profit among cassava-based farming households [13]. Farm size also showed a positive and significant association with profit ($\beta = 0.541$; $p = 0.005$), indicating that farmers operating larger cassava areas tended to earn higher farm returns, provided they managed additional production resources efficiently.

Household income was positively associated with farm profitability ($\beta = 0.912$; $p < 0.001$). This relationship may reflect the greater financial capacity of relatively better-resourced households to finance production inputs and manage seasonal liquidity constraints. Planting materials ($\beta = 0.105$; $p < 0.001$) and agrochemical use ($\beta = 0.111$; $p < 0.001$) were also positively associated with profit, suggesting that access to and use of production inputs may contribute to improved farm performance. However, these coefficients reflect statistical associations rather than causal effects because the cross-sectional design does not establish causality. Recent evidence from Southwest Nigeria similarly identifies farm size and production-related factors among the variables associated with cassava farm income and net revenue [13,7].

Family labour had a negative and significant coefficient ($\beta = -0.140$; $p = 0.008$), while hired labour showed a positive association at the 10% level ($\beta = 0.114$; $p = 0.082$). The negative association between family labour and profitability may indicate that greater reliance on family labour does not necessarily translate into higher measured profit, particularly where labour is abundant but productivity is relatively low. Conversely, the positive coefficient for hired labour may reflect the ability of farmers to obtain additional labour when timely farm operations are important. These results should, however, be interpreted in relation to how family labour was valued in the profitability calculation. If family labour was not assigned an opportunity cost, comparisons between family and hired labour may partly reflect differences in cost accounting rather than differences in economic efficiency.

Gender was negatively associated with farm profit ($\beta = -0.312$; $p = 0.060$), while marital status was positively associated ($\beta = 0.184$; $p = 0.050$). These findings indicate differences in profitability across the respective categories after controlling for the other variables in the model. They should not be interpreted as evidence that gender or marital status directly causes differences in profitability, since such variables may capture differences in access to resources, labour arrangements, farm management or other unobserved characteristics.

Age ($\beta = -0.186$; $p = 0.208$), education ($\beta = 0.667$; reported $p = 0.910$), and perceived temperature ($\beta = 0.493$; reported $p = 0.676$) were not statistically significant. Thus, within the specified model, the evidence did not support an independent association between these variables and farm profit. The lack of statistical significance does not mean these factors are irrelevant to farm performance; rather, their effects were not distinguishable from zero at the significance levels in this study.

Table 6: Profitability Cobb-Douglas regression model

Variable	Estimate	Standard error	P-value
Age	-0.186	0.147	0.208
Gender	-0.312*	0.164	0.060
Marital status	0.184**	0.093	0.050
Education	0.667	0.591	0.910
Farming experience	0.132**	0.026	0.000
Household income	0.912***	0.152	<0.001
Farm size	0.541***	0.189	0.005
Planting materials	0.105***	0.013	<0.001
Temperature	0.493	0.518	0.676
Family labour	-0.140***	0.035	0.008
Hired labour	0.114*	0.059	0.082
Agrochemical use	0.111***	0.016	<0.001
Constant	0.546	0.571	0.341

$R^2 = 0.9800$; adjusted $R^2 = 0.9777$. F -value = 67.981 (Prob. = 0.0001), Dependent variable = $\ln(\text{profit})$

4. Conclusion and Policy Implications

The study found that smallholder cassava farmers in Ekiti State perceived climatic change and reported several adaptation responses, particularly soil conservation, purchased input use and mulching. Adaptation was constrained mainly by inadequate information, limited funding, insufficient technological know-how and poor irrigation potential. Age, household income, farm size, credit access, reported funding constraints and temperature perception were significantly associated with adaptation decisions. Cassava production generated positive returns under the reported cost structure, while farming experience, household income, farm size, planting materials and agrochemical use were positively associated with profitability. Family labour showed a negative association, while gender, marital status and hired labour also displayed significant or marginal associations at the reported levels.

The findings support interventions that improve farmers' access to usable climate and production information, practical technical guidance and appropriate financial services. Extension and other agricultural support institutions could strengthen locally relevant demonstrations and advisory services, particularly where farmers report difficulty accessing adaptation information and technologies. Financial interventions should also account for the seasonal liquidity needs of cassava production and the costs of land, labour and purchased inputs.

Positive farm returns indicate economic potential within the study's production and accounting framework, but the regression results should guide rather than determine programme targeting. Interventions involving input use, farm expansion or labour arrangements should consider costs, resource availability, environmental and safety implications and farmer preferences. Because the study used cross-sectional data, future panel, quasi-experimental or experimental research would be valuable for assessing whether specific adaptation interventions improve profitability and resilience overtime.

References

1. Intergovernmental Panel on Climate Change. (2022). Africa. In *Climate Change 2022: Impacts, Adaptation and Vulnerability* (pp. 1285-1455). Cambridge University Press. <https://doi.org/10.1017/9781009325844.011>
2. Food and Agriculture Organization of the United Nations. (2024). The unjust climate: Measuring the impacts of climate change on rural poor, women and youth. FAO. <https://doi.org/10.4060/cc9680en>
3. Jarvis, A., Ramirez-Villegas, J., Herrera Campo, B. V., & Navarro-Racines, C. (2012). Is cassava the answer to African climate change adaptation? *Tropical Plant Biology*, 5(1), 9-29. <https://doi.org/10.1007/s12042-012-9096-7>
4. Omodara, O. D., Ige, O. A., Oluwasola, O., & Oyeibanji, A. T. (2023). Factors influencing cassava farmers' choice of climate change adaptation practices and its effect on cassava productivity in Nigeria. *Heliyon*, 9(3), e14563. <https://doi.org/10.1016/j.heliyon.2023.e14563>
5. Osuji, E. E., Igberi, C. O., & Ehirim, N. C. (2023). Climate change impacts and adaptation strategies of cassava farmers in Ebonyi State, Nigeria. *Journal of Agricultural Extension*, 27(1), 35-48. <https://doi.org/10.4314/jae.v27i1.4>
6. Okpara-Okafor, B., & Okafor, A. (2025). Effects of climate change adaptation strategies on the productivity of cassava-based farmers in Bende Local Government Area, Abia State. *Nigeria Agricultural Journal*, 56(1), 198-204. <https://www.ajol.info/index.php/naj/article/view/324862>
7. Olutumise, A. I., Ekundayo, B. P., Omonijo, A. G., Akinrinola, O. O., Aturamu, O. A., Ehinmowo, O. O., & Oguntuase, D. T. (2024). Unlocking sustainable agriculture: Climate adaptation, opportunity costs, and net revenue for Nigeria cassava farmers. *Discover Sustainability*, 5, Article 67. <https://doi.org/10.1007/s43621-024-00249-8>
8. Bello, L. O., Awotide, B. A., & Sakurai, T. (2024). Climate change adaptation and smallholder farmers welfare: Empirical evidence from the Sahelian Region of West Africa. *Land Use Policy*, 142, 107181. <https://doi.org/10.1016/j.landusepol.2024.107181>
9. Bello, T. O., Oguntade, A. E., & Afolayan, T. T. (2025). Profitability and efficiency of cassava production in Ekiti State, Nigeria. *Agriculture Archives: An International Journal*, 4(1), 10-19. <https://doi.org/10.51470/AGRI.2025.4.1.10>
10. Adelaye, K. A., Okonkwo, V. C., & Afolayan, A. F. (2024). Rural cassava farmers' agro-climatic information needs in Osun State, Nigeria. *Journal of Agricultural Extension*, 28(3), 60-69. <https://doi.org/10.4314/jae.v28i3.7>
11. Solaja, S., Kolawole, A., Awe, T., Oriade, O., Ayojimi, W., Ojo, I., Nayan, G., Adedayo, R., Etta-Oyong, S., Olasehinde, F., Asemokhai, O., & Nsikak, I. (2024). Assessment of smallholder rice farmers' adaptation strategies to climate change in Kebbi State, Nigeria. *Heliyon*, 10(15), e35384. <https://doi.org/10.1016/j.heliyon.2024.e35384>
12. Ojo, M. P., Ayanwale, A. B., Adelegan, O. J., Ojogho, O., Awoyelu, D. E. F., & Famodimu, J. (2024). Climate change vulnerability and adaptive capacity of smallholder farmers: A financing gap perspective. *Environmental and Sustainability Indicators*, 24, 100476. <https://doi.org/10.1016/j.indic.2024.100476>
13. Ogunleye, A., Lukman, A., Ogunwemimo, H., Tanimonure, V., Ismail, E., Awwad, F., & Ajayi, O. (2025). Determinants of farm profit among cassava-based farming households in Osun State Nigeria: Robust estimation approach. *Cogent Food & Agriculture*, 11(1), 2449577. <https://doi.org/10.1080/23311932.2024.2449577>
14. Oluwafolakemi, A. O. (2024). Farmers' climate change adaptation strategies and cassava production in Akoko South West Local Government Area, Ondo State. *Journal of Agricultural Extension*, 29(1), 140-147. <https://doi.org/10.4314/jae.v29i1.16S>
15. Greene, W. H. (2008). *Econometric Analysis* (6th ed.). Pearson/Prentice Hall.