

Agro-climatic shocks and multidimensional poverty in rural Nigeria: The nexus

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Abstract

The increasing frequency and intensity of agro-climatic shocks pose serious threats to rural livelihoods in Nigeria, where agriculture remains the primary source of sustenance. This study examines the relationship between agro-climatic shocks and multidimensional poverty among rural households, utilizing data from the 2018/2019 General Household Survey. Using the Multidimensional Poverty Index, logit regression, and ordinary least squares regression models, the study assesses the extent and determinants of multidimensional poverty in the face of climate-induced shocks. The findings reveal that many rural households experience multidimensional poverty, with 60.8 percent facing key deprivations in access to education, healthcare services, and basic infrastructure. Poor rainfall, property loss, and declining output prices are major contributors to worsening poverty. Households affected by poor rainfall are more likely to fall into multidimensional poverty, reflecting the vulnerability of rain-fed agriculture to climatic variability. Limited access to credit, non-participation in cooperative societies, and lack of extension services further increase poverty risks by weakening adaptive capacity. The study calls for climate-resilient agricultural policies, improved rural financial inclusion, and stronger social safety nets as essential measures to reduce the adverse effects of agro-climatic shocks and support the resilience of rural communities in Nigeria.

Keywords: Agro-climatic shocks, general household survey, logit regression, multidimensional poverty, ordinary least squares regression, rural Nigeria.

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Contribution of this paper to the literature

This study contributes to the growth of empirical research by examining multidimensional poverty arising from agro-climatic shocks, thereby emphasizing the need for adaptive strategies, policy interventions, and resilience mechanisms to mitigate the adverse effects of climate-induced poverty.

1. Introduction

Climate change, agriculture, and poverty are critical concerns for developing nations, particularly in sub-Saharan Africa (Erezi, Ehi, & Ayodeji, 2023). Nigeria, the most populous country in Africa, faces significant challenges, with a substantial portion of its rural population dependent on agriculture for livelihood (Adejumo & Owoade, 2020). The vulnerability of these rural households to agro-climatic shocks has become increasingly apparent in recent years, as climate change continues to exacerbate the frequency and intensity of extreme weather events (Endalew & Sen, 2021).

The increasing frequency and severity of agro-climatic shocks, exacerbated by global climate change, pose a significant threat to the livelihoods and well-being of rural households in Nigeria (Onyenekwe, Opata, Ume, Sarpong, & Egyir, 2023). These households, which predominantly engage in agriculture, are particularly vulnerable to climate-induced disruptions, which can have far-reaching consequences on various dimensions of poverty beyond mere income deprivation (Maganga, Chiwaula, & Kambewa, 2021). Despite the recognized importance of this issue, there remains a critical gap in understanding the mechanisms through which agro-climatic shocks impact multidimensional poverty in the Nigerian context.

Multidimensional poverty, a concept that extends beyond income-based measures to encompass various aspects of deprivation, provides a more comprehensive framework for understanding the complex nature of poverty in rural Nigeria (Adepoju, 2019). This approach recognizes that poverty is not solely a function of income but also encompasses factors such as access to education, healthcare, and basic infrastructure (Mackie, 2020). Previous research has primarily focused on the economic impacts of climate variability on agricultural productivity and income (Kumari & Kanga, 2021). However, this narrow perspective fails to capture the full spectrum of deprivations that rural households may experience due to agro-climatic shocks. The multidimensional nature of poverty, encompassing education, health, and living standards, necessitates a more comprehensive analysis of the effects of these shocks (Callander, Schofield, & Shrestha, 2012).

Additionally, there is limited empirical evidence on the differential impacts of agro-climatic shocks across various dimensions of poverty in rural Nigeria. This lack of nuanced understanding hinders the development of targeted policies and interventions to enhance the resilience of vulnerable rural households (Ha, Tan, Thang, Que, & Van Tuyen, 2023). Recent studies have highlighted the potential for agro-climatic shocks to perpetuate and exacerbate poverty cycles among rural populations in developing countries (Pérez-Uribe & Palacios, 2025). However, the specific mechanisms through which these shocks affect multidimensional poverty in the Nigerian context remain understudied. This research gap is particularly significant given Nigeria's unique socio-economic landscape and position as a major agricultural producer in West Africa (Snyder, Miththapala, Sommer, & Braslow, 2017). The study's focus on Nigeria is particularly significant given the country's strategic importance in sub-Saharan Africa.

As the most populous nation on the continent and a major agricultural producer, Nigeria's experiences with agro-climatic shocks and their effects on poverty have far-reaching implications for regional food security and economic stability (Baptista, Diallo, & Kaho, 2023). The findings of this research could inform policy decisions in Nigeria and other developing countries facing similar challenges. The research's emphasis on rural households is particularly relevant given their heightened vulnerability to climate change impacts. With a significant portion of Nigeria's population residing in rural areas and dependent on agriculture for their livelihoods (Donkor, Onakuse, Bogue, & De Los Rios-Carmenado, 2019), insights from this study could have direct implications for improving the well-being of millions of individuals.

Understanding the nuanced effects of agro-climatic shocks on multidimensional poverty among rural households in Nigeria is crucial for developing targeted interventions and policies to enhance resilience and reduce vulnerability (Adepoju, 2019). This study aims to contribute to this understanding by examining the complex interplay between climate variability, agricultural productivity, and various dimensions of poverty among rural Nigerian households. This study, therefore, seeks to answer the research questions outlined above.

- i. What are the determinants of the multidimensional poverty index among rural farmers?
- ii. What are the effects of agro-climatic shocks on the multidimensional poverty status of rural farmers?

2. Literature Review

Agro-climatic shocks, encompassing extreme weather events, shifts in temperature and precipitation patterns, and other environmental disturbances, pose significant threats to rural livelihoods. These shocks contribute to multidimensional poverty by affecting food security, income stability, and overall well-being. Research on multifaceted poverty in Turkey, using panel data from the Survey of Income and Living Conditions between 2007 and 2010, found that new poverty measures were partially consistent with existing indices and that multidimensional poverty decreased over time (Acar, 2014). Factors such as higher education and homeownership were identified as reducing the likelihood of multidimensional poverty.

In Africa, various risk-reduction strategies, such as early warning systems, social protection schemes, disaster risk contingency funds, livelihood diversification, and migration, are employed to mitigate the impacts of climate factors (Moeketsi, 2023). Climatic shocks have been shown to significantly increase household vulnerability to poverty by influencing resource allocation and investment decisions. A mediating-effects model demonstrated that climate shocks negatively affect developmental and productive investments and precautionary savings, leading to greater economic insecurity (Talukder, Philpot, & Hipel, 2020). Adaptation strategies to such shocks vary, as shown

in a study where regional temperature and rainfall patterns aligned with local perceptions of long-term climate change (Kannan, Bessette, & Abidoye, 2022).

Climate change has had measurable impacts on food production in Nigeria, with increases in temperature and fluctuating rainfall patterns affecting agricultural output. Analysis of FAOSTAT data and records from the Nigerian Meteorological Agency revealed a gradual rise in temperature between 1975 and 2010, with a mean increase of 1.9°C. Significant drops in agricultural production corresponded with years of lower precipitation, highlighting the direct effects of atmospheric relative humidity on productivity (Vale, Spyrides, De Melo Barbosa Andrade, Bezerra, & Da Silva, 2020). Female-headed households in Nigeria and those with only primary education remain the most vulnerable to multidimensional poverty (Adepoju & Oyewole, 2020). An analysis of rural poverty transitions, which examined changes in MPI, headcount ratio, and poverty intensity, showed that these groups had the highest adjusted poverty gap values and severity indices (Adepoju & Oyewole, 2020). A similar study revealed that health, asset ownership, and education contributed most to poverty levels, with rural well-being primarily determined by economic capability and asset accumulation (Adeoti, 2014).

Institutional arrangements play a crucial role in climate change adaptation, as farmers' perceptions of climate change have been found to align with historical climatic data (Darabant et al., 2020). However, contrary evidence suggests that climatic shocks may not always directly influence household consumption, as an ordinary least squares regression study in rural Nigeria found no significant effect (Shehu & Sidique, 2015).

Climate shocks have also been linked to declining household welfare, with research showing that they negatively affect living standards, consumption levels, poverty rates, and nutritional outcomes (Bechetti, Mancini, & Savastano, 2024). In Nigeria, multivariate logistic regression has been used to classify rural households into poor and non-poor categories, confirming the model's statistical significance in predicting poverty status (Adeoti, 2014).

Further insights from Ethiopia suggest that larger household sizes increase vulnerability to poverty due to higher dependency ratios. A study employing quantile regression and ordinary least squares (OLS) models found that larger families, often characterized by economically inactive members, face a greater risk of poverty (Garza-Rodriguez, Ayala-Diaz, Coronado-Saucedo, Garza-Garza, & Ovando-Martinez, 2021). In rural Nigeria, similar findings emerged, with key determinants of poverty including education, household size, farming experience, market access, and social group membership (Ogundipe, Ogunniyi, Olagunju, & Asaleye, 2019).

Multidimensional poverty remains widespread, with an estimated 62% of rural households in Nigeria affected. Age, family size, and marital status positively correlate with multifaceted poverty. In contrast, gender, years of schooling, livestock ownership, farm size, and credit access negatively correlate with deprivation (Michael, Tashikalma, Maurice, & Tafida, 2019). The literature emphasizes the necessity of adaptive strategies, policy interventions, and resilience mechanisms to mitigate the adverse effects of climate-induced poverty. It highlights the need for future research to explore long-term adaptation measures and the effectiveness of policies.

2.1. Study Area

Nigeria, at a Latitude of 9° 04' 39.90" N and a Longitude of 8° 40' 38.84" E, is demographically the most populous country in Africa, the seventh worldwide, with an estimated population of over 200 million in 2020 (Worldometer, 2020). The Federal Republic of Nigeria is a federal constitutional republic comprising 36 states and its Federal Capital Territory, Abuja. The country is further subdivided into 774 Local Government Areas (LGAs). It has a land area of 900,000 square kilometers, including approximately 13,000 square kilometers of water. Nigeria is divided into six geopolitical zones: North West, North East, North Central, South East, South South, and South West. As of 2017, the population was approximately 220 million. Nigeria is located in West Africa and shares land borders with the Republic of Benin to the west, Chad and Cameroon to the east, Niger to the north, and the Atlantic Ocean to the south.

Nigeria is considered a multinational state as it is inhabited by 250 ethnic groups, of which the three most significant are the Hausa, Igbo, and Yoruba. The country's climate varies from arid in the north, tropical in the center, to equatorial in the south. The mean maximum temperature ranges from 30°C to 32°C in the south and 33°C to 35°C in the north. Agriculture is the main occupation of rural households in Nigeria.

2.2. Data Source

The data were sourced from the General Household Survey (GHS) for the 2018/2019 wave. The data were collected jointly by the World Bank and the Nigerian government. It covers all 36 states of the federation, including the Federal Capital Territory (FCT). The survey provides an annual indicator for monitoring and evaluating various aspects, including but not limited to socio-demographic characteristics such as age, sex of household members, household size, educational level of household members, access to credit, marital status, and access to extension agents. Additionally, it includes other relevant data pertinent to the subject matter, offering comprehensive insights into household dynamics and socio-economic conditions across Nigeria.

3. Methodology

3.1. Multidimensional Poverty Index

Multidimensional poverty is used to assess the level of poverty across multiple aspects. The Multidimensional Poverty Index (MPI) measures the percentage of households in a country that are deprived in three key dimensions: monetary resources, education, and access to essential infrastructural services. This index provides a more comprehensive understanding of poverty by capturing various facets of well-being beyond income levels. The MPI is an effective tool for illustrating the complexity of poverty, as it considers multiple dimensions of deprivation, offering a holistic view of the challenges faced by impoverished populations.

The multidimensional measures seek to understand poverty beyond monetary deprivations by including access to education and basic infrastructure, as well as the monetary headcount ratio (Diaz-Bonilla, Sabatino, Wu, & Nguyen, 2022). The global MPI identifies more people as poor than \$1.25/day across all developing countries and in Africa. One way to focus on the poorest of the poor is to change the poverty cut-off. For example, to identify a person as severely poor if they are deprived of 1.5 or more weighted deprivations simultaneously, the United Nations

Development Programme (UNDP) and Oxford Poverty and Human Development Initiative (OPHI) (2020) report these measures of severe MPI poverty. The multidimensional poverty index is shown in Table 1.

Table 1. Measure of the multidimensional poverty index.

Dimension	Indicator	Deprived if	Relative weight
Education	Years of schooling	No household member has completed 5 years of schooling	1/6
	Child enrolment	Any school-aged child is out of school in years 1 to 8	1/6
Health	Child mortality	Any child has died in the family	1/6
	Nutrition	Severe undernourishment of any =adult (BMI<17KG/m) or child.	1/6
Standard of living	Electricity	The household has no electricity	1/18
	Improved sanitation	There is no facility	1/18
	Safe drinking water	The household does not have access to safe drinking water, or safe water is more than a 45-minute walk	1/18
	Flooring	The household has dirt, sand or dung floor	1/18
	Cooking fuel	The household cooks with dung or wood	1/18
	Assets	The household has no assets, such as a radio or mobile phone, but owns a car.	1/18

Source: United Nations (2010) and Alkire and Santos (2011).

4. Econometric Model

4.1 Logit Regression Model

The MPI was categorized as a binary variable: multidimensionally poor or non-poor. The determinant of the multidimensional poverty index is estimated using a logit regression model. The logit regression model is a robust analytical tool frequently employed to explore the relationship between a binary dependent variable and a set of independent variables. In examining the effect of agro-climatic shocks on multidimensional poverty, this technique is particularly well-suited because it can model dichotomous outcomes, such as whether a household is multidimensionally poor (coded as 1 or 0).

$$pi = E(y = \frac{1}{xi}) \frac{1}{1+exp(-\beta_1+\beta_2x_2x)} = \frac{1}{1+exp(-zi)} \quad (1)$$

4.2 Ordinary Least Squares Regression Analysis

The effect of shocks on multidimensional poverty was estimated using ordinary least squares regression. The Ordinary Least Squares (OLS) regression model is a widely used econometric technique for estimating relationships between a continuous dependent variable and a set of independent variables. In this research, the OLS approach is employed to examine the determinants of the Multidimensional Poverty Index (MPI) among rural households in Nigeria, providing insights into the socioeconomic and demographic factors contributing to poverty. The demographics of the respondents are shown in Table 2.

Table 2. Demographic characteristics of the respondents.

Variables	Frequencies	Percentages	Mean
Sex			
Male	3168	82.09	
Female	691	17.91	
Total	3859	100.00	
Household size			7±4
1-5	1727	44.75	
6-10	1637	42.42	
>10	495	12.83	
Total	3859	100.00	
Education level			
No formal	288	7.46	
Primary	2303	59.68	
Secondary	1003	25.99	
Tertiary	265	6.87	
Total	3589	100	
Age			51±15
17-20	17	0.44	
21-30	353	9.15	
31-40	811	21.02	
41-50	882	22.86	
51-60	846	21.92	
>60	950	24.62	
Total	3859	100.00	
Marital status			
Unmarried	904	23.43	
Married	2955	76.57	
Total	3859	100.00	
Farm size			0.94±1.63
<1	70.20	70.20	
1-5	27.21	97.41	

>5	2.59	100	
Total	3859	100.00	
Access to credit			
Yes	604	15.65	
No	3255	84.35	
Total	3859	100	
Membership of Cooperative			
Yes	471	12.2	
No	3388	87.79	
Total	3859	100	

5. Results and Discussion

5.1. Multidimensional Poverty

The level of multidimensional poverty among rural households was presented in [Table 3](#). The multidimensional poverty index was categorized following [Alkire and Santos \(2011\)](#). Household heads with a score below 0.33 were classified as poor, while those above the threshold were classified as non-poor. The result showed that 60.8% of the households were dimensionally poor while 39.2% were multi-dimensionally non-poor. It showed that the majority of the households in Nigeria were multidimensionally poor. This agrees with the findings of the [National Bureau of Statistics \(2022\)](#) and [Adeyinka and Salman \(2024\)](#), who found that the majority of households in Nigeria were multidimensionally poor.

Table 3. Level of multidimensional poverty among households.

Multidimensional poverty status	Frequency	Percentage
Poor	2,346	60.8
Non-poor	1513	39.2
Total	3859	100.0

5.1.1. Determinants of Multidimensional Poverty Index

The determinants of the multidimensional poverty index are estimated using the logit regression, and the results are shown in [Table 4](#). Nine variables were considered in the model estimation, while only six were statistically significant. A P-value of 0.000 indicates that the model is good.

A unit increase in age will lead to a 12.25% increase in multidimensional poverty, significant at the 1% level. This indicates that age will contribute to the rise in the multidimensional poverty index. This could be because, as people grow older, they are less energetic and cannot cultivate more land to meet their basic needs. This aligns with [Mobilaji \(2024\)](#), who found that about 75% of older Nigerians are multidimensionally poor. On the other hand, a unit increase in age squared will lead to a 0.12% decrease in the multidimensional poverty index, which is significant at the 1% level. This indicates that the multidimensional poverty index (MPI) is likely to decrease among respondents over the long term. This trend could be attributed to households accumulating assets and capital, thereby reducing MPI over time.

A unit increase in household size will lead to a 1.24% decrease in the multidimensional poverty index, significant at the 1% level. This indicates that an increase in household size will contribute to the rise in multidimensional poverty. This could be because having more people in the household increases household expenditures and basic needs, thereby increasing multidimensional poverty ([Adeyinka & Salman, 2024; Jerumeh, 2024](#)).

Lack of access to extension will lead to a 0.72% increase in multidimensional poverty, which is significant at the 10% level. This indicates that an increase in households without access to extension may contribute to the rise in the multidimensional poverty index.

However, not belonging to a cooperative society and having no access to credit decreases multidimensional poverty. This is contrary to a priori assumptions, as belonging to a cooperative society typically contributes benefits, such as reduced prices for consumption goods through collective bargaining, thereby reducing the multidimensional poverty index; likewise, access to credit reduces poverty.

Table 3. Determinant of the multidimensional poverty index.

Multi-dimensional poverty	Coefficient	Standard error	Z	P-value	Marginal effect
Age	0.1225***	0.0144	8.48	0.000	0.0278
Age square	-0.00012***	0.0001	-9.02	0.000	-0.0003
Sex (Female)	-0.2208	0.1501	-1.47	0.141	-0.05083
Marital status (Married)	-0.00193	0.1368	-0.01	0.989	-0.0004
Household size	-0.0549***	0.0102	-5.40	0.000	-0.0125
Cooperative society (No)	-0.7348***	0.1168	-6.29	0.000	-0.1555
Extension No	0.3316*	0.1834	1.81	0.071	0.7729
Credit No	-0.2752***	0.0960	-2.87	0.004	-0.0614
Farm size (ha)	-0.0089	0.0212	-0.42	0.674	-0.0020
Constant	-1.4015	0.4214	-3.33	0.001	
LR chi ² (9) = 182.6					
Prob> chi ² = 0.0000					
Log likelihood = -2492.9185					

Note: *** represents 1% and * represent 10%.

5.1.2. Effect of Agro-Climatic Shocks on Multidimensional Poverty Index

The effect of shocks on multidimensional poverty was estimated using ordinary least squares regression. The p-value of 0.000 indicates the model's goodness of fit. Eleven variables were used to evaluate the model, eight of which were significant (Fall in output price, loss of property, poor rains, and the zone where the household resides).

As shown in **Table 5**, those who experience a fall in the output price will have their multidimensional property index increased by 3.01% compared to those who do not.

As a result, those who experience property loss will have their multidimensional poverty index increased by 0.0203 compared to those who do not. This is significant at the 10% level, indicating that those who experience property loss contribute to the multidimensional poverty index. Households experiencing low rainfall contribute to a 20.2% increase in the multidimensional poverty index compared to those without low rainfall. This is significant at 10%. This implies that experiencing low rainfall contributes to an increase in the multidimensional poverty index among households. This is probably because most households engage in farming; therefore, poor rainfall will affect the quantity of farmers' output, reduce revenue from their farming activities, and increase the multidimensional poverty index.

An increase in households residing in the north-central region will lead to a 10.8% rise in the multidimensional poverty index compared to households in the southwest. This suggests that households living in the north-central and other northern zones will contribute to an increase in multidimensional poverty, with a significance level of 1%, compared to those residing in the southwestern zones, which have a significance level of 5%.

Table 5. Effect of agro-climatic shocks on multidimensional poverty.

MPI	Coefficient	Standard error	t-value	P-value
Fall in the price of the output	0.0301**	0.0122	2.45	0.014
Flooding	-0.0110	0.0118	-0.94	0.348
Increase in the price of major food items	0.0110	0.1237	0.89	0.89
Loss of land	0.0123	0.0123	0.98	0.329
Loss of property	0.0203*	0.0125	1.65	0.098
Low rains	0.0202*	0.0121	1.67	0.094
North Central	0.1080***	0.0231	4.67	0.000
North East	0.0930***	0.0197	4.73	0.000
North West	0.1192***	0.2001	5.96	0.000
South East	0.0344*	0.1945	1.77	0.076
South South	0.3892*	0.1988	1.96	0.050
No of obs.=2590				
Prob>F= 0.0000				
R-Squared= 0.0437				

Note: *** represents 1%, ** represent 5% and * represent 10%.

6. Conclusion and Recommendations

The study highlights the determinants of multidimensional poverty and examines how various agro-climatic shocks influence poverty levels in rural Nigeria. Key factors such as age, household size, and access to extension services are identified as major determinants of multidimensional poverty. Agro-climatic shocks, including declines in output prices, property loss, and low rainfall, have contributed to an increase in household poverty. These shocks can exacerbate existing vulnerabilities by reducing household income, discouraging investment in productive assets, and weakening the coping capacity of rural populations. Persistent exposure to such shocks without adequate adaptive measures may deepen deprivation across health, education, and living standards, thereby entrenching multidimensional poverty. Furthermore, these challenges can hinder the government's long-term economic development goals by slowing progress toward sustainable rural transformation and inclusive growth. To address these issues, targeted policy interventions are essential to mitigate the adverse effects of agro-climatic shocks and enhance household resilience. The government and development agencies should prioritize investments in rural infrastructure, irrigation systems, and climate-smart agricultural practices to stabilize production and incomes. Expanding access to extension services, credit facilities, and weather information will empower farmers to make informed decisions and adapt effectively to changing environmental conditions. Additionally, social protection programs such as conditional cash transfers, subsidized inputs, and agricultural insurance should be scaled up to cushion the impact of shocks on vulnerable households. Addressing multidimensional poverty in rural Nigeria requires an integrated approach that combines poverty alleviation initiatives with climate adaptation strategies. Strengthening institutional capacity, promoting inclusive rural development, and enhancing community-based resilience mechanisms will not only reduce poverty but also ensure sustainable improvements in the welfare of rural households in Nigeria.

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