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Open Access Journal of Agricultural Research
ISSN: 2474-8846

Economic and Welfare Consequences of Climate Change Among Maize Farming Households in Bayelsa State, Nigeria

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Research Article
Volume 11 Issue 4
Received Date: September 08, 2026
Published Date: November 27, 2026
DOI: 10.23880/oajar-16000390

Abstract

Climate change has become a major threat to agricultural productivity, rural livelihoods, and household welfare, particularly in climate-sensitive regions such as the Niger Delta of Nigeria. This study examined the economic and welfare consequences of climate change among maize farming households in Bayelsa State, Nigeria. Specifically, the study assessed the effects of climate-related factors on farmers' economic performance, evaluated the welfare status of maize farming households, and identified the determinants of household welfare. A multistage sampling technique was employed to select 255 maize farming households, out of which 240 valid responses were used for analysis. Primary data were collected using structured questionnaires and analysed using descriptive statistics, Ordinary Least Squares (OLS) regression, Foster–Greer–Thorbecke (FGT) poverty indices, and the Ordered Logit model. The OLS results revealed that age, land size, access to credit, extension contact, and weather condition significantly influenced farm income, while oil spill incidence negatively affected farmers' income. The FGT analysis showed a poverty incidence, poverty gap, and poverty severity of 26.9%, 10.2%, and 5.3%, respectively, indicating that over one-quarter of the sampled households lived below the poverty line. The Ordered Logit model further revealed that age, education, land size, access to credit, weather condition, extension contact, farming experience, and oil spill incidence significantly influenced household welfare status. The study concludes that climate variability and environmental degradation continue to undermine the economic wellbeing of maize farming households, while productive assets and financial access substantially enhance welfare outcomes. The study recommends expanding farmers' access to affordable credit, strengthening climate-smart agricultural extension services, promoting sustainable land management practices, and intensifying environmental protection and remediation efforts to improve agricultural productivity and rural welfare in the Niger Delta.

Keywords: Climate change; Maize farmers; Welfare; Poverty; Farm income; Ordered Logit; Foster–Greer–Thorbecke Index; Bayelsa State; Nigeria

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Introduction

Climate change is one of the biggest threats to agricultural productivity, food security and rural livelihoods, particularly in developing countries where agriculture is still largely rain-fed and highly dependent on weather. Agriculture is a livelihood for millions of rural households across the world; however, rising temperatures, unpredictable rainfall patterns, prolonged droughts, floods, and more extreme weather events threaten their agricultural output [1]. Agriculture is one of the sectors most exposed to climate change, as alterations in temperature, rainfall and other climatic factors directly affect crop growth, farm productivity and household income. Smallholder farmers produce most of the agricultural output in Sub-Saharan Africa, and climate variability has emerged as a major barrier to sustainable agricultural development, food security, poverty reduction, and attainment of the Sustainable Development Goals [2]. Today, understanding the economic and welfare implications of climate change is more crucial than ever to develop effective adaptation measures, increase livelihood resilience and support sustainable agriculture systems [3].

Agriculture remains one of the major drivers of employment, rural livelihoods and national food security in Nigeria. The industry is important in the agricultural GDP and employs a large chunk of the workforce of the country. Maize is one of the important among the main crops grown all over the country due to its significance as a staple food, animal feed and industrial raw material. It provides food and income for millions of farming households and significantly increases the availability of food at the national level [4]. However, climate variability especially rainfall variation, increasing temperatures, flooding, droughts and changes in relative humidity makes maize production highly vulnerable. These climate disruptions result in lower yields and higher production costs [5], thus exposing farmers to significant production and market risks. Recent research in Nigeria has demonstrated that climate variability negatively impacts household welfare, food security, and agricultural productivity through decreased yields, increased costs of production, and greater vulnerability of livelihoods [6-8]. Likewise, studies in Sub-Saharan Africa have indicated a significant negative effect of climate change-related shocks on agricultural productivity, livelihood resilience and poverty among households engaged in smallholder farming [9,10].

Lack of institutional support, poor rural infrastructure, weak agricultural extension services, limited access to agricultural credit and low adoption of climate-smart agricultural technologies constrain rural farming households' capacity to adapt to climate variability. These constraints restrict farmers' ability to deal with production risks associated with climate change, often leading to declining farm income and worsening household welfare [11]. Governments and development organisations have increasingly promoted climate-smart agriculture, better access to financing, improved extension delivery and sustainable natural resource management to increase agricultural productivity and strengthen the resilience of farmers to climate change [12]. Hence, it is important to understand the interaction between these socio-economic factors and climate variability to develop policies that enhance the adaptive capacity of farmers to sustain their livelihoods in the long term.

The Niger Delta region of Nigeria is one of the country's most environmentally fragile agricultural ecosystems due to the simultaneous exposure of farming households to climate variability and environmental degradation from crude oil exploration activities. In one of the major oil-producing states in the region, Bayelsa State, frequent flooding, oil spills, gas flaring, coastal erosion, saline water intrusion, and land degradation negatively affect agricultural productivity and rural livelihoods [13,14]. Recent studies in Nigeria indicate that environmental pollution, flooding and climate variability have reduced productivity, farm income and the sustainability of livelihoods of farming households in southern Nigeria [15]. These environmental problems harm agricultural lands, degrading soil fertility, disrupting agricultural activities, and putting farming families at risk of sustained income losses and deprivation of wellbeing. Consequently, maize farmers in Bayelsa State face several environmental and climatic challenges that endanger household well-being and agricultural sustainability.

Several studies have examined the impacts of climate change on agricultural productivity, farmers' adaptation strategies and crop performance. However, few studies have specifically examined the economic and welfare effects of climate change among households that produce maize, especially in environmentally vulnerable areas such as the Niger Delta. Most earlier studies have focused on crop yield responses, adaptation strategies, or farmers' perceptions of climate variability, with little attention to understanding how climate change-induced shocks affect household income, poverty, and welfare [16-18]. Also, the relationship between climatic variability and environmental degradation associated with crude oil extraction has received relatively less empirical attention, despite its serious implications for agricultural livelihoods in Bayelsa State. This lack of information is a barrier for the development of integrated strategies that address environmental sustainability, rural welfare enhancement and climate resilience at the same time.

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In view of this, the study examined the welfare and economic effects of climate change on maize growing households in Bayelsa State, Nigeria. Specifically, the study used the Ordered Logit model to identify the determinants of household welfare, the Foster–Greer–Thorbecke (FGT) poverty indices to assess the welfare status of maize farming households and the effects of climate-related factors to the farmers' economic performance. The study integrates farm revenue analysis with poverty and wellbeing assessment to offer deep empirical information on how environmental degradation and climatic change impact the livelihoods of maize farmers in the Niger Delta region. The findings are expected to contribute to the growing literature in climate change economics, agricultural development and rural welfare by providing evidence-based recommendations for policymakers, development organizations and other stakeholders interested in strengthening climate resilience, improving household welfare and promoting sustainable agricultural development in Nigeria.

Conceptual framework

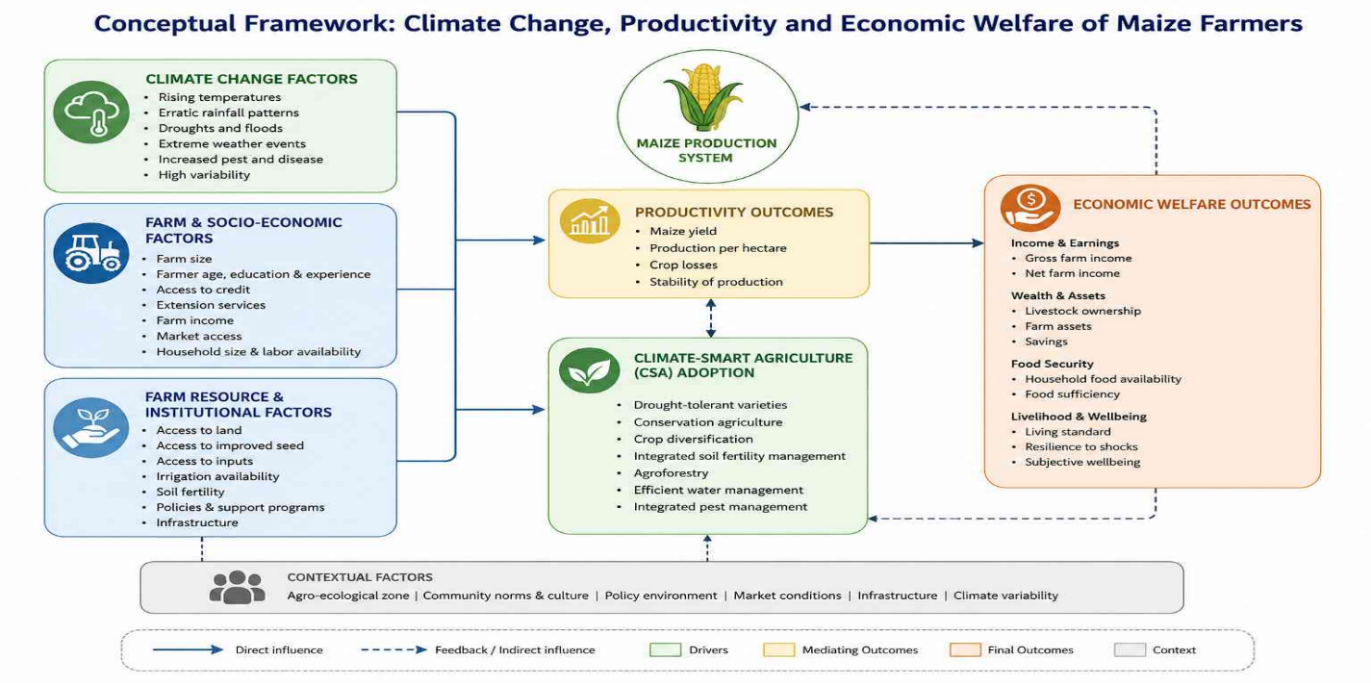

Figure 1: Conceptual framework.

The framework also suggests that the use of climate-smart agricultural practices such as drought-tolerant maize varieties, conservation agriculture, crop diversification, integrated soil fertility management, efficient water management, agroforestry and integrated pest management contribute to increased maize productivity through improved yield, production stability and resource use efficiency and reduced crop losses. The productivity gains that follow lead to better economic welfare results, such as higher farm incomes, increased wealth accumulation in households, enhanced food security, greater livelihood resilience, and improved overall well-being. The framework also recognizes the importance of contextual factors such as agroecological conditions, policy environment, market dynamics, infrastructure and climate variability that can influence the adaptive capacity of farmers and the effectiveness of climate-smart interventions. Therefore, the framework provides a comprehensive theoretical basis for investigating the direct and indirect associations of climate change, adaptation strategies, maize productivity, and economic well-being of maize farming households.

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Materials and Methods

Study Area

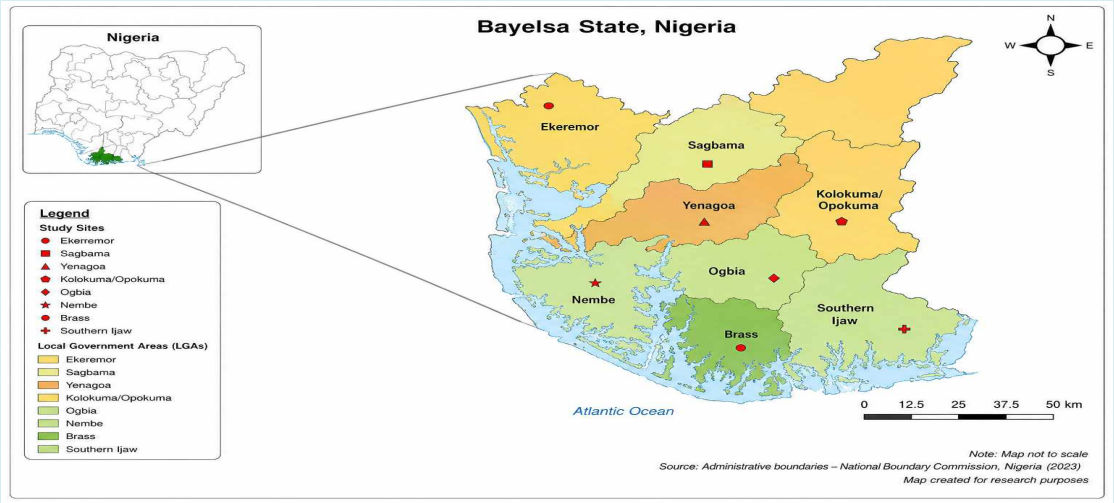

Figure 2: Map of Bayelsa State.

The study was carried out in Bayelsa State, Nigeria, one of the core states in the Niger Delta region. Bayelsa State is located between latitude 4°15′N and 5°23′N and longitude 5°22′E and 6°45′E. The state has humid tropical climate with high annual rainfall, high relative humidity and fairly high temperatures throughout the year. Agriculture is still one of the main livelihood activities among rural households with crop farming, fishing and livestock production providing employment and income to a large proportion of the population. Maize is one of the major food crops grown in the state because of its role in household food security and income generation. However, climate related issues such as flooding, irregular rainfall, rising temperature and environmental degradation associated with crude oil exploration and spill incidences are increasingly affecting agricultural production in the state. Bayelsa State's climate features and agricultural practices provide a conducive environment for studying the effects of climate variability on agricultural productivity and rural livelihoods [19,20].

Research Design

The study utilised a cross-sectional survey research design. This design was considered appropriate because it gave a chance to collect data from the maize farming households at a point in time to assess the economic and welfare consequences of climate change. Cross-sectional survey designs are widely employed in agricultural and socioeconomic studies as they allow the collection of household level data to analyse relationships between socioeconomic, institutional and environmental variables [21,22]. The study employed descriptive and econometric analytical approaches to examine the nexus between climate-related factors, farm income, poverty status and household welfare. The design was considered appropriate because it allowed for the collection of data from maize farming households at a single point in time to assess the economic and welfare consequences of climate change. The descriptive and econometric analytical approaches were combined in the study to investigate the relationship between climate related factors, farm income, poverty status and household welfare. The population of this study comprised all maize farming households in Bayelsa State. Households actively engaged in maize production during the 2025 farming season were part of the study.

Sampling Procedure and Sample Size

A multistage A multistage sampling procedure was used to select the respondents. The first stage was the purposive selection of major maize producing Local Government Areas (LGAs) – Ogbia, Yenagoa and Sagbama – based on the intensity of maize production. In the second stage, five (5) farming communities were randomly selected at the selected LGAs, to give a total of fifteen (15) Communities. The third stage involved a random selection of seventeen (17) maize farming households from each of the sampled communities. Therefore, two hundred and fifty-five (255) maize farming households were interviewed using structured questionnaire. However, after data cleaning and deleting incomplete observations, two hundred and forty (240) valid responses were retained for econometric analysis. Multistage sampling has been widely used in agricultural household surveys because it enhances representativeness and reduces sampling costs in

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geographically dispersed populations [22,23].

Data Collection

The study used the primary data. Data collection was made through structured questionnaire administered to maize farmers' household. The data collected included farmers' socioeconomic features, farm production variables, climate-related experiences and environmental challenges, access to institutional services, farm income and household welfare indicators. Climate-related variables were farmers' experience with weather variability, flooding, effects of climate change and crude oil spill incidents. Household welfare data were collected using annual farm income data. The structured questionnaire remains one of the most reliable instruments for the collection of primary socioeconomic data from farming households as it provides for standardised data collection and makes possible the quantification of the data [21].

Measurement of Welfare Status

The welfare status of maize farming households was measured using annual farm income. Following the welfare and poverty analysis approach commonly used in agricultural economics studies, the poverty line was computed as two-thirds of the mean annual farm income of the sampled households. The use of annual household income as a proxy for welfare has been widely adopted in welfare and poverty studies because income reflects households' capacity to satisfy basic needs and improve living standards [24,25].
The poverty line was specified as:

$$Z = \frac{2}{3}\bar{Y} \quad (1)$$

Where:
Z = Poverty line
$\bar{Y}$ = Mean annual farm income
Households with annual income below the poverty line were classified as poor, while those with income above the poverty line were classified as non-poor.

For the Ordered Logit analysis, welfare status was further categorized into three levels based on income distribution:
Low Welfare = 0
Medium Welfare = 1
High Welfare = 2
The categorization was based on income terciles.

Analytical Techniques

Descriptive Statistics

Descriptive statistics such as frequencies, percentages, means, and charts were used to describe the socioeconomic characteristics of maize farmers and their climate-related experiences. Descriptive statistics such as frequencies, percentages, means, and charts were used to summarize the socioeconomic characteristics of maize farmers and their climate-related experiences. These descriptive measures provide useful summaries of data distributions and facilitate interpretation of household characteristics [26].

Effect of Climate-Related Factors on the Economic Performance of Maize Farmers

Ordinary Least Squares (OLS) regression analysis was employed to determine the effects of climate-related and socioeconomic factors on farm income. Ordinary Least Squares (OLS) regression was employed because the dependent variable (annual farm income) is continuous. The OLS estimator provides efficient and unbiased parameter estimates under the classical linear regression assumptions and has been widely applied in agricultural economics studies to analyse determinants of farm income and productivity [26,27].
The model is specified as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \varepsilon \quad (2)$$

Where:
Y= Average annual farm income (₦)
X_1= Age of farmer (years)
X_2= Years of schooling (years)
X_3= Household size (number)
X_4= Farm size (hectares)
X_5= Farming experience (years)
X_6= Extension contacts (1 = Yes, 0 = No)
X_7= Access to credit (1 = Yes, 0 = No)
X_8= Weather condition (1 = Favourable, 0 = Otherwise)
X_9= Climate change perception (1 = Yes, 0 = No)
X_{10}= Oil spill incidence (1 = Yes, 0 = No)
β_0 = Constant term
β_1 - β_{10} = Parameters to be estimated
ε = Error term

Assessment of Welfare Status Using Foster–Greer–Thorbecke (Fgt) Poverty Model

The welfare status of maize farming households was assessed using the Foster–Greer–Thorbecke (FGT) poverty index developed by Foster, Greer, and Thorbecke (1984). The Foster–Greer–Thorbecke (FGT) model remains one of the most widely accepted poverty measurement techniques because it simultaneously estimates poverty incidence, poverty depth, and poverty severity, thereby providing a comprehensive assessment of household welfare [28,24].
The model is expressed as;

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$$P_{\alpha} = \frac{1}{N}\sum_{i=1}^{q}\left(\frac{z - y_i}{z}\right)^{\alpha} \quad (3)$$

Where:
P_{α} = Poverty index
N = Total number of households
q = Number of poor households
Z = Poverty line
Y_i = Income of the ith household
α = Poverty aversion parameter
The study estimated:
Poverty Incidence (P_0)
Poverty Gap (P_1)
Poverty Severity (P_2)

Determinants of Welfare Status Among Maize Farming Households

An Ordered Logit Model was employed to identify factors influencing the welfare status of maize farming households. The model is specified as:

$$W_i^* = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \mu_i \quad (4)$$

Where:
W_i^* represents the latent welfare status of the household.
The observed welfare categories are defined as:
0 = Low Welfare
1 = Medium Welfare
2 = High Welfare

The explanatory variables include:
Age (years)
Years of schooling
Household size
Farm size (hectares)
Farming experience (years)
Extension contacts (1 = Yes, 0 = No)
Access to credit (1 = Yes, 0 = No)
Weather condition (1 = Favourable, 0 = Otherwise)
Climate change perception (1 = Yes, 0 = No)
Oil spill incidence (1 = Yes, 0 = No)
Where:
β_0 = Constant term

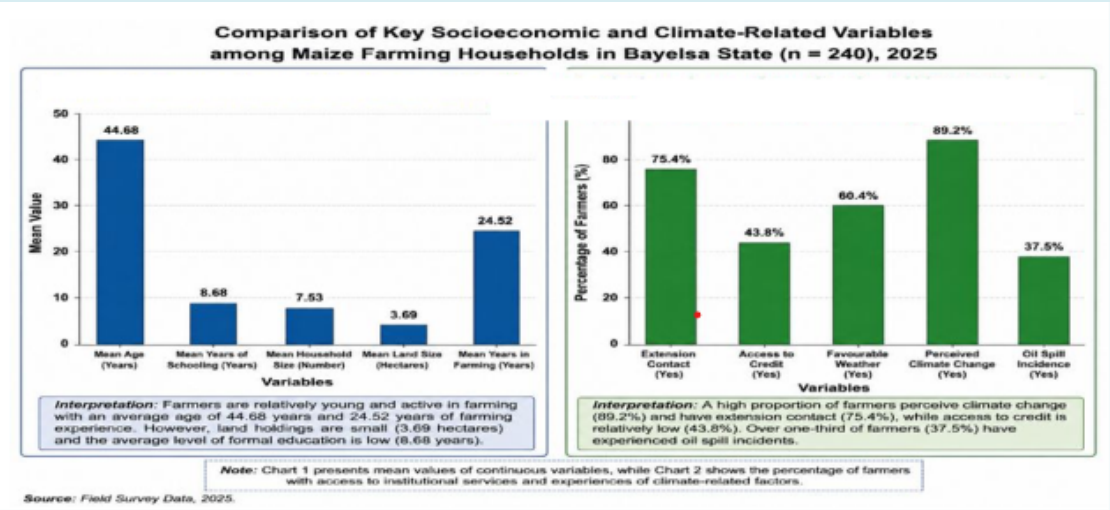
β_1 - β_{10} = Parameters to be estimated
μ_i = Error term

Data Analysis

The collected data were coded, entered, cleaned, and analyzed using Statistical Package for Social Sciences (SPSS Version 27), Stata 18, and Microsoft Excel. Descriptive statistics were used to summarize the data, while Ordinary Least Squares (OLS), Foster–Greer–Thorbecke (FGT) poverty indices, and Ordered Logit regression models were employed to achieve the study objectives. Statistical significance was evaluated at the 1%, 5%, and 10% probability levels. Statistical significance was evaluated at the 1%, 5%, and 10% probability levels following conventional econometric practice [27].

Results and Discussions

Socio-Economics Characteristics of the Respondents



Figures 3 and 4: socio-economic characteristics of the respondents.

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The figures give useful information on the socio-economic characteristics and climate-related conditions of maize farming households in Bayelsa State. The mean age of maize farmers was 44.68 years as shown in (Figure 1), indicating that most of the respondents were in their economically active and productive years. The average farming experience of 24.52 years indicates that the farmers possessed a good deal of practical knowledge and skills in maize production. However, the mean years of schooling (8.68 years) points to relatively low educational attainment that may limit farmers' capacity to access and use modern agricultural innovations and climate adaptation technologies. Also, the average farm size of 3.69 hectares reveals the prevalence of smallholder farming systems in the study region, whereas the mean household size of 7.53 persons indicates relatively large family structures that could increase household dependency burdens and strain available farm resources.

The institutional and climate-related characteristics of the sampled farmers are shown in (Figure 2). A large proportion of respondents (89.2%) perceived climate change as a major challenge to agricultural production implying the widespread awareness of changing climatic conditions among the maize farmers. Likewise, 75.4% of the respondents reported having contact with extension agents which reflects a relatively high access to agricultural information and advisory services. However, 43.8% of farmers reported low access to credit which may limit their ability to invest in improved technologies and climate adaptation measures. The figure also shows that 37.5% of the farmers suffered oil spill incidences, a situation that points to the environmental challenges facing agricultural production in the Niger Delta region. In summary, the results suggest that the farmers are aware of climate change and have some access to extension services, but lack of financial resources and environmental degradation are still serious threats to agricultural productivity and the welfare of households in Bayelsa State.

Effect of Climate-Related Factors on Economic Performance

Source: field survey, 2025

Variables	Coefficient	t-value	p-value	Decision
Age	12,610.00	2.333	0.021	Significant (5%)
Years of Schooling	-9,565.05	-0.993	0.322	Not Significant
Household Size	48,620.00	1.387	0.167	Not Significant
Land Size	249,200.00	6.174	0	Significant (1%)
Years in Farming	-7,746.21	-1.358	0.176	Not Significant
Extension Contact	-347,700.00	-3.903	0	Significant (1%)
Access to Credit	924,600.00	9.885	0	Significant (1%)
Weather Condition	279,300.00	3.116	0.002	Significant (1%)
Climate Change	136,200.00	1.282	0.201	Not Significant
Oil Spill Incidence	-120,200.00	-1.067	0.287	Not Significant

Table 1: Ordinary Least Squares (OLS) Regression Results on the Effects of Climate-Related Factors on Farm Income of Maize Farmers.

The result of the OLS regression showed that age, land size, extension contact, access to credit and weather condition had significant effect on the annual farm income of maize farmers in Bayelsa State. Land size had a positive and highly significant impact on farm income. Farmers with larger cultivated area earned higher income than farmers with smaller land holdings. Similarly, access to credit led to a significant increase in farmers' income levels. The negative coefficient of oil spill incidence indicates that environmental degradation has a negative impact on the maize production and income generation. The results generally underscore the importance of productive resources, institutional support and conducive climatic conditions in improving the economic performance of maize farmers.

The results shown in (Table 1) are consistent with some previous studies on the effects of socioeconomic and climate related variables on agricultural income in developing countries. The positive and significant effect of land size on farm income is in line with the findings of [6] who reported that farmers who had larger cultivated areas had higher productivity and income levels because of increased output and economies of scale. Similarly, the positive influence of access to credit is consistent with the findings of [29] who noted that credit accessibility enhanced the ability of farmers to purchase improved inputs, adopt climate-smart technologies and mitigate production risks.

The positive effect of favourable weather conditions on

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income also supports the findings of [30], who found that stable climatic conditions significantly increase agricultural productivity and farm profitability. The negative effect of oil spill incidence on the other hand corroborates the findings [14,31] who reported that environmental degradation caused by oil exploration activities reduces soil fertility, low crop yields and thus negatively affects farmers' livelihoods in the Niger Delta region. However, the negative coefficient of extension contact is contrary to the results of many agricultural extension studies which generally report positive impacts of extension services on farm performance. This implies that extension services in the study area may be poorly targeted or ineffective in addressing the specific challenges faced by maize farmers.

Welfare Status of Maize Farming Households (Fgt Analysis)

Source: field survey, 2025

Poverty Measure	Value
Mean Annual Farm Income (₦)	1,716,337
Poverty Line (₦)	1,144,224
Poverty Incidence (P_0)	0.269
Poverty Gap (P_1)	0.102
Poverty Severity (P_2)	0.053

Table 2: Foster–Greer–Thorbecke (FGT) Poverty Indices for Maize Farming Households.

The Foster–Greer–Thorbecke poverty analysis showed that about 26.9% of households growing maize were poor. This means that over a quarter of the surveyed households had incomes below the defined poverty line. The poverty gap and severity indices suggest that, while poverty exists amongst maize farming households, targeted interventions have the potential to significantly improve household welfare. The Foster–Greer–Thorbecke poverty analysis revealed a poverty incidence (P_0) of 0.269, a poverty gap (P_1) of 0.102 and a poverty severity (P_2) of 0.053. The results indicate that 26.9% of sampled maize farming households were poor with an average income shortfall of 10.2% of the poverty line among poor households.

The incidence of poverty obtained in this study implies that more than one quarter of the households involved in maize farming are still economically vulnerable despite their engagement in agricultural production. The causes of this level of poverty are production losses caused by climate, environmental decay, scarce access to productive assets and market failures. The result supports the argument that climate variability can worsen rural poverty due to its negative impacts on agricultural productivity and household income.

The poverty gap and severity indices show that maize-farming households are indeed poor, but the depth and intensity of poverty are relatively moderate. This suggests that policy measures such as access to affordable credit, support for climate adaptation, improved extension services and development of rural infrastructure could greatly improve the welfare of households and reduce the level of poverty among farmers in the study area.

The poverty results in (Table 2) are consistent with previous studies of rural welfare and agricultural households in Nigeria and other developing countries. The poverty incidence of 26.9% suggests that a high proportion of maize farming households are living below the poverty line, thus corroborating the findings of [29] that climate variability and limited access to productive resources are major contributors to rural poverty among farming households. Likewise, the observed poverty gap of 10.2% indicates that poor households need more income support to reach the minimum welfare threshold.

This is in line with the results of [32] who disclosed that poor access to credit, low productivity and climate-induced production losses widen the income deficiencies among rural farmers. The relatively low poverty severity index (5.3%) suggests that extreme poverty is not prevalent among the sampled households. These findings are consistent with the findings of [33] who reported that while many farming households experience welfare challenges, the depth of deprivation is often alleviated by diversified livelihood activities and social support mechanisms. Overall, the findings reinforce a growing body of evidence that climate-related shocks, environmental degradation and resource constraints remain important drivers of poverty and welfare vulnerability among agricultural households in Nigeria.

Determinants of Welfare Status (Ordered Logit Model)

Source: field survey, 2025

Variables	Coefficient	p-value	Decision
Age	0.044	0.017	Significant (5%)
Years of Schooling	0.08	0.018	Significant (5%)
Household Size	0.161	0.154	Not Significant
Land Size	0.724	0	Significant (1%)
Years in Farming	-0.055	0.004	Significant (1%)
Extension Contact	-1.096	0	Significant (1%)
Access to Credit	2.577	0	Significant (1%)
Weather Condition	0.733	0.025	Significant (5%)
Climate Change	0.577	0.107	Not Significant
Oil Spill Incidence	-0.854	0.037	Significant (5%)

Table 3: Ordered Logit Regression Results on Determinants of Welfare Status of Maize Farmers.

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The result of the ordered logit showed that age, education, land size, access to credit, weather condition, farming experience, extension contact, and oil spill incidence were significant determinants of welfare status. Access to credit and land size increased the probability of being in higher welfare categories while oil spill incidence significantly reduced household welfare. The result of Ordered Logit showed that age, years of schooling, land size, access to credit, weather condition and oil spill incidence had significant influence on household welfare status. A strong positive effect of access to credit ($\beta = 2.577$; $p<0.01$) and land size ($\beta = 0.724$; $p<0.01$) on the likelihood of belonging to a higher welfare category was observed. Incidences of oil spills had a significant negative effect on welfare status.

The findings in (Table 3) are generally consistent with those of previous empirical studies on rural welfare, agricultural livelihoods and climate vulnerability. The positive and significant effects of age and education on welfare status are in support of the findings of [33] who reported that educated and experienced farmers are more likely to adopt improved agricultural technologies, access information and make better production decisions that enhance household welfare. In the same vein, the positive and significant influence of land size and access to credit agrees with the results of [29,30] which revealed that ownership of productive assets and access to financial resources significantly enhance farmers' income generating capacity and welfare outcomes.

Studies showing the positive influence of stable climatic conditions on agricultural productivity and better household wellbeing further support the positive effect of favourable weather conditions. On the other hand, the significant negative effect of oil spill incidence is consistent with the findings of [14,31] who reported that environmental pollution as a result of oil exploration activities reduces agricultural productivity, income opportunities and worsens the welfare problems of the rural areas in the Niger Delta region. However, the negative coefficient of extension contact is not in conformity with the conventional expectation that extension services are welfare enhancing to farmers. This may be indicative of the ineffectiveness, poor quality or poor targeting of extension programs in the study area. The results confirm that access to productive resources, financial services and conducive environmental conditions are important determinants of welfare among maize farming households while environmental degradation remains a major constraint to livelihood sustainability in the Niger Delta.

Conclusion

This study investigates the effect of climate change on the economic and welfare of maize farming households in Bayelsa State, Nigeria. The findings suggest that climate related factors still have a considerable influence on the agricultural livelihoods and household welfare in the Niger Delta region. Farm size, access to credit and favourable weather conditions significantly improved farmers' income, while environmental challenges such as oil spill incidents reduced economic performance. The welfare analysis also showed that about one-quarter of the sampled maize farming households were living below the poverty line, indicating that climate variability and environmental degradation continue to be factors contributing to rural poverty and vulnerability of livelihoods. The ordered logit results indicated that access to productive resources, education, favourable weather conditions, and financial services all significantly increased the likelihood of households experiencing higher levels of welfare, whereas oil spill events reduced household welfare. In conclusion, the study finds that interventions to improve the welfare of maize farming households should be integrated to address climate change adaptation, environmental sustainability, financial inclusion and agricultural productivity simultaneously. Investment in climate-resilient farming practices, institutional support services and environmental restoration will increase farm income, reduce poverty and increase the resilience of rural households to future climate-related shocks. Such interventions are necessary for sustainable agricultural development and for improving the livelihood of farming communities in Bayelsa State and the wider Niger Delta region.

Recommendations

1. Enhance farmers' access to affordable agricultural credit: Government agencies, commercial banks, microfinance institutions and agricultural development programmes should expand low-interest credit facilities targeted specifically at maize farmers. Better access to financial resources will enable farmers to buy better seeds, fertilisers, climate-smart technologies and other productive inputs that raise farm productivity and household welfare.
2. Strengthen climate-smart agricultural extension services: Agricultural extension agencies should strengthen the training of farmers on climate smart agricultural practices including improved crop management, soil conservation, water management, early warning systems and climate adaptation strategies. Extension programs need to be well funded and tailored towards the peculiar climate challenges of maize farmers in the Niger Delta.
3. Promote sustainable land and environmental management: Federal and state governments should strengthen policies on environmental protection through enforcement of regulations on crude oil pollution, accelerate the remediation of contaminated farmlands and promote sustainable land management practices. Improving the environment will lead to better soil productivity, higher agricultural production

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and better welfare for farming households.

4. Create integrated climate resilience and rural livelihood support programmes: Policymakers should implement comprehensive programmes that combine climate adaptation measures with rural infrastructure development, agricultural insurance, market access and livelihood diversification. These integrated interventions will make farmers less vulnerable to climate shocks, increase household income, reduce rural poverty and promote sustainable agricultural development in Bayelsa State.

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